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Editors

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Supplementary Proceedings of the ICCE 2011

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Preface

Established in 1989, the International Conference on Computers in Education (ICCE) is an annual international conference organized by the Asia-Pacific Society for Computers in Education, and has become a major venue for scholars and researchers in the Asia-Pacific region to showcase their work in computers in education. The aim behind organizing these workshops is to bring together researchers of various interests to present, discuss and explore the state of applying information technology in various aspects of learning. The volume contains the supplementary proceedings of the 19th International Conference on Computers in Education (ICCE2011; http://www.nectec.or.th/icce2011/), held from November 27th through December 2nd, 2011 in ChiangMai, Thailand.

This year, we accepted ten workshop proposals with the goal of exploring focused issues across various themes. Each proposal in these proceedings was peer-reviewed by international reviewers in their respective areas to ensure the highest quality work. We believe that the workshops provide a valuable venue for researchers to share their work and have the opportunity to collaborate with likeminded individuals. The workshop papers spanning various topics will certainly stimulate more interesting research in respective areas in Asia-Pacific countries. We hope that readers will find the ideas and lessons presented in the proceedings relevant to their research.

Finally, we would like to thank the Executive Committee of the Asia-Pacific Society for Computers in Education and the ICCE 2011 Program Co-Chairs for entrusting us with the important task of chairing the workshop program, thus giving us an opportunity to grow through valuable academic learning experiences.

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Chapter 1

Technology Enhanced Language Learning

Preface

The aim of this workshop is to provide a forum where international participants can share knowledge on the technology enhanced language learning (TELL). With the integration of pedagogy theories and careful design, TELL has the capability of providing learners with favorable conditions for language learning, such as independent and targeted skill practice, immediate corrective feedback, portability, social interactivity, context sensitivity, connectivity, individuality, and immediacy. As various kinds of exploration and implications have been emerging, more efforts should be devoted to make further understanding about the reasonable integration of language learning theories and latest technology development. We have accepted 7 papers covering a variety issues related to TELL. The two-hour workshop will provide a forum where international participants can share knowledge, experiences and concerns on related issues in TELL, understand new era trends and strategies, as well as explore directions for future research collaborations.

Organizers
Tzu-Chien Liu*, National Central University, Taiwan*
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The Developments of EFL Vocabulary Sizes of High School Students in Taiwan

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Abstract: EFL students tend to have a common problem of insufficient vocabulary. Some studies argued that English vocabulary was one of the most difficult areas in terms of learning English. The participants (*N*=1938) were asked to take the English vocabulary tests in spelling, reading, and listening. After the tests, vocabulary Quotient (*VQ*) was used to estimate the actual size of English vocabulary of the participants. The findings of this study were generalized as the following: (1) the growing rate of English vocabulary in spelling was about 1197 words per year, the growing rate of English vocabulary in reading was about 1443 words per year, and the growing rate of English vocabulary in listening was about 1402 words per year, (2) the growth of vocabulary size in spelling was the least, and (3) the growth of vocabulary size in reading was the greatest. Results of this study suggested that English learners did not tend to equally develop their vocabulary sizes in the areas of spelling, reading, and listening.

Keywords: EFL, vocabulary size, vocabulary quotient

1. Introduction

The importance of having proficient English ability has been emphasized nowadays. Based on Johnson's statement, there were about one billion people learning English in the world, and English has become a first or an official language in most countries [3]. In addition, English is considered as students' priority to learn a foreign language in the world [13].

Reading ability has an impact on learning ability. There was a reciprocal causation between students' individual cognition and their reading ability. Students' reading abilities was associated with their learning abilities [23]. This is the well-known Matthew's effects in reading.

If one wanted to learn English well, it would be necessary to acquire sufficient English vocabulary. The more sufficient English vocabulary one had, the more proficient one's English ability would be [1]. Most college students were required to read different kinds of English documents, such as online information and textbooks. Therefore, acquiring sufficient vocabulary was an important element of building English ability.

Several assessments were used to measure English learners' vocabulary size, such as the Eurocentres Vocabulary Size Test [16, 17], and the Vocabulary Levels Test [19, 20]. Meara proposed the concept of V-Size, and the computer software was developed to test English learners' vocabulary ability [15]. When the software e-rater was measuring English learners' writing ability, their vocabulary size was measured as well [1, 5]. It was noticed that the English vocabulary tests were mostly focused on spelling, recognition, and usage in previous studies. For instance, Yes/No question was used to test whether the participants could recognize the word [2, 6, 11, 18]. However, since the guess rate was 50%, Yes/No question was not considered as a perfect measurement. Meara and Buxton presented another way of assessment: the method of multi-choice [16]; however, no study had yet included the test of listening to measure the vocabulary acquisition of English learners. Therefore, when Ho and Lin proposed the concept of Chinese character quotient [9], they included the test of listening as one of the evaluation methods.

In terms of reading, it was indicated that reading was one of the important methods of knowledge acquisition. A total of one million words was found in Brown corpus [21], and 200 million words in Collins Cobuild corpus were analyzed. If the number of learned vocabulary was about 1000 words, the text coverage would be 72%. Therefore, the context was commanded about 72%. If the number of learned vocabulary was 15851 words, the text coverage would be commanded more than 97.8% [8, 14]. Therefore, the vocabulary size really had a great impact on one’s reading ability.

Listening comprehension was playing an important role in a conversational context [22]. The unique characteristic of a dialogue had an effect on listening comprehension, that is, the features of pronunciation-reduced [7, 12]. The word would not be recognized when different pronunciations were presented at the same time [4]. Therefore, listeners would need to have strong listening abilities in order to recognize the spoken word.

Ho and Huong proposed the vocabulary quotient (*VQ*) as a KPI (Key Performance Indicator) of EFL teaching and learning [10]. *VQ* was a quantitative indicator for the acquisition of English vocabulary in multiple aspects, including spelling, visual recognition, and audio recognition. Based on *VQ*, one’s vocabulary sizes could be estimated.

The purpose of this study was to investigate the developments of English vocabulary sizes of junior and senior high school students in Taiwan. This study used *VQ* and its computer software tool to assess vocabulary sizes from the aspects of spelling, reading, and listening.

Three research questions are directing this study:
R1: How do EFL high school students’ vocabulary sizes grow in multiple aspects?
R2: Which vocabulary size of spelling, reading, and listening do students grow the least?
R3: Which vocabulary size of spelling, reading, and listening do students grow the most?

The hypotheses of this study are:
H_1: The growths of EFL high school students’ vocabulary sizes in multiple aspects are greater than 4800 words.
H_2: The growth of vocabulary size of spelling is the least.
H_3: The growth of vocabulary size of reading is the most.

2. Method

2.1 Participants

The participants in this study were selected from the contestants of the National Spelling Competition in 2010 (*N*=1938). 1156 elite students came from 169 junior high schools, and 782 elite students came from 107 senior high schools. Table 1 showed the composition of the participants. From each school, ten or less students with good English ability were recommended by the English teachers to participant in the spelling competition. The prerequisite for selection was: junior high school students had to complete at least three years of mandatory English classes. Senior high school students had to complete at least five years of mandatory English classes. All the contestants had no known hearing problems, and had normal or corrected-to-normal vision.

Table 1: Participants of two groups (N=1938)

Grade	Grade 7th~9th	Grade 10th~12th
n	1156	782

2.2 Material

The Ministry of Education in Taiwan had recommended a vocabulary list of 2200 words for junior high school students. Basically, all the junior high school English textbooks were edited according to this vocabulary list. Thus, this vocabulary list was used as the lexicon to test the junior high school students. According to the College Entrance Examination Center in Taiwan, 7000 English words were recommended for senior high school students to acquire. Between the vocabulary list of 2200 words and the vocabulary list of 7000, there were 4800 words in difference. These 4800 new words were used as the lexicon to test the senior high school students in the competition.

2.3 Tools

The software of the English vocabulary test based on *VQ* was used to test the participants. Table 2 presents three test models of English Vocabulary Test software [10]. Symbols were defined as the following: E_t was the target English vocabulary. E_x, E_y, and E_z were non-target English vocabulary, and $x \neq y \neq z \neq t$. $C_p(E_t)$ was the corresponding Chinese meaning of E_t. $V(E_t)$ was the English pronunciation of E_t. $Len(E_t)$ is the length of E_t, that is, the number of letters used to spell a target English word.

The aim of these test models was to explore the vocabulary acquisition of EFL learners from multiple aspects. The purpose of the spelling test was to find out if the examinee could correctly spell the English vocabulary when the pronunciation was given. The reading test was to test whether the examinee could understand the meaning of the target English vocabulary or not. The listening test was to examine the examinee's listening ability and comprehension of the target English vocabulary.

Table 2: The test models of English vocabulary test

Test Model	Description
Spelling test	Given $C_p(E_t)$, $Len(E_t)$, and $V(E_t)$. Examinee is asked to key-in E_t.
Reading test	Given E_t and the choices of $C_p(E_t)$, C_q, C_r and C_s in random sequence. $C_p(E_t)$ was the target choice, and C_q, C_r and C_s were the wrong choices. Examinee was asked to choose the target choice.
Listening test	Given $V(E_t)$ and the choices of $C_p(E_t)$, C_q, C_r and C_s in random sequence. $C_p(E_t)$ was the best choice which matched the given $V(E_t)$. C_q, C_r and C_s were the wrong choices. Examinee was asked to choose the target choice.

The Statistical Package for the Social Science (SPSS) v.18 for Microsoft Windows was used to provide descriptive statistics and the distributions of scores. For research question 1, 2, and 3, descriptive statistics were utilized to provide mean scores and standard deviations of three tests for both samples.

2.4 Design

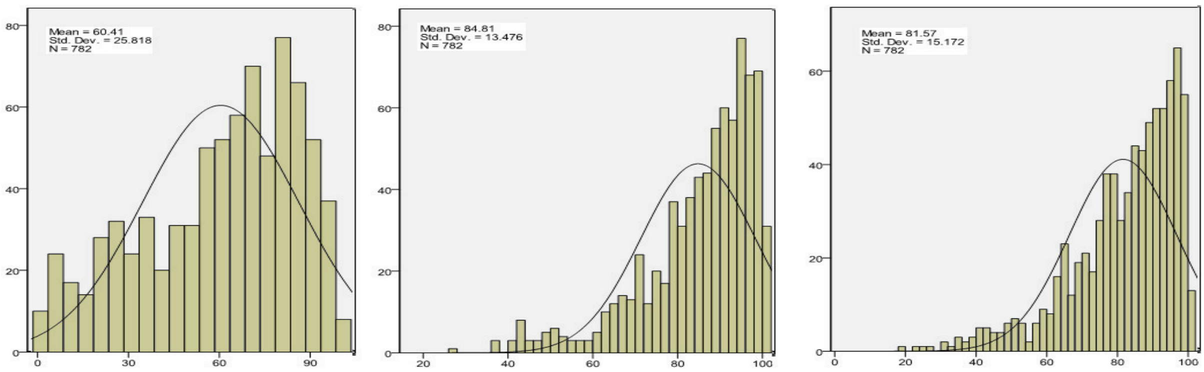
This study was a normative survey. The researcher was interested to investigate the current phenomena of English vocabulary acquisition among elite Taiwanese junior and senior high school students. *VQ* would be used to estimate the size of English vocabulary of the participants.

2.5 Procedure

The experiment was embedded in the National Spelling Competition in 2010. Three different types of English vocabulary tests were used to evaluate the participants. Every test had 100 questions and was worth 100 points. Before the tests, participants had already known how to use the software. Spelling test had to be finished in 20 minutes, while the reading and the listening test had to be finished in 10 minutes, respectively. After the test, the scores of English vocabulary tests would be collected by computers.

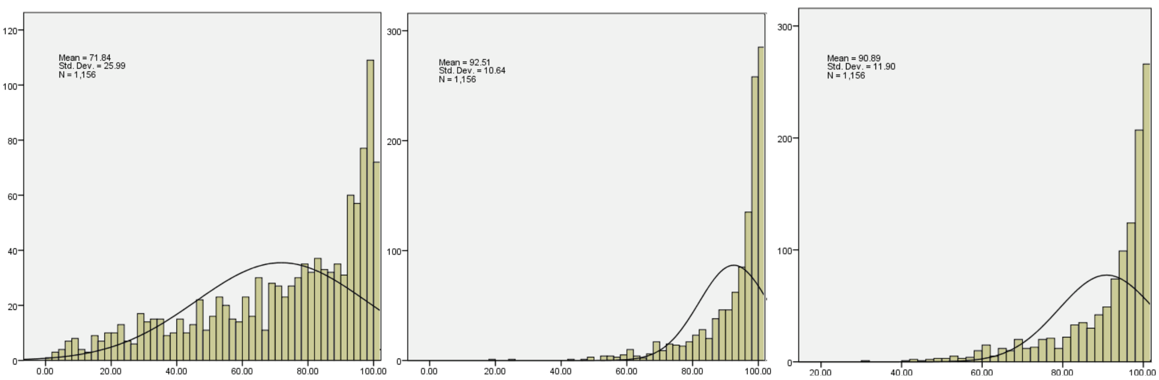
3. Results

Fig. 1 presented the histograms of scores of three English vocabulary tests for all senior high participants. Fig. 2 illustrated the test results of all junior high participants. The horizontal axis was the scores of the tests and the vertical axis was the number of participants. Distribution curves were also illustrated in Fig. 1 and 2. Results showed that the distribution of scores of spelling, reading and listening tests were all negative skewed.



(a) Distribution of Spelling. (b) Distribution of Reading. (c) Distribution of Listening.

Figure 1. Distribution of three aspects for senior high participants



(a) Distribution of Spelling. (b) Distribution of Reading. (c) Distribution of Listening.

Figure 2. Distribution of three aspects for junior high participants

Table 3 presented the means of the two groups, their standard deviations, and the scores of spelling, reading, and listening. It was found that the standard deviations of spelling were the greatest among the three tests, and that the means of spelling were the smallest among the three tests. From the viewpoint of the mean scores, the sequence of hard-level was spelling, listening, and reading. These outcomes appeared both in the group of junior high school students and senior high school students.

Table 3: Descriptive statistics for the all participants (*N*=1938)

Group	*n*	Spelling		Reading		Listening	
		M	*SD*	*M*	*SD*	*M*	*SD*
Grade7th~9th	1156	71.84	25.99	92.51	10.64	90.89	11.90
Grade10th~12th	782	60.41	25.82	84.81	13.48	81.57	15.17

Based on data in Table 3 and the method of estimating vocabulary sizes proposed by Ho and Huong [10], the estimated vocabulary sizes were calculated in Table 4 for both groups. Note that estimated vocabulary sizes of spelling, reading, and listening were all different. Senior high school students and junior high school students also differed in the areas of spelling, reading, and listening.

The difference of the means showed the growth of average vocabulary size between senior high students and junior high students. These results were for research questions 1, 2 and 3. The growth of vocabulary size of spelling between junior and senior high school students was 3591 words. The growth of vocabulary size of reading between two groups of the participants was 4328 words. The growth of vocabulary size of listening between the two groups was 4206 words. Thus, H_1 was not supported. H_2 and H_3 were supported.

Table 4: Estimated vocabulary sizes for the all participants (*N*=1938)

	n	Spelling			Reading			Listening		
		min	*max*	*M*	*min*	*max*	*M*	*min*	*max*	*M*
Grade7th~9th	1156	22	2200	1509	418	2200	1943	682	2200	1909
Grade10th~12th	782	2248	7000	5100	3496	7000	6271	3112	7000	6115
Difference of *M*				3591			4328			4206

Figure 3 presented the minimum, the maximum, and the mean of vocabulary sizes of three tests for each group of the participants. It was found that some participants performed better in reading and listening, but not in spelling. The range between the maximum and the minimum was large in every aspect of each group of the participants.

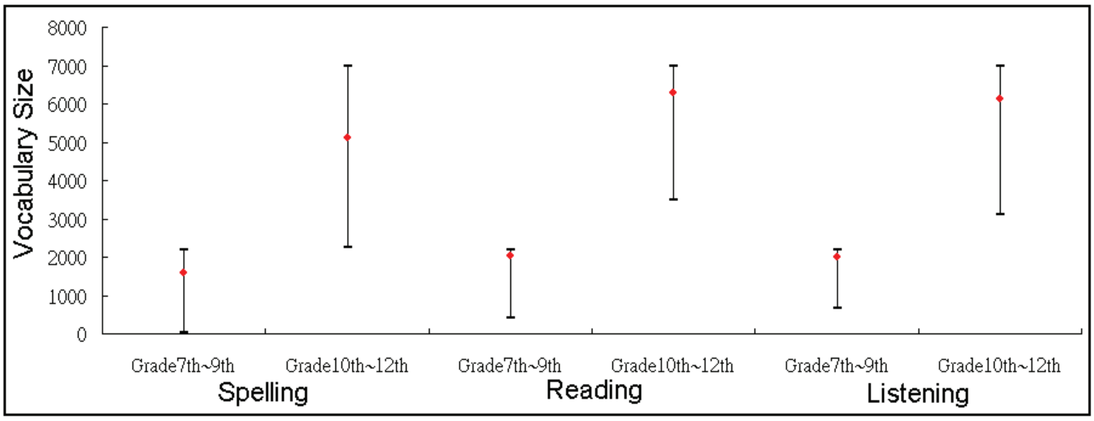


Figure 3. The min, max and mean of vocabulary sizes of three aspects

4. Discussion

Based on data in Table 4, the growth of vocabulary size of spelling was 3591 words. The growth of vocabulary size of reading was 4328 words. The growth of vocabulary size of listening was 4206 words. The growing rate of spelling was about 1197 words/year. The growing rate of reading was about 1443 words/year. The growing rate of listening was about 1402 words/year. They were far from the native speakers. The growths of EFL high school students' vocabulary sizes in multiple aspects were not found to be greater than 4800 words. Thus, H_1 was not supported. The growth of vocabulary size of spelling was found to be the least. H_2 was supported. The growth of vocabulary size of reading was the greatest. H_3 was supported.

Based on Fig. 1, 2, and 3, there were many junior and senior high students who had low vocabulary sizes. These students might have Matthew effects in reading [23]. Using *VQ* software tool, EFL teachers could find out if the students had low vocabulary sizes. After identifying the problems, necessary teaching and learning could be carried out to solve problems.

There were some limitations in this study. The number of participants was small, and only three linguistic aspects of English vocabulary were investigated. Since the lexicons in this study were set as 2200 words for junior high school students, and 7000 words for senior high school students, the estimated vocabulary sizes were within these boundaries. If any participants had the lexicon greater than 7000 words, this study would not be able to measure the actual the size of the lexicon.

This study could have both theoretical and practical contributions. Vocabulary quotient could become an effective indicator to estimate the actual vocabulary size of English learners. As the research results had showed that English learners might not grow equally in the areas of spelling, reading, and listening, English teachers might want to consider offering more instructions for students to strengthen their weakness in spelling.

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The Application of Multimedia Strategies for Learning Chinese Characters

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Abstract: The purpose of this study was to examine the effects of multimedia instructional strategies on foreign novices' learning performance and cognitive load in learning Chinese characters. Two types of multimedia strategies, including visual-cue (ViS) and voice-cue (VoS), and two types of practice, including visual-cue (ViP) and voice-cue (VoP), were employed in the experimental instruction. Participants were 109 foreign novices and were randomly assigned to one of the four experimental groups. The results showed that the VoS –VoP learners performed better than their counterparts in Chinese character stroke and writing.
Keywords: Multimedia learning, Language learning, Instructional strategy

1. Introduction

In recent years, learning Chinese has become a pervasive need in the western societies. Accordingly, research on learning Chinese for non-native novices has been focused by researchers. With the increasing usage of information technology, the application of multimedia technology in learning Chinese has been a trend. Due to the fact that Chinese characters are the basic subjects for beginners, identifying Chinese characters and comprehending the meanings of Chinese characters has become a critical and also the very first learning task for foreign novices. However, each Chinese character just looks like a picture for foreign learners and it is hard for them to memorize the strokes and meaning of a Chinese character. According to the dual-coding theory [1], representing information, such as Chinese characters, with visual and verbal codes can enhance leaning performance. In light of these concerns, the purpose of this study was to examine the effects of type of multimedia strategy on foreign novices' learning of identifying Chinese characters and comprehending the meanings of Chinese characters.

2 Literature Review

2.1 Learning Chinese Characters

Chinese characters were developed by drawing pictures of objects' shape and form without their sound [2], and were known as picture-shaped words. Unlike alphabetic language system, Chinese characters have five main structures, including shape, radical, stokes, sound and meaning [3], [4]. Therefore, there are two challenges for non-native learners to learn Chinese characters, the first challenge is the complexity of the graphic configuration of Chinese characters and the other is the lack of obvious sound-script correspondence [4]. Therefore, for novices, Chinese characters are considered one of the most challenging languages to learn due to its graphical character nature [3]. Furthermore, Kuo and Hooper [2] pointed that in traditional Chinese language teachers often ignored the unique visual and verbal information of Chinese characters which always confuses non-native novices. Moreover, there have been many studies conducted the impact of cognitive processing on character learning and there is evidence that providing visual cues for recall results in better performance [3]. Thus, it was important for Chinese language teachers to employ suitable teaching methods and learning strategies for non-native novices to learning Chinese characters better.

According to Shen's research [4], the most heavily used strategies are orthographic-knowledge-based strategies which making use of the three aspects of radical knowledge, including graphemics, semantics and phonetics. In this way, foreign learners could use the three aspects of radical knowledge as cues to encode characters and transform to their cognitive progresses. Taft and Chung [5] mentioned that emphasizing the radical structure at the time when learners encountered firstly is the most effective way to link the relationship of character and radicals. In addition, well-designed multimedia was suggested to be beneficial to novices [6]. Therefore, in the very beginning of learning Chinese language, multimedia has the potentiality to serve as a means of delivering the radical information of Chinese characters and, at the same time, providing rich cues for novices to link the relationship of character and radicals.

2.2 Multimedia Theory

The dual-coding theory referred to two parts of people's mental structure and information processing: verbal system and nonverbal system [1], [7]. The two systems construct verbal and picture representations separately. Therefore, the individual did encode when receiving information from sense organ with both of two systems. It was just like what Mayer and Moreno [8] cited that receiving words and pictures at the same time had better effect and encoded and store into long term memory more easily. Mayer and Moreno [9] mentioned that Multimedia instructions enhanced learning with presenting words and pictures, since multimedia attracted learners' attention. Therefore, Multimedia instructions applied words, pictures, sounds, videos, animations and so on to transmit contents to enhance the learning effect [10]. Moreover, multimedia instructions provided learners with making meaningful hyperlink to the contents. The principles which were offered by Meyer and Moreno [8] were: multimedia principle, spatial contiguity principle, temporal contiguity principle, coherence principle, modality principle, redundancy principle and personalization principle.

3 Methods

The participants were 81 Caucasian non-native novices who were new students of a mandarin training center located in Taipei, Taiwan. The participants had studied Chinese for less than two months. Two types of multimedia strategies were implemented in the instructional presentation, including character-radical-highlighted strategy (CRH) and character-stroke-sound strategy (CSS). Moreover, two types of multimedia strategies, including visual-cue (ViC) and voice-cue (VoC), were implemented in the practice session. Participants were randomly assigned to one of the four experimental groups.

An Internet-based e-learning course on learning "the Chinese character basics" was implemented and delivered using a Moodle platform. The experimental instruction consisted of three learning units, and each unit was designed for 2-hour self-paced learning. The content knowledge of the experimental instruction included (a) the 18 Chinese character strokes, (b) the formation of Chinese characters and (c) the 20 common Chinese character radicals with 160 corresponding Chinese characters consisting of the common radicals.

3.1 The Chinese Characters Test

The purpose of the Chinese character test is a multiple-choice test consisting 25 questions designed to assess the participants' beginning behavior and prior knowledge of Chinese characters. Each question was 1 point and total scores were 25 points. The test was developed by the researchers and examined by the experts. The reliability coefficient were Cronbach's α = .878.

3.2 The Multimedia Chinese Characters Instruction

The multimedia Chinese characters instruction was developed by the researchers and examined by the experts. According to the two types of multimedia strategies (ViS and VoS) and two types of practice (ViP and VoP), the multimedia Chinese characters instruction was divided to four groups. Participants were randomly assigned to four groups. Table 1 showed the design of four groups:

Table 1: Introduction of multimedia instruction

Group	Types of multimedia strategies	Types of practice	Instructional features
1	visual-cue (ViS)	visual-cue (ViP)	Teaching components highlighted in red and exercise with components highlighted in red.
2	visual-cue (ViS)	voice-cue (VoP)	Teaching components highlighted in red and exercise with components sounded.
3	voice-cue (VoS)	visual-cue (ViP)	Teaching components with sound on strokes and exercise with components highlighted in red.
4	voice-cue (VoS)	voice-cue (VoP)	Teaching components with sound on strokes and exercise with components sounded.

3.2.1 Visual cue strategy (ViS) vs. Voice cue strategy (VoS)

The program spoke the sound of the character and the character's components in red while other strokes in black to be distinguished (see Figure 1). The system spoke the sound of the character firstly, and then spoke the sounds of every stroke (see Figure 2).

Figure 1. Visual cue strategies (ViS)

Figure 2. Sound on strokes strategies (VoS).

3.2.3 Visual cue of practice (ViP) vs. Voice cue of practice (VoP)

The practice program with visual-cue was given to learners after learners completed the Chinese characters courses. First the system showed the whole character, spoke the sound after learners pressed the button, and then showed the flash animation (see Figure 3). The practice program with voice-cue spoke the sound of the character, and then spoke the sound of each stroke with showing each stroke. The system stopped when the whole character was presented (see Figure 4).

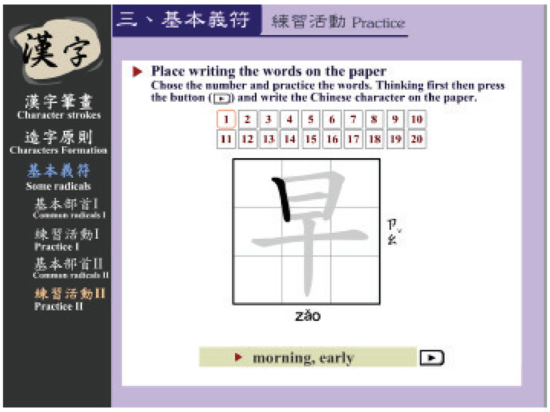

Figure 3. Visual cue of practice (ViP)

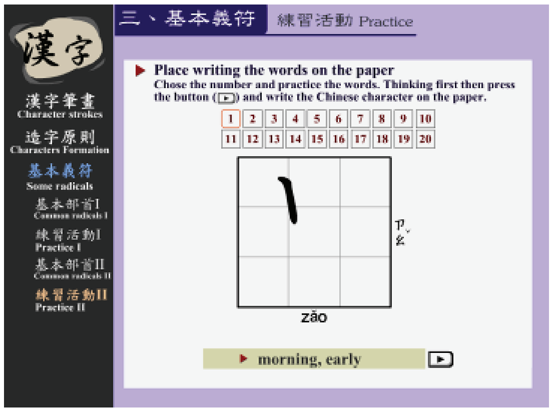

Figure 4. Voice cue of practice (VoP)

3.3 The Chinese Characters Performance Test

The Chinese characters performance test was given to students after they completed the multimedia Chinese characters instruction. The test was designed as a paper-and pencil test to access students' performance on three parts: (a) Chinese characters' strokes, (b) Chinese characters' components, and (c) Chinese characters' writing. The total questions were 30, each question was 1 point, and total scores were 30 points. The reliability coefficient were Cronbach's α = .885.

4 Results

4.1 Analysis of Learning Performance

In order to understand the learners' learning performance on Chinese characters under different types of multimedia strategies and practice, the study used the MANCONA to analyze the learning performance on three parts: (a) characters' strokes, (b) characters' components, and (c) characters' writing. The MANCONA summary of learning performance on learning Chinese characters was shown in Table 2.

The MANCONA indicates a significant interaction for characters strokes ($F_{(1,76)} = 11.502$, $p = .001$) and for characters writing ($F_{(1,76)} = 18.280$, $p < .001$). However, no significant interaction effect for characters components ($F_{(1,76)} = 11.502$, $p = .001$) was found. The main effects for characters components ($F_{(1,76)} = 6.109$, $p = .016$) showed a significant effect.

Therefore, it revealed that types of display had a significant effect for learning the characters components.

The interaction effect of multimedia strategies and practice on learning performance was shown in Figure 5. In learning characters' strokes, the group 4 (VoS-VoP) had better learning performance. Moreover, in learning characters' writing, the group 1 and group 4 had better learning performance.

Table 2 MANCOVA summary of learning performance on learning Chinese characters

Variables	Type of questions	Type III Sum of Squares	df	Mean Square	F	Sig.
The Chinese characters prior test	Characters' strokes	29.474	1	29.474	9.733*	.003
	Characters' components	28.996	1	28.996	14.501*	.000
	Characters' writing	287.830	1	287.830	75.559*	.000
Type of multimedia strategies	Characters' strokes	9.723	1	9.723	3.211	.077
	Characters' components	12.216	1	12.216	6.109*	.016
	Characters' writing	4.004	1	4.004	1.051	.309
Type of practice	Characters' strokes	.282	1	.282	.093	.761
	Characters' components	1.069	1	1.069	.534	.467
	Characters' writing	1.064	1	1.064	.279	.599
Type of multimedia strategies × Type of practice	Characters' strokes	34.833	1	34.833	11.502*	.001
	Characters' components	.228	1	.228	.114	.737
	Characters' writing	69.634	1	69.634	18.280*	.000
Error	Characters' strokes	230.155	76	3.028		
	Characters' components	151.967	76	2.000		
	Characters' writing	289.510	76	3.809		

*$p < .05$

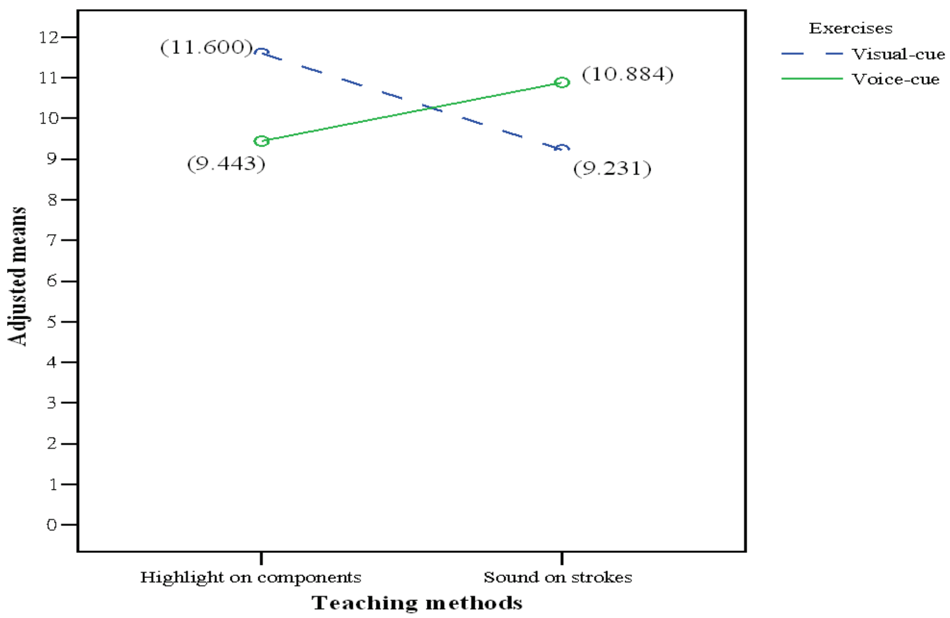

Figure 5. The interaction effect of the multimedia strategies and practice on learning performance in characters' writing

5 Conclusions and Suggestions

The findings of this study present two implications for the design of multimedia Chinese characters instruction. First, in the dimension of learning performance, learners of group 4 (VoS-VoP) had better learning performance in characters' strokes and writing. It implied that VoS and VoP provided learners with necessary demand and inform the names of strokes at the proper time which could be easily memorized. Therefore, VoS and VoP supported learners' learning on strokes and writing. Second, it may imply that the application of VoS and VoP gave learners real-time information which mentioned how to write the whole characters with voice-cue of strokes [11]. The voice-cue may help learners became more focus on their learning on multimedia instruction and sustained their attention. Thus, learners resulted in better performance. In conclusion, the results suggested that multimedia instruction with voice presentation and practice (VoS and VoP) could enhance learners' learning performance on strokes and writing.

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The influence of digital storybooks to the learning attitudes of students with reading disabilities

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Abstract: In this study, the researcher used multi-sensory teaching methods to design three digital story books as teaching materials in order to enhance the reading abilities of children with reading disabilities. The content of digital storybooks focused on the differentiation of word sounds, word forms, use of punctuation marks, and reading comprehensions. It is hoped that through the interactive reading practices, students with reading difficulties can be improved in those aspects. The results showed that digital story books teaching for dyslexic children learning attitude has improved significantly. All students gave the teaching with digital storybooks positive feedbacks and said that they like such learning method. They all hope to apply it to other subjects.
Keywords: Digital Storybook, Reading Disabled, Multi-Sensory teaching

1. Introduction

Reading is the spirit of education, and fundamental for a country's development. Reading is the means for gathering information and developing knowledge. According to The Program for International Student Assessment (PISA), those with higher reading ability have higher ability to gather, comprehend, and judge information to achieve personal goal and discover potential. They can effectively use information to participate in the complex mechanism of the modern society. Taiwan is also promoting reading exercises hoping the young students can have good reading habit and interests and enhance their creative thinking ability. Since it is the basic ability for lifelong learning, it is essential to foster good reading habits since childhood.

However, many children have learning disabilities. They might have normal intelligence, but with reading disabilities (RD), they grow to dislike learning and even against learning. Reading disability is a common learning disability. In Taiwan, 7.5% of children have the symptoms (Stevenson, Stigler, Lucker, Lee, Hsu, & Kitamura, 1982). Among them, more than 80% have reading difficulties which refers to the difficulties in reading words, spellings, and writing.

In order to foster reading motivations of those RD students, it is important to design reading materials that can enhance their interests. One of the best ways is to use multi-sensory stimulations to strengthen their memory and comprehension abilities. Multimedia has the function to allow the interaction between readers and the interface that can stimulate multiple sensories. At the same time, adding in stories to attract their attentions is one way to intrigue their reading motivations. Simmons (2002) stated that story is one of the ancient communication tools which have great power. Therefore, this research tries to create digital storybooks for RD students. The digital storybooks are designed to have text, graphics, animations, and audio narrations to stimulate children's multi-sensory learning purported to increase the effectiveness of their learning outcome, and encourage positive learning attitude.

2. Literature Review

Story is the first and most used text for every child before going to school. Everyone likes stories since stories allow readers to be involved in a scene outside of their everyday life, and be moved with the plot. Using multimedia and interactive designs to tell stories can help readers to participate the stories. Multimedia can stimulate learning connections with texts, sounds, graphics, and videos. Therefore, the design, production, and creation of digital storybooks become innovative challenges for teachers.

However, reading is not easy and interesting for everyone. For those with reading disabilities, reading is rather difficult and uninteresting. According to Lerner and Kline (2006), 80% of students have reading difficulties; not only their GPAs are low, they cannot fluently read or comprehend reading materials. Reading difficulties include word recognition, reading speed, word sound memory, word combination, phrase recognition, recitation, and find implications. According to Perfetti (1992), reading difficulties also include reading comprehension, oral presentation, letter recognition, phonetic activation, and semantic encoding. Children with reading disabilities (RD) can have symptons such as writing words upside down, mix words, or pronunce them wrongly.

These difficulties cannot be attributed to mental ages, sight problems, or learning environment. When children have such reading problems, they not only have learning problems, they would also have problems on motivation and ability to adapt to social situations. When children have reading problems, they would often feel anxious, have poor self concept, and low self identity problems. In order to eliminate those reading difficulties, multi-senrory instructions can act as remedies by adding sound stimulation and visual impressions.

Sensory learning refers to using different sensory to enhance learning process. Since the human body use visual, audio, physical sensories to learn, it is natural to combine these stimulations to strenghthen learning effects. Nevertheless, everyone has different sensibilities to those sensories so that everyone needs different ways of learning. For children with special needs, they can use their stronger senses to support weak ones so that they can conquer learning difficulties they meet.

3. Content and design of storybooks

3.1. Instructional Design

The design of digital storybooks has various criteria including story plots, scripts, narration tones, caption displays, music selections, and the combination of texts, graphics, animations and special effects. But the most important is whether the overall design can achieve the instructional goals. The stories created in this research have their educational implications such as bravity, confidence, and happiness respectively. All are surrounded with circumstances of family, friends, and love.

In each story, word recognitions, phonetic distinction, and reading comprehension are placed. For Chinese words, word sounds, word looks, and punctuations were important parts of texts which are all considered in the design of storybooks. The content is targeted to third to six grade primary school RD students. Words in the storybooks were specially chosen from the official word frequency report published by the Ministry of Education. The range was defined in the first 1000 frequently used words by primary school students. The corresponding design principles of storybooks for multi-sensory learning are as Table 1.

Table 1 Design principles for multi-sensory learning

Visual	Using flash cards with graphics and text explanations
	Disassemble words into components (Chinese words are graphical that every word is combined with roots and parts)
	Using animations to increase learning motivations
Audio	Using captions and narrations
	Provide oral hints for contents that require memories
Oral	Require to point out components of words
	Require to repeat learning content heard
Motor Skills	Require to write out words with fingers
	Require to show meanings of words and phrases with body movements

3.2 Story and system design

The three digital storybooks are: Mouse Dinky Got Lost; Beauty Pageant of Angel Whity; Green Light Legend of Alligator Ganga. These stories were created for this research, edited by primary school teachers, and proofed by professors in Chinese department. Besides reading abilities, students can reflect on their own life about family, friends, and love through the story content. The detail descriptions are as follows.

Unit 1：Mouse Dinky Got Lost

Plot：Mouse Dinky is an absent-minded little mouse. He always wants to go into town to take adventure. One day he sneak out when mommy is out, but encounter bad guys. He hided in an old temple when he got lost in town until was found by his family. He finally understand that family is the warmest place in the world.

Story Word Count：76

Unit 2：Beauty Pageant of Angel Whity

Plot：Nurse Whity is a kind and tender pig. When her hospital is holding the beauty pageant, she has no confidence to participate. She then finds out that she can help people when she is full of love, and understands that beauty comes from inside.
Story Word Count：75
Unit 3：Green Light Legend of Alligator Ganga
Plot：Alligator Ganga hears from the swallow about the green light legend that whoever has it can have happiness. He decides to take the trip to find the green light. When he reached the destination, he realizes that the real happiness is home.
Story Word Count：82
The characters, scenes, and objects in the storybooks were all graphed with Adobe Illustrator CS4, and then imported into Adobe Flash CS4 to make animations. The main functions of the storybooks include four parts: story monopoly (upper left), story content (upper right), Q&A (lower left), tests (lower right)(See Figure 1). All scenes have functional buttons to allow human-computer interactions and guide students through the learning tasks.

Figure 1 Screenshots of digital storybooks

4. Methods

This research uses pre- and post-tests to understand students' learning achievements. The process is as Figure 2. The tests used have the same content but the questions were given in different order.

Research subjects include five students (Anonymous as Adam, Brian, Colin, David, and Edison) from three primary schools in Tainan. They are students identified with medical evaluations as RD students. They have various degrees of reading difficulties in word recognitions and reading comprehensions.

The research collects both quantitative and qualitative data. The pre-, post-, and postponed-tests are self-made questionnaires that are evaluated by specialists of special education. The evaluation includes four parts: pronunciation, word sound recognitions, word shape recognition, and reading comprehension. Most questions were to be answered by choosing the right answer. There were 25 questions about word sounds and shapes, and 4 questions about reading comprehension; the two parts were graded seperately. During the storybook reading sessions, observation is conducted to record students' learning process. The section was followed with interviews to know students' thoughts and feelings toward the overall learning process.

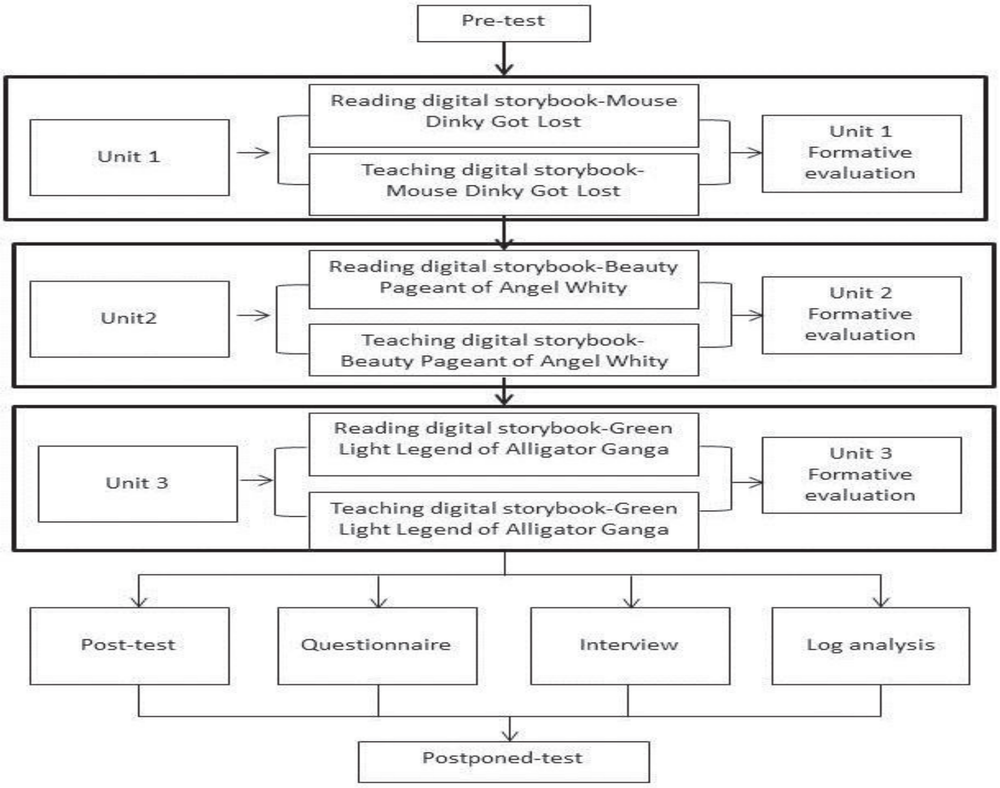

Figure 2 Research Flowchart

5. Results

Students' learning achievement was evaluated by the tests. The results show that the average scores of the post- and postponed-tests do not reach significant differences with the pre-test although both tests were obviously higher than the pre-test.

On the other hand, the questionnaire has positive results on learning attitudes. The questionnaire consisted of three aspects: the content of digital storybooks, the instruction of digital storybooks, and the intrinsic motivation of users. 4-point scale was used in the questionnaire. It shows that all children accept the teaching method of digital storybooks and favor them.

In terms of the content comprehension, the averages of all items were above 3.2 (Table 2). In "I carefully read every line in the storybooks" (t=-0.316, p=0.768), Edison expressed in the interview that he cannot pay attention to every line because he has very short attention span. (sq-20110322-stu05.doc). It shows that showing reading materials in small pieces is every important. Stories should be told in short sentences and the language delivery should be more concise and clearly stated especially for RD students. In "I pay attention to the content of storybooks" (t=-0.224, p=0.834), Edison said that he sometimes cannot think of the correct answers, and when he hesitated, he cannot pay close attention to the following content of the storybooks (sq-20110322-stu05.doc). Other possibilities include the interference of researchers sitting next to them during the testing sections. This can bring some level of pressure to push them to proceed to the next question without paying much attention to the teaching content.

Table 2 T-test results of the content of digital storybooks aspect (N=5)

Item	M	S.D.	t	p
1. I can understand the implied content in the stories	3.60	0.837	0.267	0.802
2. I carefully read every line in the storybooks	3.40	0.707	-0.316	0.768
3. I pay attention to the content of storybooks	3.20	1.000	-0.224	0.834
4. I can understand the animation with text explanations in the storybooks.	3.20	0.447	3.500*	0.025
5. I can understand the animation with oral explanations in the storybooks.	3.20	0.548	1.225	0.288

* $p<0.05$

In the question "I can understand the animation with text explanations in the storybooks" (t=3.500, p=0.025), Brian thought that the presentation of digital storybooks can help him to comprehend more of the learning content, and the animation attract his attention to the screen which leads him to learn the content in the stories (si-20110315-stu02.doc). Lai (2000) said that animation with texts can assist students to obsorb learning content and many studies also proved multimedia materials have better effects than pure text materials.

In the instruction of digital storybooks, students were all agree on "I can fluently read the words in the storybooks". Since the digital storybooks were designed to help students to distinguish word sounds and shapes, students can read more fluently after the learning tasks. It proves that developing the ability to distinguish words can enhance reading comprehensions proved by Calfee and Piontkowski (1981). In the question "I can accurately read the words in the storybooks" (t=3.500, p=0.025), students can read accurate pronunciations especially with words that have various sounds when in different situations.

Table 3 T-test results of the instruction of digital storybooks aspect (N=5)

Item	M	S.D.	t	p
1. I can fluently read the words in the storybooks	4.00	0.000	--	--
2. I can accurately distinguish the phonetic sound of the words in the storybooks	3.20	0.447	0.500	0.643
3. I can accurately read the words in the storybooks	3.80	0.447	3.500*	0.025
4. I can accurately distinguish the shape and strokes of the words in the storybooks	3.40	0.548	1.225	0.288
5. I can accurately distinguish the punctuations in the sentences in the storybooks	3.20	0.837	0.267	0.802

* $p<0.05$

Last, in the intrinsic motivation aspect, students were very agreed about "The storybooks provide me a lot of learning opportunities", ". Learning with digital storybooks is much more interesting than reading traditional books", and "I would suggest my friends to read these digital storybooks". That shows they have very high acceptance rate to digital storybooks, and believe they have more opportunities to practice with digital storybooks. In traditional classrooms, multimedia were seldom used. For RD students, they need more stimulation to multiple sensory. Animations with stories not only can increase learning motivation, they generally feel the digital storybooks to be interesting. Therefore, the result of the question "Learning with digital storybooks is much more interesting than reading traditional books" ($t=3.500$, $p=0.025$) reached significant level. Through the digital storybooks and in the near future to have gaming learning tasks can students obtain knowledge or restore the false knowledge in the learning process.

However, in "I would suggest my friends to read these digital storybooks" ($t=-0.612$, $p=0.573$), the average is 2.8 because one of the students answer "very disagree"; reversely, he answer "very agree" to the question "The storybooks are attractive to me." In the interview, he stated that because some students said these stories were not true stories so he would not want to recommend them to read these storybooks (sq-20110315-stu01.doc); but for those friends who like stories, he would suggest them to try these digital storybooks.

Table 4 T-test results of intrinsic motivation of users (N=5)

Item	M	S.D.	t	p
1.The storybooks give me a lot of fun.	3.80	0.447	3.500*	0.025
2. The storybooks are attractive to me.	3.60	0.548	2.041	0.111
3. The storybooks can increase my reading motivation	3.40	0.548	1.225	0.288
4. The storybooks provide me a lot of learning opportunities	4.00	0.000	--	--
5. Learning with digital storybooks is much more interesting than reading traditional books.	4.00	0.000	--	--
6. I would suggest my friends to read these digital storybooks	2.80	1.095	-0.612	0.573
7. I like reading more than before after reading these storybooks	4.00	0.000	--	--

* p<0.05

In the Pearson Correlation analysis to see the correction level between the four aspects (Table 5), it shows significant correlation between “storybooks” and “intrinsic motivation”. The more the students like the storybooks, the more intrinsic motivation they have. Not only they would actively attend to reading, they start to show positive attitude to overall learning.

Table 5 Correlation between factors of digital storybooks

		Digital Storybooks	Content of Storybooks	Instruction of Storybooks	Intrinsic Motivation
Storybooks	Pearson Correlation	1			
	Sig. (2-tails)				
Content of storybooks	Pearson Correlation	.515	1		
	Sig. (2-tails)	.374			
Instruction of storybooks	Pearson Correlation	.553	.704	1	
	Sig. (2-tails)	.334	.185		
Intrinsic motivation	Pearson Correlation	.924*	.742	.804	1
	Sig. (2-tails)	.025	.151	.101	

* p<0.05

The students have positive attitude to reading digital storybooks can be attributed to the story-based reading materials. They accept more arrangements of learning tasks when reading stories, and can show positive improvement of learning effects.

6. Conclusion

Electronic books have become the trend today. But most of them are traditional text presented digitally on the digital book readers without much human-computer interaction. Especially for RD students, learning without appropriate instructional design can make learning more difficult for them. Using multi-sensory instructional design in the digital storybooks has proved by this research to help RD students to increase learning motivation. By completing the learning tasks in the storybooks, students can enhance their recognition of word sounds, shapes, use of punctuations and content comprehension.

It is suggested to let more children with or without special needs to test these digital storybooks to know how much such instructional design can help for enhancing reading abilities. Various difficulty levels of reading materials can be developed for different learning needs. It can also be considered to add more materials to enhance reading abilities such as writing and voice recognition since we have gained positive results from this research.

Acknowledgements

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Technology Implementation: A Conceptual Framework derived from the Use of Audio Podcasting and EFL Student Perceptions

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Abstract: The implementation of technology is a daunting task. Much research has focused on either the implementation of the technology itself, or taken a standpoint from the instructors' perspective. With this in mind, research as of late, has seldom adapted a learner perspective or focused on issues related more closely to the learners' requirements. In this vein, the current study qualitatively gathered student perceptions and central concerns regarding technology implementation in an EFL listening comprehension class. From the findings, a conceptual framework was created which will enable EFL instructors and course designers to make informed choices on how best to implement technology, benefiting all students regardless of their academic proficiency.

Keywords: EFL, podcast, TAM, learner perceptions

Introduction

Technology implementation for instructional purposes has always created interest amongst administrators and instructors since researches have suggested various potential benefits of incorporating computer technology into language learning. However, while research foci have been on the overall benefits of implementation, the individual needs of learners has all but been overlooked. Apparently, the disregard of students' needs while using implemented technology, are the reasons that cause the gap between instructors' expectations and students' actual learning outcomes. Nicholson, Irvine, & Tooley have pointed out that the mere provision of technology does not ensure that learning will occur [1]. Moreover, without the consideration of student involvement and participation, even the best developed system cannot be successful [2]. Since the learners are an integral part of implemented educational technology, Dillen & Gabbard have called for more research on technology-rich learning environments with a particular emphasis on the learner as receiver [3]. In this vein, the current study aimed to employ a mixed methods study to further investigate and assess Taiwanese students' perceptions and central concerns of technology implementation (in this case, audio-podcasting) in their school contexts of English language learning classes.

1. Background of the study

Listening comprehension is an important skill for learning a foreign language; according to current research, the use of authentic material to aid second language listening is the most appropriate means for learning. However, many English as a Foreign Language (EFL) learning environments, Taiwan in particular, lack authentic listening materials. Consequently, gathering such resources is difficult [4] and, as a result, Taiwanese students may not have equal chances to practice listening as compared to other English skills, i.e. reading [5]. With recent advances of internet technology, such as high speed internet and digital storage, there has become an abundance of learning resources online, particularly audio material in the forms of MP3s and podcasts. With these resources readily available, instructors and course designers have easy access to authentic materials for listening instruction and may thus provide students with a variety of learning opportunities.

Khadimally stated that, "…technological implementations in the classroom can be a powerful means to help students acquire a new language…" [6]. However, "… learners with different levels of prior knowledge require different kinds of instructional approaches" [7]. Moreover, the learning content must be delivered in not only an appropriate manner but in an appealing one. As Nayak & Rai pointed out, lessons are generally created for a target audience: those students who are classified as academically average [8]. Moreover, lessons are also delivered in a manner which best suits the target audience, further compounding the problem for non-average learners. Consequently, those whom are classified as either higher or lower academically, fail to receive adequate attention [8] and are faced with unappealing delivery methods.

Furthermore, research into learning preferences show that while learners with a greater degree of prior knowledge show more control over the media, those with a lesser degree of prior knowledge require additional support. With this in mind, audio podcasting has become a popular medium for instructional delivery as it holds mass appeal to a more general audience. Nevertheless, for it to be an effective instructional delivery medium, it must be appealing to students, regardless of their academic abilities. Still, as much of the research on technology implementation has focused on the potential for enhancing students' learning achievement [9] [10] as well as the strategies of implementation technology in a particular subject areas. There has been a limited body of literature centering specifically on the students' perspective of technology implementation. To this end, the aim of this study is to assess students' perceptions of classroom technology implementation, more specifically, audio podcasting. A particular focus will be given to lower academic achievers, as they tend to require additional support. From their perceptions, determinations as to the best possible enhancements to instructional audio podcasting are deduced, in turn creating a more appealing and effective instructional environment applicable to a greater range of students.

2. Methodology

2.1 Sample and Setting

Participants included 121 students, enrolled in the twelfth grade of an English language program at a private senior high school in northern Taiwan in the spring of 2011. Seventy-seven percent (77%) of the participants (N=121) were females and all participants were aged 17 or 18.

2.2 Procedures

The mixed-method study addressed the effectiveness of implemented technology (audio-podcasting) with learner satisfaction in the form of acceptance using a triangulation strategy with multiple resources of data collection. Primary data sources included three questionnaires: the first concerning participants' prior exposure to English as a foreign language instruction; the second regarding their preferred method of communication in English (reading, writing, listening, speaking); and the third, an open-ended questionnaire concerning their learning needs which mirrored the desired enhancements for audio-podcasting. The first questionnaire contained an additional subscale measuring students' acceptance of the implemented technology was modified from the Technology Acceptance Model (TAM) developed by Davis [11] and consists of twelve 7-point Likert scale items where 1 indicated "strongly unlikely" and 7 indicated "extremely likely".

3. Results and Discussion

To permit a more vivid understanding of the different perceptions students held, two distinct clusters were formed according to the TAM results: Cluster A comprised approximately the 10% of respondents with the lowest acceptance ratings; while Cluster B was comprised of approximately 10% of respondents with the highest TAM acceptance ratings. In effect, all participants who returned responses indicating acceptance of the technology implementation but did not indicate any particular central concerns, were removed from statistical analysis as they neither augmented nor diminished the outcome, but obscured it. With this more distinct grouping, four specific themes emerged: 1) the addition of subtitles or captions; 2) the addition of user controlled audio speed; 3) the addition of single word support; 4) and the addition of translation support. Each theme is described in the following section.

Qualitative Findings

The data from the open-ended questionnaire generated four key themes that support and further clarify the quantitative results. The first one deals with *the addition of subtitles or captions* (i.e. the redundant text in the learners' native language: subtitles, or in the target language: captions). Those students who were classified as "lower academic achievers" believe that audio-podcasting provides a valuable means to enhance their listening ability; however, many were not able to grasp particular utterances or words. For instance, Student A said, "Students who do not understand the listening content can get the ideas from the additional information (Chinese or English text)." Likewise, Student B stated that the addition of Chinese text would facilitate understanding of the "…more difficult vocabulary" and in some instances, the "Chinese meaning…" should be given. According to Vandergrift, lower prior knowledge in second language learning rely on "bottom-up" processing to garner understanding from listening content [12]. Consequently, these students may have difficulty inferring the meaning of particular words from the phrasal context in which it is given. Thus, as Student C commented, the provision of visual content (i.e. text, graphics or pictures) "… may give a deeper impression or understanding…" of the listening content.

The second theme to emerge was the *addition of user controlled audio speed* (i.e. the ability to increase or decrease the rate of speech (wpm)). Interviewees described confusion when the content was presented too quickly for them to process. As Student D stated, "I think the addition of a function which can adjust the speed, either fast or slow, would be good: since I feel that some parts are too fast to understand well". Some students, particularly lower academic achieving students, rely on "bottom-up processing" and thus need time to: 1) process each word individually, 2) combine the individual words in the sentence, and 3) process the sentence as a whole.

The third theme to arise was the *addition of single word support* (i.e. similar to dictionary-like function to check word definitions). Several students mentioned that although full attention was given during the listening process, some contextual keywords were still missed. Student E reflected, "…vocabulary explanation is needed, especially for some [words] with difficult or multiple meanings". Coming across such words created a period of slower processing followed by confusion. This confusion was further compounded when the subsequent sentences were not processed due to the continued processing of previous items.

The fourth theme to become apparent was the *addition of translation support* (i.e. the provision of immediate English-to-Chinese interpretation).Those participants, categorized as lower academic achievers in English listening, needed an alternate aid to check the word and/or phrase meaning during states of confusion caused by the listening content, without interfering with ensuing sentences or interrupting the lesson flow. For instance, Student F commented, "…if there was a Chinese translation, I would better comprehend the context". Also, Student G noted that a supplement of whole text Chinese explanation would be beneficial to quickly clarify the meaning of context. An optional translation will allow for faster processing and permit students to continue without contextual confusion.

Table 1 Conceptual framework

Theme	Low Academic Achievers			Technology Implementation (Audio-podcasting)	High Academic Achievers		
	Characteristics	Requirements	Enhancement		Characteristics	Requirements	Enhancement
1	Low level of prior knowledge	visual cues: textual or pictorial; to gain contextual knowledge	provision of contextual-graphical cues	learner control of caption/subtitle availability	High level of prior knowledge	n/a	No additional support needed
2	Slower processing	Slower audio at a speed which may be processed	Ability to slow down content to avoid confusion	variable speed control	Faster processing	Faster audio which content is delivered more efficiently	Ability to speed up content to avoid boredom

3	Uses bottom-up processing	available meanings of singular words	optionally target language dictionary support	Link to online dictionary, or pop-up dictionary	Uses top-down processing,	meaning gathered from context,	no additional support needed
4	Low level of prior knowledge	available translation of translation	optionally native language support	Link to online translator, or pop-up translations	High level of prior knowledge	n/a these student can deduce meanings from context	no additional support needed

4. Conclusion

The overall findings from the current study show that students, regardless of academic achievement tend to perceive audio-podcasting as a useful deployment of technology integration. The results of the statistical analysis illustrate that perceived levels of acceptance are positively associated with the type of learning supports required as well as the level of prior knowledge. The indications are thus two-fold: first, this indicates that students with greater prior knowledge need fewer additional supports, however they would benefit from acquiring individual control over the speed of delivery which in turn will expedite learning; second, students with less prior knowledge require additional support which will enable faster processing of meaning and overall comprehension, i.e. visual cues in the forms of either text, graphics or both, as well as individual control over the speed of delivery which will slow the learning as to facilitate the additional time required to process the content. Furthermore, low academic achievers will further benefit from the implementation of an online dictionary in the target language as well as having translation support available. The aim of this study was to assess students' perceptions of classroom technology implementation, specifically audio podcasting. From this assessment themes emerged concerning the students' learning needs and a conceptual framework was created. This framework will assist instructors and course designers to generate a more appealing learning environment, which addresses the learning requirements of a wider spectrum of students, in answer to the students' principal concerns.

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Analyzing Students' Eye Movements of their EFL Reading with Concept Mapping Strategy

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Abstract: The study aimed to investigate the effectiveness of applying concept mapping strategy by monitoring EFL students' eye movements during English reading process. The participants were divided into two groups: the one applied concept mapping strategy (N = 10), and the control group (N = 12). The experimental group received two reading materials with the aid of concept maps while the control group received the same reading materials without the aid of concept maps. Major findings included that participants in the experimental group spent less time significantly on the texts and the AOIs, and their fixation numbers on the AOIs were also less than the control group. It indicated that the concept mapping strategy could shorten learners' reading time and enhanced learners' reading effectiveness. The eye movement data provided concrete evidence to explain how concept mapping strategy could facilitate learners' reading of previous studies.

Keywords: concept mapping strategy; EFL reading ability; eye movements

Introduction

A concept map is a diagram showing the relationship among concepts (Liu, 2010; Guastello, 2000). It organizes the information and the concepts, usually formed with circles and boxes, and a connecting line linked two concepts together. Moreover, the link between the concepts can be on-way, two-way, or non-directional (Lanzing, 2004; Novak & Canas, 2008).
Concept mapping is a reading strategy which assists learners to conduct information about the reading content through visual aids. Previous studies also showed that concept mapping reading strategies had greater benefit for learners' reading comprehension (Cassata-Widera, 2008; Dyer, 1985; Liu, 2010; Stice & Alvarez, 1986). During the reading process, using concept mapping not only can help learners to organize information about the reading materials, but be easier to memorize (Chiu, 2004; Liu, Chen, & Chang, 2010) and summarize (Esiobu & Soyibo, 1995) the content which conveyed by concept mapping. Moreover, according to Liu's (2010) research, it was suggested that students were able to apply reading strategies such as "inferring", "enforcing", and "reviewing" while they used the concept mapping strategy. The listing strategy provided the organization ability for learners after they got the main point and understood the whole meaning of the context (Hidi an Andersin, 1986). For reviewing strategy, according to Liou & Chen(1999), they pointed out that learners could go back to content and try to recall the detail under the subtitle after they completed the reading. In addition to these reading strategies, Goodman (1989) also

mentioned that learners using inferring strategy could go thought the relevant paragraphs to confirm their inferences.

Although the previous studies showed that concept map is an important reading strategy via evaluating the learners' performance from paper-pencil tests (Chang, Sung&Chen, 2002; Dyer, 1985; Esiobu, & Soyibo, 1995; Stice & Alvarez, 1986), through questionnaire(Liu, Chen, & Chang, 2010)and observation(Cassata-Widera, 2008; Huang, 2005) However, there was no concrete evidence to explain the reasons why the learners got benefit from this strategy and how it change learners reading pattern.

Eye movements are part of the normal reading, this method allows readers read the reading without any interruption, and reader' reading pace and route could be monitored (Hyönä & Nurminen, 2006). Monitoring eye movements during reading can provide valuable information regarding reading comprehension processes (Rayner, Chace, Slattery, & Ashby, 2006). Base on the above reasons, this study recorded readers' eye movement pattern during their reading and aimed to provide the concrete evidence for explaining how concept maps affect learners' reading comprehension. The research questions were:

(1) What was the influence of the concept mapping strategy on learners' reading time in texts and AOIs?

(2) What was the influence of the concept mapping strategy on learners' fixation numbers in texts and AOIs?

1. Methods

1.1 Participants

The participants of this study were 22 Non-English majored students from one Universality in Taiwan. The participants have been studied English for over six years. In this research, 16 females were selected while 6 males participated in. The participants' English proficiency level was intermediate to high-intermediate. Moreover, the native language of all the participants is Chinese. All the participants attended this experiment voluntarily. Before the experiment, participants were divided into the experimental and the control groups. The participants in the experimental group (N=10) received two reading materials with the aid of concept maps, while control group (N=12) received the same reading materials without the aid of concept maps.

1.2 Apparatus

Eye movements/fixations were recorded during the solving of the word problems with the eye-tracker faceLAB4.5 which sampled the position of the participant's gaze every 16 ms (i.e., 60 Hz). The stimuli were presented by the software GazeTracker on a 19-in.Viewsonic (1280×1024 pixels) monitor. In addition, and the other (out of sight of the participant) for the experimenter to give feedback in real time about the participant's computed gaze position through the monitoring system overlay, which allows the experimenters to evaluate the system's accuracy and to initiate a recalibration if necessary. The stimuli were situated approximately 0.6 m from the subject. In order to avoid distracting the participant during experiments, a divider was set to reduce the empirical interference.

1.3 Materials

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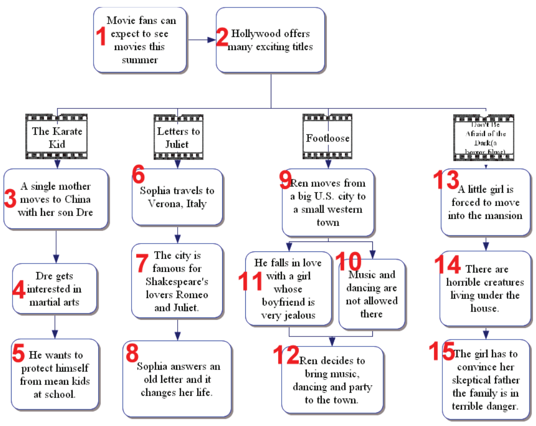
2.2.1 Reading articles: Two articles included in the high-intermediate proficiency level of an English magazine were selected as the reading materials in this research: *Some expecting movies* as Article 1 and *MBA programs in the US* as the Article 2. The first article talked about four upcoming movies in the summer, which are *The Karate Kid, Letters to Juliet, Footloose,* and *Don't Be Afraid of the Dark*. The difficulty levels of the articles were .32 (Article 1) and .54 (Article 2). Then the second article described an institution called MBA which can help students to have their further studies in the US. The basic vocabulary size required for the reader was 3000-5000 words. Moreover, the contents of these two articles are related to real life. In this case, participants do not necessary to have any pre-knowledge of any specific domain.

2.2.2 Concept map: the concept map is expert-constructed concept map which is developed by the instructor. This kind of concept mapping strategy provide leaners a guide to follow in a top- down approach to reading and finding the focus points in the text (Liu, 2010). The contexts of each box in concept map were associated with the knowledge in the articles.

In this research, two articles were included, and both of the articles were drawn AOIs. Area of interest (AOI), or called lookzone, usually refers to the area that the study is going to measure. In this study, the AOIs were drawn as the major concepts or focus points of the articles. The participants could find the focus point of the articles through these areas. In the first article, both the concept map and the text were drawn 15 AOIs while 11 AOIs were shown in article 2 (See *Figure 1*).



1 Movie fans know that Hollywood offers many exciting titles between May and August. Here's **2** some of what eager moviegoers can expect to see this summer. Kids will enjoy a remake of the 1984 film *The Karate Kid*. In the movie, **3** a single mother moves to China with her son Dre. Once there, **4** Dre gets interested in martial arts. **5** He wants to protect himself from mean kids at school. His teacher is a martial arts master, played by Jackie Chan. The drama *Letters to Juliet* follows **6** Sophia, a young American woman, as she travels to Verona, Italy. **7** The city is famous for Shakespeare's lovers Romeo and Juliet. **8** Sophia answers an old letter to Juliet seeking advice about love, and it changes her life. In *Footloose*, a family with a teenage son, **9** Ren, moves from a big U.S. city to a small western town, where **10** music and dancing are not allowed. This is a shock for Ren, and his difficulties increase when **11** he falls in love with a girl whose boyfriend is very jealous. **12** Ren decides to bring music and dancing back to the town, beginning with a party for students at the town's high school. If you like horror films, you won't want to miss *Don't Be Afraid of the Dark*. In this remake of a 1973 TV movie, **13** a little girl is forced to move into the mansion where her father and his new wife live. **14** The girl discovers that there are horrible creatures living under the house. Somehow **15** she has to convince her skeptical father that the family is in terrible danger.

Figure 1. AOIs and its correlation between concept map and text in Article 1: *Some expecting movies*

1.4 Procedure

The participants seated approximately 70 cm form the computer screen. Before the experiment, participants' eye movements were adjusted and calibrated by using a 9-point calibration grid that presented over the entire computer screen. The participants' eye movements were checked if this research is valid. After the adjustment, participants were asked to read two reading comprehension. Two articles were showed in the screen. The experimental group received two reading articles with the concept mapping strategy while control group read the two reading materials only. For the experimental group, the participants received the concept map of the article first, and then the next page was shown both the concept map and the article. There is no time limitation during their reading. However, the participants usually took one hour to finish this experiment. After they read the articles with and without the aid of concept mapping strategy, they had to answer the following four reading comprehension tests for each article.

1.5 The eye tracking method

In the study, the eye-tracker was used to monitor the participants' eye movements through the EFL reading process. In this study, fixation points were identified by the number of 3 gaze points that fell within a certain dispersion, and were grouped within a radius of 40 pixels, and then gathered with a minimal duration of 200ms. Using Gazetracker the time and fixation data were exported to Microsoft Excel. The participants' fixation and total reading time were checked as a concrete evidence to see whether the concept map could assist their reading. In the reading materials, both the concept maps and texts were drawn AOIs. The AOIs were selected as the key knowledge or content in the articles. The AOIs between concept maps and texts were correlated. In this study, three eye movement data were corroborated: the total reading time were defined as (1) the spending time on the articles (2) and the time the participants spend on all the AOIs. In addition, (3) the fixation numbers that the participants fixated from the AOIs were illustrated as well. These variable data in two groups was compared to observe whether there is any significant difference between these two groups.

2. Result

2.1 Participants spent less time on the reading with the aid of concept maps

Several series of analyses were computed on the eye-movement data. The data investigated the amount of time that the participants spent on all the text, the total reading time in AOIs of two articles, time spent on the concept maps, and the fixation numbers in the AOIs and texts.

Table 1. *The Independent T-test and descriptive data of total reading time in texts*

Reading Material	Concept Map	*N*	*M*	*SD*	*t*	*df*	*p*
Article 1	with	10	106.75	99.89	2.73	20	.01*
	without	12	204.98	68.21			
Article 2	with	10	91.09	99.56	1.91	20	.07
	without	12	154.55	52.63			
Article1&2	with	10	197.85	196.52	2.41	20	.03*
	without	12	359.53	113.97			

Table 1 shows the number of the participants' mean and standard deviations of total reading time in Article 1 and 2. Independent T-test was conducted with concept mapping strategy and total reading time as the variables. The result showed the significant differences between the experimental group and control group ($p < .05$) in Article 1. It indicated the total reading time of experimental group of Article 1 ($M = 106.75$, SD = 99.89) was shorter than the control group in Article 1 ($M = 204.95$, SD = 68.21). Note that this result indicated participants reading with the aid of concept mapping strategies revealed shorter time on the Article 1. Then the data only shows little differences in Article 2. However, when took the articles together, the result showed the significant differences between the experimental group and control group ($p < .05$). It indicated the total reading time of experimental group of two articles (M = 197.85, SD = 196.52) was shorter than the control group (M = 359.53, SD = 113.97).

Table 2. *The Independent T-test and descriptive data of total reading time in AOIs*

Reading Material	Concept Map	*N*	*M*	*SD*	*t*	*df*	*p*
Article 1	with	10	36.10	36.67	-2.68	20	.01*
	without	12	70.33	22.78			
Article 2	with	10	24.24	27.72	-2.17	20	.02*
	without	12	45.35	17.54			
Article1&2	with	10	60.34	63.25	2.53	20	.02*
	without	12	115.69	38.08			

Table 2 presents the number of the participants' mean and standard deviations of total reading time in AOIs. In this, independent T-test was conducted with concept mapping strategy and total reading time as the variables. The result showed the significant differences between the experimental group and control group ($p < .05$). It indicated the total reading time in AOIs of experimental group of Article 1 (M = 36.10, SD = 36.67) and Article 2 (M=24.24, SD=27.72) was shorter than the control group in both Article 1 (M = 70.33, SD = 22.78) and Article 2 (M = 45.35, SD = 17.54). In addition, when took the articles together, the result showed the significant differences between the experimental group and control group ($p < .05$). It indicated the total reading time in AOIs of experimental group of two articles (M = 60.34, SD = 63.25) was shorter than the control group (M = 115.69, SD = 38.08).

Figure 4 shows the mean of total reading time in AOIs of the texts from experimental group and control group, and it indicated the participants reading with concept mapping strategies spent less time on the texts.

Table 3. *The participants' means (and SD) of total reading time in concept maps*

Reading Material	Concept Map	*N*	*M*	*SD*
Article 1	with	10	19.54	14.70
Article 2	with	10	19.81	23.39
Article 1&2	with	10	39.35	34.34

Table 3 indicates the mean and standard deviations of total reading time in the concept maps. It showed that the participants in experimental group spent 19.54 second on the map in Article 1, and 19.81 second on the map in Article 2.

2.2 Participants had less fixation numbers on the AOIs with the aid of concept maps

Table 4. *The Independent T-test and descriptive data of fixation numbers in the texts*

Reading Material	Concept Map	*N*	*M*	*SD*	*t*	*df*	*p*
Article 1	with	10	201.00	203.93	2.58	20	.01*
	without	12	389.58	136.52			
Article 2	with	10	168.80	198.73	1.83	20	.08
	without	12	293.50	115.20			
Article1&2	with	10	369.80	396.65	2.28	20	.03*
	without	12	683.08	241.61			

Table 4 shows the number of the participants' mean and standard deviations of the fixation numbers in texts. Independent T-test was conducted with concept mapping strategy and the fixation numbers as the variables. The result showed the significant differences between the experimental group and control group ($p < .05$). It indicated the experimental group in Article 1 ($M = 201$, SD = 203.93) revealed less fixation numbers than the control group ($M = 389.58$, SD = 136.52) while it only showed little differences in Article 2. However, when took the articles together, the result showed the significant differences between the experimental group and control group ($p < .05$). It indicated the fixation numbers of experimental group in two articles ($M = 369.8$, SD = 396.65) was less than the control group ($M = 683.08$, SD = 241.61).

Table 5. *The Independent T-test and descriptive data of fixation numbers in AOIs*

Reading Material	**Concept Map**	*N*	*M*	*SD*	*t*	*df*	*p*
Article 1	with	10	113.90	119.45	2.53	20	.02*
	without	12	224.92	77.56			
Article 2	with	10	84.30	101.87	1.85	20	.07
	without	12	153.17	64.97			
Article1&2	with	10	198.20	216.70	2.37	20	.03*
	without	12	378.08	136.08			

Table 5 demonstrates the number of the participants' mean and standard deviations of the fixations. In this, independent T-test was conducted with concept mapping strategy and the fixation numbers as the variables. The result indicated the significant differences between the experimental group and control group ($p < .05$) in Article 1. It indicated the fixation in the AOIs of experimental group in Article 1 ($M = 113.90$, $SD = 119.45$) was less than the control group ($M = 224.92$, $SD = 77.56$). However, when took two article together, the result showed the significant differences between two groups ($p < .05$). It indicated the fixation of experimental group of the articles ($M = 198.20$, $SD = 216.70$) was shorter than the control group ($M = 378.08$, $SD = 136.09$).

Figure 7 and 8 present the fixation numbers and the reading route of two articles from two participants in different groups. It showed that the particpants read with the concept mapping strategy revealed less fixation numbers than the participant in the control group. The result indicated that the particpant in the experimental group fixated less on text and could find the key words or sentence easily. Moreover, the particpant read with the concapt map could use some reading strategies(listing, inferring, and reviewing) while the the particpant in control group read the atricle word by word.

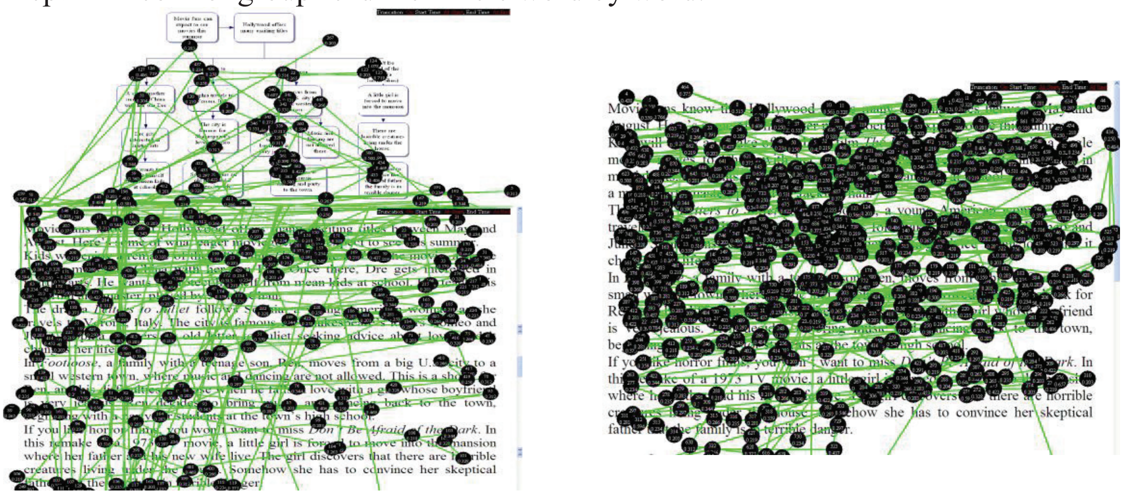


Figure 2. The fixation numbers in Article1 from the participants of two groups (Left: The experimental group; Right: The control group)

3. Disscussion

As the previous studies mentioned that the concept mapping strategy provided positive effects in learners' reading (Dyer, 1985; Esiobu & Soyibo, 1995; Liu, 2010). However, the evidence was not provided to prove how readers utilize concept maps when they read a text. In this case, the questions in this study explored whether the aid of concept mapping strategy would influence the students' eye movements on English reading time and pattern. The results of the eye tracking data suggested that the adopted concept mapping strategy help participants read more effectively. There were two pieces of evidence supporting the influence of concept mapping strategy. First, reading time either in texts or AOIs were shorter than the one without the aid of concept maps. Second, readers tended to skip over words in irrelevant sentences which were not included in the AOIs (see Fig 2.). More generally speaking, these results suggest that concept maps guides readers' visual attention in a selective manner (Anderson, 1982) and defines what information is processed to a deeper level and integrated to the developing memory representation (Kaakinen & Hyona, 2007).

4.1 Participants revealed less reading time with the aid of concept maps

The result corroborated that the participants read without the aid of concept mapping strategy revealed longer reading time and more fixation numbers than those read with the aid of the mapping strategy. The longer reading time appears to be due to a larger fixation numbers in texts.

According to Rayner et al.'s (2006) finding, they claimed that time and numbers of fixations are affected by texts difficulty of readers' self-awareness. It indicates that while readers read without concept map, they had more reading difficulties than reading with the aid of concept maps. In addition, from the aspect of concept mapping strategy, Cassata-Widera (2008) pointed out that concept map not only can develop learners' literacy skills but provide ways to represent and organize the knowledge from the separated context. Then, new linguistic forms were shown to express the concepts. When corresponding to the current study, the reason for the participants read with concept map spent less time on the articles is that the concept map helps learners to display whole relationship of the context. It indicated that the aid of concept maps helps learners to summarize the article, and then the participants could directly catch the focus point. In this case, the participants could spend less time to understand the article.

These results thus provide further confirmation that concept map could reduce readers' reading difficulties and reading time.

4.2 Participants tended to use some reading strategies with the aid of concept map during the reading process

From data showed in Figure 2, readers with the aid of concept maps had less fixation numbers on the AOIs and had more strategic processing mode during reading by paying particular attention to relevant information emphasized by concept maps. The participant in the experimental group would use some reading strategies through the reading process. This finding might correspond to Liu, Chen and Chang's (2010) study. In this study, the fixation numbers showed the participants read with the concept mapping strategy tended to use the reading strategies: listing, inferring, and reviewing. For listing and inferring, the participant read with the concept map put most of his attention to the sentences or the paragraph which is related to the main points while the participant read without the concept mapping strategy only read the articles word by word. As for the reviewing strategy, from the participant's reading route, it showed that the participant in experiment group would go back over the content or glace though subtitle to recall the main idea after he read the whole article. When it comes to the participant in control group, read without the concept mapping strategy, his reading route was systematically from left to right, and he seldom went back to organize and clarify the article.

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Mobile Assisted Game-based Chinese Character Recognition

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Abstract: This paper reports on the effects of two different dynamic grouping strategies in a mobile-assisted Chinese character learning game. The game application assigns each student a component of a Chinese character through their smartphones and requires them to form groups that can assemble a legitimate Chinese character using the components held by the group members. Sixteen Primary 3 (3rd grade) students taking Chinese as a second language (L2) class involved in the study. Video-recordings of the game and the transcriptions of focus group interviews were qualitatively analyzed. The study aims to explore the patterns of social interactions during the game, especially on the varied impacts of the two different grouping rules (allowing versus not allowing each student to join more than one group at one time) on the students' game behaviors and their learning gains.
Keywords: Mobile-assisted Language Learning (MALL); game-based learning; Chinese character learning; Computer-supported Collaborative Learning (CSCL)

1. Introduction

Chinese has long been regarded as one the most challenging languages to learn. One major challenge to the non-native learners is the complexity of the logographic configuration of Chinese characters [15][23]. There are two categories of Chinese characters in terms of their physical structures. One is called an integral character which contains only one component, such as 口, and the other one is named compound character, which includes at least two components [15]. Most Chinese characters are composite made up of multiple reusable components that fit into the square space. The spatial configurations of these compositions usually follow about 15 different patterns [7][28]. Taking ⿱ as an example, there are many Chinese characters that fits the pattern, such as 吾, 尘, and so on. Some simple components can be combined to form more complex components or compound characters [7]. Psycholinguists have stressed the importance of the awareness of part-whole relations and component knowledge in the processing of language [17]. Previous studies have also concluded that it is hard to memorize the strokes in whole words [19]. Therefore, other studies favored the instructions on the structure and form of characters that require the students to pay attention to the association between character, form and meaning. Students are encouraged to add associations to the characters and their forms using their imagination and creative thinking [11].

In turn, we developed a game-based learning approach on collaborative Chinese character formation, namely, "Chinese-PP" (汉字，拼一拼). PP refers to 拼一拼 or "Pīn yì Pīn" in Chinese, which roughly means "trial assembling", and also colloquially means "striving for better (outcomes)". In playing the game, the students are assigned smartphones in 1:1 (one-device-per-student) basis. The activity is conducted in multiple rounds. In each round, a set of Chinese character components is randomly assigned by the system server via 3G connections to individual students. The students have to recognize and compose legitimate compound characters by grouping with their peers who have different components. This paper focuses on analyzing the social interactions, collaborative behavioral patterns and competitive strategies that were emerged during several game playing sessions. In particular, we will discuss the different impacts of two different grouping rules (allowing or not allowing the players to join more than one group at each time) on the students' game behaviors and their learning time.

2. Related Literature

2.1. Chinese character learning

Many studies emphasized the importance of Chinese character recognition. For example, previous research indicated that the students' mastery of components and their vocabulary have direct impact on character learning. Other studies also noted that novel students should focus on learning character recognition which is more important than writing [1]. Shen and Ke (2007) stated that component information is involved in word recognition in the area of morphological processing of Chinese character [16]. For example, some scholars found that characters can be recognized by the activation of submorphemic (radical) information [18].

A Chinese character consists of three tiers: whole character, components and strokes. Moreover, the middle part, the components, is the core and the base for the formation of a Chinese character [20]. While Chinese characters are composed from a limited number of common components, previous scholars had successfully used computer technologies to help students to develop such structural awareness about Chinese character [10]. Teaching the structures of characters and simultaneously addressing the relationship between parts and wholes would generate positive effects on character learning [2][12].

2.2. Mobile Assisted Language Learning

Mobile learning makes diverse possibilities of innovative instructional method be carried out in the general classroom in more effective and efficient ways. Scholars noted that mobile-assisted language learning (MALL) provide students with rich, real-time, convenient, social contact, collaborative, contextual learning opportunities no matter inside and outside the classroom (Kukulska-Hulme,& Shield, 2008). The paradigm has also been applied to Chinese Language learning in recent years. A previous study explored the feasibility of using of a wireless handheld system (WHS) that supports the individual and co-operative reading activities in Chinese language classes, and found that WHS improved students' Chinese language and facilitated co-operative learning in the Chinese class [4]. Another study on Chinese vocabulary (idiom and conjunction) learning placed an emphasis on learner created contexts and contents, and found that the students' ongoing, open-ended, personal-to-social meaning making processes showed potential of transforming language learning into an authentic learning experience [22][24][26][27].

2.3. Game-based Learning

The purpose of new interactive models in learning environment is to involve students in their learning tasks. Games are regarded as effective tools for enhancing learning [5][14] because Game-based learning assists students to learn the material by overcoming challenges in games. Game-based learning has the characteristics of helping learners enthusiastic, focused, and engaged. As a result, the students can be interested in and enjoy the tasks they do [13]. The students do their best to achieve their goals by insisting on the end of playing game without forces [6]. The Chinese-PP approach in the study was designed on the foundation of the games and learning model which is illustrated in Figure 1 proposed by Garris et al. (2002). In the beginning of the game cycle, the judgments of users are based on free will, and their intentions representing engagement and enjoyment. User behaviors are triggered in exert intense effort and concentration. The feedback is critical to support performance and motivation [3][21]. Research suggested that the effects of feedback on performance are highly variable; especially well feedback can improve performance [8].

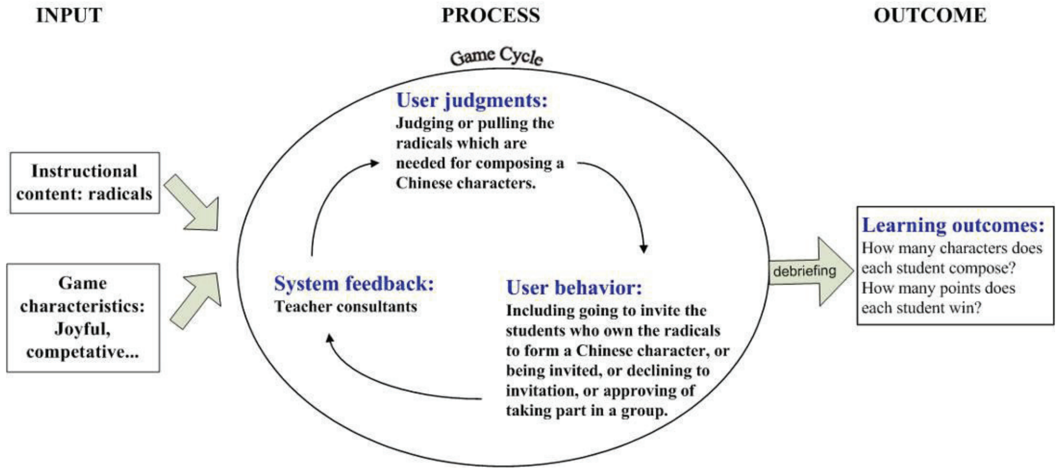

Figure 1. The Input-Process-Outcome Game Model used in ChinesePP (Garris et. al., 2002)

3. Method

3.1 Procedure

Sixteen P3 students who were learning Chinese as second language in Singapore in a primary school participated in the empirical study. Six one-hour Chinese-PP learning sessions were designed with the involvement of the researchers and teachers. Each learning session consisted of three sections, namely, warming up (about 15 minutes), game playing (about 30 minutes), and recalling (about 15 minutes). The learning sessions were enacted between May-September, 2011.

More specifically, in the warming up section, the teacher delivered brief instructions with Powerpoint files on specific knowledge of Chinese character structure, such as *pictophonetic character* (a character that composes of a component indicating the pronunciation and another representing the semantics, e.g., 晴 [means "sunny", pronounced as 'qíng'], with 日["sun"] representing the semantic meaning or 'picture' of the character, while 青 [similarly pronounced as 'qīng'] indicating the pronunciation), and enacted relevant paper-based group activities. The aim was to equip students with prerequisite knowledge for the subsequent (two to three rounds of) mobile-assisted game playing. After the game, the teacher facilitated a recalling activity where students were asked to relate the characters that they had composed during the game with the character structure knowledge that they learned from the teacher (e.g., relating 晴 to 'pictophonetic character').

3.2. Design of game-based learning activities

Figure 2 shows the framework of the Chinese-PP game. At least two game-based factors and three learning theories are integrated in the system. The Chinese-PP game was designed by means of integrating mobile learning in the general classroom setting with the aim of promoting interactions and collaborations among learners. The game approach can be characterized as spontaneous, dynamic grouping game as no fixed student group is determined before each game round. Each student is equipped with a smartphone in which they can see what components they have and what components the other classmates are assigned. The students will identify their partners in order to collaboratively compose the components into a legitimate Chinese character. When one game advances to the next round, the existing groups are all disbanded and a new set of components are assigned to the students.

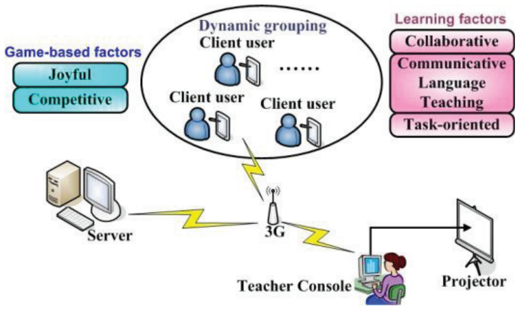

Figure 2. Framework of Chinese-PP in class

The setting and devices used in the study consists of a projector, the 3G wireless connection, a laptop with the Chinese-PP teacher console being installed, 16 smartphones installed with the client application of Chinese character recognition game. The facilitator (usually teacher) prepares several sets of Chinese components that are equal to the number of participating students in advance. When the game starts, the client application on the smartphone displays all the components for a student to select and configure (spatially) in order to form a Chinese character (see the left of Figure 3). Upon submission of her composed character to the server, the other students who "own" the components that the student has selected will receive the character on their "My Groups" window as a proposal for grouping. However, the proposed student cannot take for granted that her peers will join her group as the other students might have also formed their own characters or receive other proposals. This is the point where she will need to negotiate with the peers to join her group.

In addition, the system allows the teacher to tweak the game rule of whether to allow an individual student to form or join more than one group at a time (known as "single-group mode" and "multi-group mode" respectively). For example, a student who is assigned the component "五" ("five") submits a character "吾" (I). At the same time, another student may propose "伍" ("group") and invites the former to join them. During the single-group mode, she will have to choose one between the two options. Otherwise, she can join both groups if she thinks the two proposed characters are legitimate ones. During the learning sessions, the teacher complied to our advice by alternating between the two modes across different game rounds in order to experiment their effects on the students' collaborative patterns and game behaviors.

The group which is organized by the students themselves based on their requirement. At the right of Figure 3, the teacher not only checks the characters which the students compose on the teacher console (projected on the screen), but also explains and gives just-in-time feedback to all the students. Moreover, the students can know the characters composed by other students and the scores they win (see below) in the teacher console.

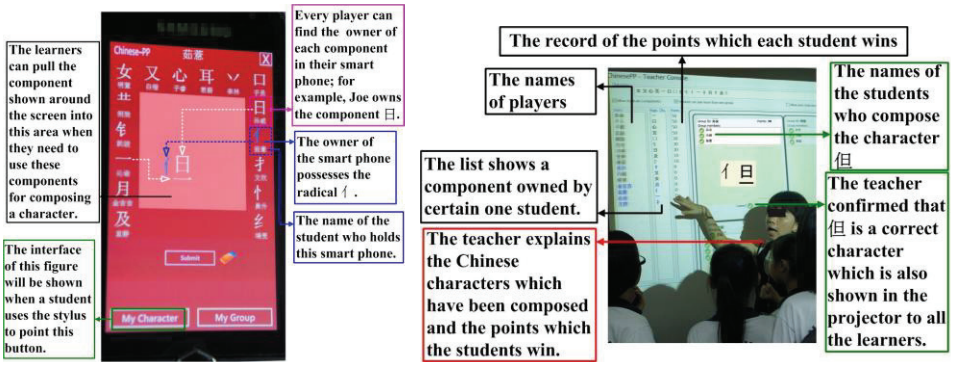

Figure 3. The user interface of the smart phone client (left), and the teacher console (right)

A scoring scheme is applied in the game in order to motivate the students to strive for greater game achievement. Students earn and accumulate scores by forming legitimate groups – 10 points for a 2-component character, 20 points for a 3-component character, 30 points for a 4-component character, and so on (same score to be awarded to each member of the group). This is to encourage the students to form bigger legitimate groups for identifying more complex characters. During the multi-group mode, a student who joins more than one group will earn accumulated scores from all the groups carrying the legitimate characters.

4. Results and Discussions

4.1. The social interactions in the game-based learning

The dynamic collaborative grouping strategy enabled by mobile information exchange and face-to-face interaction had successfully motivated learners' active desire in finding out what components can be put together to form a Chinese character in Chinese-PP. In terms of peer collaboration, competition, and tutoring, the higher-achievement (HA; in terms of their academic achievements in the Chinese Language course) students who have indomitable characteristics become the leaders and advisors of the group to guide other students in determining which are legitimate characters and which are not, or suggesting alternative characters by replacing one or more components. For example, in the study, a HA student Wendy (pseudonym) often took the initiative to advise other groups in their game playing. After two Chinese-PP learning sessions, her peers became more inclined to seek for her assistance. Albeit taking place in a general classroom, we rearranged the student chairs and desks to set aside an empty space and encouraged the students to walk around, form and re-form ad-hoc physical clusters to ardently discuss with different peers so as to explore alternative possibilities of characters, as shown in Figure 4. As for the lower-achievement (LA) students, we observed that they were not left alone during the game. This was because the more proactive students (who were not necessarily HA students) would search for partners to compose their own groups. When other students needed the components which the LA students had, they would explain their proposed characters and invite the LA students to join their groups. As a result, the Chinese character knowledge of the HA could be transferred to their counterparts.

Figure 4. The students carry smart phone with them and go around to discuss with others

4.2. Different impacts of two grouping modes on the game playing and learning

In this section, we compare the effects of the two collaborative grouping modes, single-group mode and multi-group mode, to the students' game playing and interactional patterns in the game. According to our analysis on the video and server logs, during the single-group game rounds, most of the students usually spend more time to figure out the most complex characters that they could recall from the given components before making their submissions. Conversely, during the multi-group rounds, they would attempt to submit more alternatives of characters and were engaged in interactions with more peers to confirm the legitimacy of those characters. The game had also become more competitive as students who submitted multiple characters were more likely to gain higher scores. As the scores and their overall rankings were dynamically updated in the teacher's console and projected to the students to refer to, that became one of the motivating factors for them to remain active in playing the game.

Indeed, the students were keener on attempting to compose more complex characters. Take one example that we observed within the single-group mode, four students formed the character 熟(literally means "cooked" or "ripe") whose configuration is not taught in P3. In turn, each of the four members won 40 points respectively at the same time.

Conversely, during the multi-group mode, students tended to perform frequent group re-forming to explore more possibilities. In one instance, five students formed the 5-component character 警 ("warn") and received 40 points each. They then gradually decomposed the character by removing one component each time, and "transformed" it to 敬 ("salute", 30 points each), 苟 ("thoughtless", 20 points) and 句 ("sentence", 10 points each). In another case, two students who received the components 龷 and 日 respectively first formed the character 昔 ("previous", 10 points), and then teamed up with two other students separately to form 借 ("borrow", 20 points) and 惜 ("cherish", 20 points) respectively. In turn, both of them earned 50 points respectively. Apparently, the students had applied the knowledge of pictophonetic character to figure out multiple characters that their components can compose.

It is important to note that during the warming up sections of the past sessions, the teacher had only taught ten most basic spatial configurations for composing Chinese characters to the participating students. Nevertheless, Chinese characters with more complex spatial configurations that were previously untaught had been identified and submitted by the students during the activities. The above-stated example of 熟 with the spatial configuration is one of such student-identified characters. Our video and audio analysis shows that it was the intensive peer tutoring and collaboration during the games that resulted in such unexpected knowledge gains.

4.3 Focus groups interview

We selected nine students with equal number of HA, middle-achievement and LA students, including Wendy, for a focus groups interview. Seven students informed us that they were usually taking the initiative to form characters and invite peers to join their group, while the other two were more being invited. All of the students expressed that they enjoyed the activities and would like to take part in more Chinese-PP sessions in the future. Seven students indicated their perception of having learned new characters during the game activities while, the other two students stated that they made guesses most of the time in playing the game. In particular, Wendy expressed that she had been willing to assist other students whenever requested by them, even though the characters that she suggested or affirmed did not make use of her own components. In this regard, the Chinese-PP approach has indeed resulted in the students' enjoyment, competitions and collaborations.

In addition, the students agreed that the teacher console could help them confirm whether their answers or guesses were correct or not. It became an important feedback mechanism in the game. Typically, in the first two minutes of each game round, most of the students studied their own smartphones as they could browse through all the components available for the game round and proceed to trial-compose their first characters. After the first character which is composed and submitted to the teacher console, some of the students started to notice what was displayed on the projected screen. As the learning sessions progressed, the time they needed to trial-compose their first characters became shorter. In the final (sixth) learning session, the students submitted their first character composed in less than one minute.

5. Conclusion and Future Recommendations

We have developed and studied Chinese-PP, a game-based MALL approach to address the Chinese as L2 learners' need of enhancing their understanding in the structures of Chinese characters. Two different grouping modes, namely, single-group mode and multi-group mode, were implemented in the activities. Through our empirical study, we discovered that the students were more deliberate in composing more complex characters in one shot during the single-group mode. Conversely, during the multi-group mode, the students were more inclined to draw the sentence structure knowledge that they picked up during the warming up sections in the present and past learning sessions to trial constructing multiple characters. Both modes of game playing have resulted in different game patterns and learning gains. In the future, we will further analyze the game process data in order to distill various cognitive processes of their game playing. We will then make an attempt to map the cognitive processes to the relevant theories of second language acquisitions and Chinese character learning. It is hoped that such an effort will lead to the discovery of more effective pedagogy and learning strategies for younger Chinese L2 students in understanding the structure of Chinese characters.

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A Study of Mobile-assisted Photo-taking for English Phrase Learning

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Abstract*:* Owing to the rapid advance of mobile technologies, numerous studies about the use of mobile phone in education have been reported. Although most mobile phones have photo-taking function, not many research have applied this function in language learning. The study aims to explore the influence of integrating MALL photo taking activity on the learner's English phrase learning performance. A total of 116 students enrolled in a college in central Taiwan participated in this study. Participants were divided randomly into two groups: control group and experimental group. The control group is assigned the traditional sentence making activity for phrase learning. The experimental group is assigned the activities of taking photos through participants' mobile phone for phrase learning. The study primarily connected to their daily encounter with newly acquired phrases by using mobile phone to take photos and associate to the sentences they made. The college students were assigned a one-to-one basis on taking photos in their daily encounter substance in order that construct sentences with newly acquired phrases. The results indicated that the experimental group had significant gigher scores than the control group on the post test and delayed post test.

Keywords: mobile-assisted language learning (MALL), English phrase learning, Photo-taking

Introduction

"Phrase is a group of words that are used together in fixed expression" (Macmillion, 2007, p.1119). Phrases can help writers illustrate their own ideas more clearly and enrich the meaning of the sentences, rather than creating word by words, and easier their writing task (Li & Schmitt, 2009). To help learners better comprehend and remember these lexical units of phrases, most teachers would ask students to make a meaningful sentence for memorizing the corresponding phrases and learn how to use phrases well in the sentence.

However, some learners make sentence through observing the sample sentences provided by instructors and then modeling what sample sentences do. Other learners may copy similar sentences from dictionaries or websites. These learners perform the desire task while modeling others do without creating association to their personal experience. As a result, the meaning of phrases do not fully comprehended and actively processed from sensory memory to long-term memory through the traditional sentence making activity. Therefore, effective memory strategies and tool are needed to improve phrases proficiency (sentences wrote by Liu, P. L., 2011/5/25).

Oxford (1990) provided three effective memory strategies for instructors to promote phrase learning: creating mental linkages (i.e., placing a new phrase in a meaningful sentence), employing action (i.e., physically acting out a meaningful relating expression), and applying images (i.e., relating new phrase by meaningful visual imagery in the mind or in actual drawing) (Oxford, p.39). However, the applying images strategy can be used through associating phrases with a visual symbol or picture of a concrete object, but drawing might be a frustrating aspect to learners who were not good at drawing and increase their cognitive load. To capture the physically acting features of phrases concretely and efficiently, plug-in

cameras of mobile phones can make learning more efficient to take photographs and further collect data for their retention. The researchers named the activity used plug-in camera of mobile phone as MALL (Mobile Assisted language learning) photo-taking.
For knowing the effect of using MALL photo taking on English phrase learning and sentence making performance, the researcher adopted Nation's (2001) learning general processes (noticing, retrieval, and generative use) as the base for designing the English phrases learning activities. The four activities includes: phrases learning instruction (Activity 1), MALL photo taking (Activity 2), sentence making (Activity 3), and online voting (Activity 4). Both control and experimental groups received Activity 1, 3, and 4. However, only the learners in the experimental group had the MALL photo taking activity (Activity 2) and needed to make sentences according to the photos they took (Activity 3) (sentences wrote by Liu, P. L., 2011/6/1).
The major purpose of this study was to investigate the application of Oxford's (1990) three effective memory strategies of using MALL photo taking activity to assist English phrase learning. The secondary purpose of this study was to investigate the difference of the learners' attitudes toward phrases learning activities whether they used the MALL photo taking or not. The following research questions were investigated:
RQ 1 What is the influence of integrating the MALL photo taking activity on the learner's English phrase performance?
RQ 2 What are the differences on learners' attitudes toward phrases learning activities?

Literature Review

One of the critical problems in traditional phrase learning instruction is that such instruction are fragmented, and tend to be teacher-centered and separated from the students' daily life and interests (Cullen, 1994; Wong & Looi, 2010). There is significant potential in the portability and versatility of mobile devices in promoting a pedagogical shift from instructor centered to learner-centered learning (Jeng, Wu, Huang, Tan, & Yang, 2010; Wong & Looi, 2010; Wong, Chin, Tan, & Liu, 2010) (sentences revised by Liu, P. L., 2011/6/3, 2011/6/6). Numerous studies about the use of mobile technology in education have been reported, in which these technology-enhanced learning approaches are referred to as mobile learning by the researchers (Hwang & Tsai, 2011).
In the past decade, various studies concerning mobile learning have been conducted in museums, classrooms or labs (i.e., Hwang & Chang, 2011; Reynolds, Walker, & Speight, 2010). In addition to these indoor activities, an increasing number of mobile learning activities have been conducted in the fields (i.e., Chu, Hwang, & Tsai, 2010; Hung, Lin, & Hwang). However, there are only few research focused on the applications of mobile photo taking function in language learning. The studies which applied the mobile photo taking can be categorized into two different categories by the learning focus of the study: vocabulary (Joseph, Bisted, & Suthers, 2005; Hasegawa, Ishikawa, Shinagawa, Kaneko, & Mikakoda's, 2008), and phrase (Pemberton, Winter, & Fallahkhair, 2009; Wong & Looi, 2010; Wong, Chin, Tan, & Liu, 2010) (sentences wrote by Liu, P. L., 2011/9/23).
Joseph et al. (2005) is focus on the word-image paired associated wired PhotoStudy system for learners to upload images from a shared database for viewing the learning content with related photos through context and photo viewing and reviewing multiple choice activities.
In Hasegawa et al.'s (2008) study, learners can create their own learning materials register to the data base for sharing, and assessed to others' creating materials for vocabulary learning by using their favorite images or movies. The researchers compared the teacher-created and student-created learning materials by using PSI (Personal SuperImposer) system. The result indicated that memory retention of the participants who

learned through creating their own learning materials is much higher than who only used PSI system.
In Pemberton et al.'s (2009) study the learners learned the culture-related content in their daily life through sound, image, sound and videos. Learners also build up different scenarios to illustrate the phrases they don't know through combining the text, sound, image, and even a videos for providing in more interesting ways. Wong & Looi (2010) present two novel case studies of MALL that emphasize learner-created content. In learning English prepositions and Chinese idioms, respectively, the primary school students used the mobile devices assigned to them on a one-to-one basis to take photos in real-life contexts so as to construct sentences with the newly acquired prepositions or idioms. Subsequently, the learners were voraciously engaged in classroom or online discussion of their semantic constructions, thereby enhancing their understanding of the proper usage of the prepositions or idioms. The photo blogging project described by Wong et al. (2010) involved students using iPhones to take photos to illustrate Chinese idioms being studied and to share their photos and comments with the class through a wiki. Students were encouraged to take photos based on their daily lives using their immediate surroundings. This use of the student's actual environment improves upon similar projects that have used an artificial space such as a lab or a classroom (sentences wrote by Liu, P. L., 2011/9/23).
So far, no previous studies conducted MALL photo taking on English learning. Thus, this study complements previous studies in three ways:
(1) This study measure learners' English pareses and extended sentence making performance via MALL photo taking, whereas previous MALL photo taking studies only focus on Chinese learning performance (sentences wrote by Liu, P. L., 2011/5/26).
(2) Learning gains were measured by means of a pre-test and a post-test while previous studies only had one post-test.
(3) Quasi-experimental design was used for comparing the effects of Phrase learning MALL photo taking, while previous studies usually used observation and survey (sentences wrote by Liu, P. L., 2011/6/2).

Method

Participants

The participants were 116 English as second language (EFL) students in a university in central Taiwan (68 females and 48 males). The participants were from two intact classes enrolling in General English classes. The average age of the participants is 20. The length of participants' English learning experience ranged from six to eight years, from middle school to high school. The English proficiency level of participants was intermediate level, which is regarded as a person who was able to read short stories, private letters, or fax mails. The total number of already-learned word for participants can be reached to 7000 (sentences revised by Liu, P. L., 2011/5/3).
The experiment of this study was a quasi-experimental study. The participants from two intact classes were divided randomly into the control group (CG: N=48) and the experimental group (EG: N=68). The researcher further paired participants into small groups according to participants' willing for English phases learning activities. There were 24 pairs in the control group and 32 pairs in the experimental group.

Instrument

English phrase preliminary test

The English phrase preliminary test consisted of 35 fill-in items which where delivered from Common American Phrases in Everyday Contexts: A Detailed Guide to Real-Life Conversation and Small Talk (Spears, 2002). Twenty English phrases were chosen by the correct rate of learner's answers.

English phrase learning activities

The English phrase learning activities were designed by Nation's (2001) three general learning process for remembering words: noticing, retrieval, and generative use. The processes of the activities are described below.
Activity 1 - Phrases learning instruction: It offered an aid for visually by explaining the meaning of the sentences, and instructor also asked learners orally repeating the sample sentence.
Activity 2 - MALL photo taking: It was an activity for experimental group. The EG learners worked as pairs and illustrated the 20 phrases with photo taking functions of their own mobile phones.
Activity 3 - Sentence making: All learners were worked in pairs to make new sentence for new learned phrases. The learners in the EG made sentences to describe the photos they took in Activity 2.
Activity 4 - Online voting: All the sentences were posted on the class website for voting the " top five excellent sentences".

Table 1 *General Process*

	Noticing	Retrieval		Generative use
	Activity 1 (week 2) →	Activity 2 (week 3-4) →	Activity 3 (week 5) →	Activity 4 (week 6)
	Phrases learning instruction	MALL photo taking	Sentence making	Online voting
EG	○	○	○	○
CG	○	x	○	○

Note: Table 1 was designed by Liu, P. L.
Note: EG = Photo-taking group; CG = No photo-taking group.
Note: The CG searched three related phases while the EG did the Activity 2.

English phrases immediate and delay post tests

The content for the English phrases immediate and delay post tests were the same. The tests were containing three parts: translation (*N* = 20), fill-in blanks (*N* = 10), and multiple choices (*N* = 20). The purpose of the tests was designed to evaluate participants' recognition, comprehension, and application of target phrase. Specifically, the purpose of the English phrases immediate and delay post tests were to detect the participants' short-term memory and long-term memory of the phrase learning (wrote by Liu, P. L., 5/13/2011). English phrases immediate post test was conducted in week 7, and the English phrases delay post test was conducted four weeks later (week 11).
Translation (2 points): Participants were required to write down the English phrases according to the corresponding Chinese meaning, measuring the recognize ability to target phrases.
Fill-in blanks (2 points): Participants had to fill in 10 phrases in the blanks of each sentence to make the sentence completely, measuring the ability to comprehend the English phrases.

Multiple choices (2 points): Participants were required to answer 10 items in the multiple choices parts. In the multiple choice part, each item included one correct answer with three distracters, measuring the ability to apply the English phrases to new language contexts.

Phrase learning survey

The survey was 9-item, five- point Likert-scale evaluation questionnaire; which elicited the concerning information about participants' motivation. This questionnaire (α = .85) was to evaluate learners' attitude toward three English phrases learning activities (*Activity 3: sentence making*, *Activity 4: online voting*). For example: Q1-Q3: I think that learning through *sentence making /online voting* promotes my phrase learning interests; Q4-Q6: I think that learning through *sentence making /online voting* increases my phrase learning opportunities; Q7-Q9: I think that learning through *sentence making /online voting* increases my discussion opportunities with peers.. The goal was to investigate learners' attitude about the effects toward four English phrases learning activities on their motivation, the learning opportunity increase, and the involvement of cooperative discussion (wrote by Liu, P. L., 5/18/2011).

Procedure

The whole experiment took place over 11 weeks, and the data sources included English phrase preliminary test, sentence making assignments, online voting , English phrases post-test, English phrases delayed post-test, and phrase learning survey.
The English phrase preliminary test was conducted in week 1. In week 2, all participants received the phrasing learning instruction regarding the 20 phrases. In the following two weeks (week 3-4), the EG learners had to do the assignment as MALL photo taking activity related to the sentence that they would made, and the CG learners tried to find three related phrases for each phrase with derived from the same verb by searching on the web. After completed their MALL photo taking activity or derived phrase searching assignment, all learners were asked to completed sentence making activity as class assignment in week 5.
In week 6, the on-line voting activity would be conducted. All learners then voted the top five excellent sentences for each phase from paired learners. In week 7 and 11, the English phases delayed post-test was used for testing their delayed memory of learned phrases.

Table 2 *Mall Photo-taking and Sentence Making Activities for the Experimental and Control Groups*

Experimental Group		Control Group
MALL photo taking	Sentences making	Sentences making
	The boy can sleep through fair and foul. 男孩可以在任何情況下睡著。	He never gives up through fair and foul. 在任何情況下他都不會放棄。
	He has passed on because he jumped from a floor. 他因為跳樓去世了。	I'm so sorry to hear the news that your father passed on. 我很抱歉聽到你父親去世的消息。

	He worked out a good answer. 他想出一個好答案。	Allen was beat up by the Ben because he kissed Ben's girlfriend. Allen 被 Ben 痛打,因為他親了 Ben 的女友

Result

The MALL photo-taking group had higher performance on the post and delayed post English phrases tests

Research question one asks if there is significant influence of integrating MALL photo taking activity on the learner's English phrase learning performance. The results of the *t*-test confirmed that there were no significant differences in the preliminary test of the two groups. (t= -1.15, p=.26). Students who received Mobile assisted photo-taking training and assignment gained significantly higher scores on post test (see Table 3) and delay post test (see Table 4).

According to the Independent *t*-test results shown in Table 3, there was no significant difference in the multiple choice section on the post-test. However, the experimental group performed better than the control group in the multiple choice part on the delayed post test. We may concluded that the experimental group performed better than the control group after the mobile-assisted photo-taking tasks in longer time rather than a short term period.

Table 3 English phrases post-test for the experimental and control groups

	Group	*N*	*M*	*SD*	*t*	*p*
Post-test	EG	68	73.72	23.70	1.86	.07
	CG	49	64.57	26.54		
Translation	EG	68	32.00	10.54	2.51	.01*
	CG	49	26.00	12.99		
Fill-in blank	EG	68	11.94	5.59	2.32	.02*
	CG	49	8.76	7.66		
Multiple choice	EG	68	29.78	10.393	-.01	.99
	CG	49	29.81	8.931		

Table 4 *English phrases delayed post test score for the experimental and control groups*

	Group	*N*	*M*	*SD*	*t*	*p*
Delayed Post-test	EG	68	57.71	25.33	2.51	.01*
	CG	49	46.06	23.80		
Translation	EG	68	38.88	28.47	4.20	.00*
	CG	49	22.53	12.61		
Fill-in blank	EG	68	16.60	14.51	4.29	.00*
	CG	49	8.20	5.73		
Multiple choice	EG	68	26.98	10.08	3.90	.00*
	CG	49	21.49	8.52		

The MALL photo-taking group had higher motivation on the phases learning survey

According to the Independent *t*-test results shown in Table 5, there was significant difference in the multiple choice section on the T-test result of English phrases. However, the experimental group performed better than the control group in the multiple choice part on the English phrases survey. We concluded that the experimental group performed better than the control group because experimental group motivated better than the control group.

Table 5 T-test result of English phrases survey for the experimental and control groups

	Group	*N*	*M*	*SD*	*t*	*p*
Motivation	Photo	29	3.86	0.41	11.94	.00*
	No photo	34	2.64	0.39		
Phrases learning	Photo	29	3.98	0.46	3.62	.06
	No photo	34	3.84	0.49		
Sentence making	Photo	29	3.86	0.57	2.05	.04*
	No photo	34	3.59	0.52		
Online voting	Photo	29	3.94	0.50	3.36	.00*
	No photo	34	3.45	0.64		

Discussion

This research conducted image and physically acting out a new expression for aiding learners recall and transform the phrases in long term memory. Mobile assisted photo-taking seems to be an effective way for learners to apply images which is more concretely and efficiently than drawing for a meaningful visual imagery. According to Oxford (1990) memory strategies for instructors to promote phrase learning includes creating mental linkages (with learner's personal meaning), applying images and sounds (linkage verbal material with image or sound), reviewing well (reviewing in intervals), employing action (linkage verbal material with motion or touch). Memory strategies are more effective as learners synchronously than using meta-cognitive strategies. On the other hand, mind storage capacity for visual material is better than verbal one, visual information is more effectively transformed to long term memory, and visual images aid recall of verbal material, and a great rate of learner prefer visual learning. The illustration explains the experimental group with mobile-assisted photo-taking tasks performed better than the control group in the translation. The fill-in blank sections need more memory loading to answer. In Chen, Hsieh, & Kinshunk (2008) study, the result describes learners with higher verbal and visual ability or lower verbal and visual ability learn easily by providing image annotation with written learning content through mobile language learning environment. The learners easy to create mental image by the meanings of the phrases turned phrases into photos. After the learners finished the photos and sentence making, they reviewed for online voting to enhance short term and long term memory. The lecture procedure design also followed Nation's (2001) three general learning process: noticing, retrieval, and generative use. The result shows that learner got better performance in experimental group because the delay post test and the mobile photo-taking task improved the learners English phrase ability even in a longer time period.

For further research, the application of mobile –assisted photo-taking may use for learning idioms, slangs, or sentences.

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Chapter 2

The Trends, Design, and Evaluation of Science Educational Game

Mohd Ayub A. F. et al. (Eds.) (2011). Workshop Proceedings of the 19th International Conference on Computers in Education. ChiangMai, Thailand: Asia-Pacific Society for Computers in Education.

Preface

In the recently years, game-based learning has been gradually emphasized in the educational technology field, and novel technology and instructional methods which facilitated social interaction were also discussed and proposed by researchers in game-based learning. Nowadays, the cultivation of the citizens' scientific literacy has received more and more attention in all countries around the globe.

To improve the citizens' scientific literacy, technology-enhanced science learning has been highlighted by science educators. In particular, how educational games play roles in promoting student science learning outcomes and their scientific literacy should be a crucial research issue. Recently, research concerned with science educational games has been an emerging research field. The studies in this field can facilitate the integration of theories and practices in digital learning and science education, and provide insights into the use of educational games or toys to help science learners' knowledge construction, conceptual change, reasoning and argumentation, scientific inquiry, collaborative learning, and their learning engagement. To address this important issue, this workshop aims to explore the trends, design, and evaluation of science educational game.

Seven papers were finally selected for this workshop. Each selected paper went through a blinded peer review process. These papers explore various science educational game issues, including science teachers' experiences, attitudes and perspectives on digital games, web-based drill game and RPG game development, multi-user game system, 3D virtual worlds and evaluation of serious educational games. It is hoped that these papers will bring about in-depth discussions during the workshop.

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Elementary school science teachers' experiences, attitudes and perspectives on digital games and using digital educational games in science classrooms

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Abstract: This study aimed to investigate science teachers' experiences, attitudes and perspectives on digital games and using digital educational games in science classrooms. To this end, a total of 14 elementary science teachers were interviewed. The teachers' narratives obtained by tape-recorded interviews were analyzed qualitatively. Major findings and implications are discussed.

Keywords: digital game-based learning, digital game, science education, in-service teacher

Introduction

In the recent years, digital educational games have been considered as potentially effective and powerful instructional tools [1]. Consequently, digital game-based learning (DGBL) has been highlighted by researchers and educators [2].In science education, some empirical studies have been conducted to examine the effects of science educational games in school setting [3][4]. These studies have revealed that digital educational games are capable of improving science student content knowledge understanding, inquiry ability and motivation [5].

Many researchers have proposed that games are powerful educational tools if used appropriately [6]. However, digital game-based learning has not being widely adopted in schools by teachers [1]. Undoubtedly, teachers, teachers' experiences and perceptions on digital games and their perspectives on the use of digital educational games are crucial to their adoption of digital educational games in classrooms and the success of digital game-based learning. To address this important issue, this study investigate a group of elementary science teachers' experiences and perceptions on digital games and their perspectives on the use of digital educational games in science classrooms.

1. Methods

1.1 Subjects

The subjects of this study are 7 male and 7 female voluntary in-service elementary science teachers (a total of 14 teachers). Their teaching experiences ranged from three to twenty seven years, and all of them hold undergraduate degrees.

1.2 Data collection

This study was conducted to explore a group of elementary science teachers' experiences and perceptions on digital games and their perspectives on the use of digital educational games in science classrooms. To this end, tape-recorded interviews were conducted. The interview questions are listed below:

Question 1: Have you ever played a computer game? (Understanding science teachers' experiences in playing computer games)

Question 2: How do you think of playing computer games? (Assessing science teachers' perceptions in playing computer games)

Question 3: Do you agree that computer games could assist science education? Why? (Assessing science teachers' positions regarding the use of digital educational games in science classrooms)

Question 4: Have you ever employed any computer game in your science classes? If so, how did you apply it? (Assessing science teachers' experiences regarding the use of digital educational games in science classrooms)

Question 5: What are the possible advantages or disadvantages for students' learning if employing educational computer games in science classrooms? Why? (Assessing science teachers' perspectives regarding the use of digital educational games in science classrooms)

1.3 Data analyses

After the tape-recorded interviews, the narratives of the participants are transcribed and, then, were analyzed qualitatively.

2. Major findings and discussion

2.1 Science teachers' experiences in playing computer games and perceptions in playing computer games

This study explored the science teachers' experience of playing computer games. All the participants stated that they had played computer games. Four teachers only had little experience of playing computer games, while two teachers had very much experience.

Table 1. Teachers' attitudes toward playing computer games

	N (%)
Positive	8 (57.14%)
Negative	3 (21.43%)
Neutral	3 (21.43%)

As revealed in Table 1, more than a half of the interviewed teachers showed positive attitudes toward playing computer games. It should be noticed that three teachers had neutral attitudes toward playing computers. To sum, most of the teachers did not show negative attitudes toward playing computer games.

2.2 Science Teachers' positions regarding the use of digital educational games in science classrooms

Table 2 showed that most of the teachers in this study agreed with the use of digital games in science classrooms. Those agreed with the use of digital games in science classrooms proposed that use of digital games in science classrooms could encourage student motivation and improve their learning outcomes, while the only one teacher who disagreed with the use of digital games stated that if the digital games were just used as quizzes. Moreover, two teachers holding neutral position mentioned that proper digital games were still not available.

Table 2. Teachers' positions regarding the use of digital educational games in science classrooms

	N (%)	Reason
Agree	11 (78.57%)	Encouraging motivation (n=8), Improving learning outcomes (n=5)
Disagree	1 (7.14%)	Poor usage of digital games
Neutral	2 (14.29%)	Unavailability of suitable digital games

2.3 Science teachers' experiences regarding the use of digital educational games in science classrooms

In this study, science teachers' experiences regarding the use of digital educational games in science classrooms were also explored. It was found that a half of the participants (n=7) had ever employed computer games for science teaching, while a half of the participants (n=7) had not yet.

Most of the teachers having the experiences regarding the use of digital educational games in science classrooms mentioned that they used the digital educational games as instructional tools, such as teaching materials demonstrated by teachers or supplementary learning materials (n=4), while the other teachers employed computer games in their science classrooms as assessment tools (n=3).

Those who had not employed computer games for science teaching mentioned that because instructional time was insufficient they were not able to make use of digital educational games in their science classrooms. They also mentioned that the use of digital educational games may encourage learners' motivation.

2.4 Science teachers' perspectives regarding the use of digital educational games in science classrooms

The science teachers in this study also mentioned the possible advantages or disadvantages for students' learning if employing educational computer games in science classrooms. Their responses were summarized in Table 3. According to Table 3, three major advantages were mentioned by the teachers. The advantage most frequently mentioned by the teachers is that the use of educational computer games in science classrooms will encourage students' learning motivation. The second advantage most frequently mentioned by the teachers is that the use of educational computer games in science classrooms can be used as supplementary materials to support students' abstract thinking and promoting their conceptual understanding. Also, some teacher mentioned that educational computer games can be used for students' adaptive learning after school.

Table 3. Teachers' perspectives regarding the use of digital educational games in science classrooms

		N (%)
Advantages	Encouraging motivation	12 (85.71%)
	Enriching learning materials	6 (42.86%)
	Students' adaptive learning after school	2 (14.29%)
Disadvantages	Addiction in playing digital games	2 (14.29%)
	Uninterested in other learning materials or teachers' instruction	3 (21.43%)
	Healthy considerations	1 (7.14%)

The science teachers in this study also pointed out some disadvantages of the use of educational computer games in science classrooms. For example, they were afraid that students may have addition in playing digital games. Also they were afraid that students might only interested in the educational computer games used in science classrooms, and uninterested in their teaching or other learning materials. In sum, according to the possible advantages or disadvantages proposed by the teachers, it seems that the teachers might have poor understanding of educational computer games. As a result, they stated surface advantages or disadvantages of digital game-based learning.

3. Conclusions

This study explored elementary science teachers' experiences, attitudes and perspectives on digital games and using digital educational games in science classrooms. The findings of this study may provide some insights for teacher educators or educational game developer. This study revealed more than a half of the science teachers had positive attitudes towards digital games, and most of them agreed with the use of digital educational games in science classrooms. However, only a half of the science teachers had ever made use of digital educational games in their science classrooms. According to the possible advantages or disadvantages proposed by the teachers, it seemed that teachers in this study had poor understanding regarding digital game-based learning. To promote the implementation of digital game-based learning in science classroom, more digital educational games designed for science learning will be needed. Besides, to get deeper understanding regarding digital game-based learning, science teachers should be provided more opportunity to experience digital educational games. Also, teacher professional development regarding DGBL in science education will be crucial.

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Designing a web-based drill game to improve learners' resources classification abilities: A case study

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Abstract: There is still limited research investigated the effectiveness of and mental aspects toward web-based drill games on learning resources classification. The purpose of this study was to design a web-based drill game "Happy Black-faced Spoonbill", to improve learners' resources classification abilities. Content analysis was used to investigate each aspect of motivation, attention, perceived ease of use, and perceived usefulness toward the game owned by students from the interview data. Twelve students of grade 4 to 6 who were randomly selected from a cram school were volunteered in this study to play the game. The findings showed that the drill game could be useful in helping learners to acquire and practice the targeted content knowledge. In addition, providing features of fun, points, and rewards were deemed as important and attractive in game design for obtaining learners' attention and targeted learning outcomes. The game with ease of use and usefulness features could also facilitate students to improve their learning performance, increase their knowledge acquisition, and experience more effective learning.

Key words: Web-based drill games, motivation, attention, ease of use, usefulness.

Introduction

Recently, with prosperous technology, researchers have been interested in the possibilities that game brought to the learning environment [1, 2]. For instance, researchers have found that during game playing, learners were more active and engaged in learning [1, 2], possessed positive attitude toward learning, and displayed better learning performance [3]. It is found that game can be designed to supplement traditional classroom education through satisfying learners' varied preferences and providing opportunities for learners to think and learn in innovative ways and yet at the same time enhancing learners' performance.

According to Alessi and Trollip [3], the feature of drill game is providing useful learning information for repeated practices rather than oral guidance to enable fluency. The practice itself is very important, and as Alessi and Trollip [3] pointed out, "most educational games at elementary level are in fact drills in game clothing." Content knowledge and procedural skills can be learnt through reiteration with support of instructional strategies and principles designed in games. In this study, we have designed and developed a web-based drill game, which aims at facilitating students' learning through repeated playing experience online. Although several studies were conducted to investigate the effectiveness of drill game on learning mathematics [4], limited research investigated the effectiveness of and mental aspects toward a web-based drill game on learning resources classification. Therefore the objectives of this study were to:

1. Design and develop a web-based drill game, "Happy Black-faced Spoonbill", for elementary-level students in a cram school to play and record the content of interviews.
2. Use content analysis to investigate each aspect of motivation, attention, perceived ease of use, and perceived usefulness toward the web-based drill game owned by students from the interview data.

Methodology

1. Participants

A total of 12 students consisted of 5 female students and 7 male students of 4th grade to 6th grade volunteered to participate in this study. These students came from a cram school in Taoyuan County in Taiwan. All of these students attended the cram school for additional instruction in English, Chinese, and mathematics.

2. Game Introduction and Design Mechanics

2.1 Game introduction

The web-based drill game, "Happy Black-faced Spoonbill" was designed and developed by NTUST MEG Mini Educational Game Group in 2011 for elementary school students. The web-based drill game in this study was designed to be completed within three minutes for a single drill session, where players can choose to repeat the game for several times. Before each player starts to play, they are free to choose whether they want to view or skip the cover story on the main menu, which will take them one minute to complete. The game consists of the following features. First, learning goals are addressed in a specific way that learners know what should be learnt. In the current study, the game contains both content knowledge of resources classification and the features of drill-based learning, which is about repeated practices to maintain learnt content knowledge. Learning goal of the game is that players will be able to learn content knowledge of classifying resources based upon different classifying features, for instance, most medal objects can transmit heat, reflect light in a certain degree, and so on. Besides, the mission of this game expected learners to classify at least three resources for each of six recycle bins (medal, wooden, paper, plastic, glass, and poisonous bins) correctly. The cover story motivates learners to play within a context where Black-faced Spoonbill lives and to participate in tasks described in the mission. The role set as a curious elementary-level boy who attends to the Double Tenth Day to celebrate with friends and in some reasons becomes a Black-faced Spoonbill to help save the environment.

To connect the game goal/mission and learning goal, the player in the game has to search three resources to complete the game missions. The game interface was designed to be simple and intuitive for players to navigate without instructions and technical help. When students login the game, they can see the cover story, rules and mission, main screen for playing, and the ending story, in order. Players are only given ten health points and 180 seconds to complete the mission. When players are in final countdown, the speed of music will be faster until the time runs out. If the time or health points run out, the game is over. On the main screen for playing, players use the mouse to control the bird (cursor) to move around and clip, drag, and classify the scattered resources to the corresponding recycle bin.

The points are shown under each recycle bin so that players can evaluate how well or how poor they are doing at ease. The feedback is prompted at the bottom right corner of the screen with a Black-faced spoonbill's mad face each time when the player classifies resource wrong to a recycle bin. Also, if players classify resources wrong continuously, the health points will decrease to zero. Besides, players are given a badge on the upper right side of the screen every time when they collect more than three objects of garbage for each classification or recycle bin (e.g. medal) as reward mechanics. When the game is over, the score statistics will give performance of an entire play of the player.

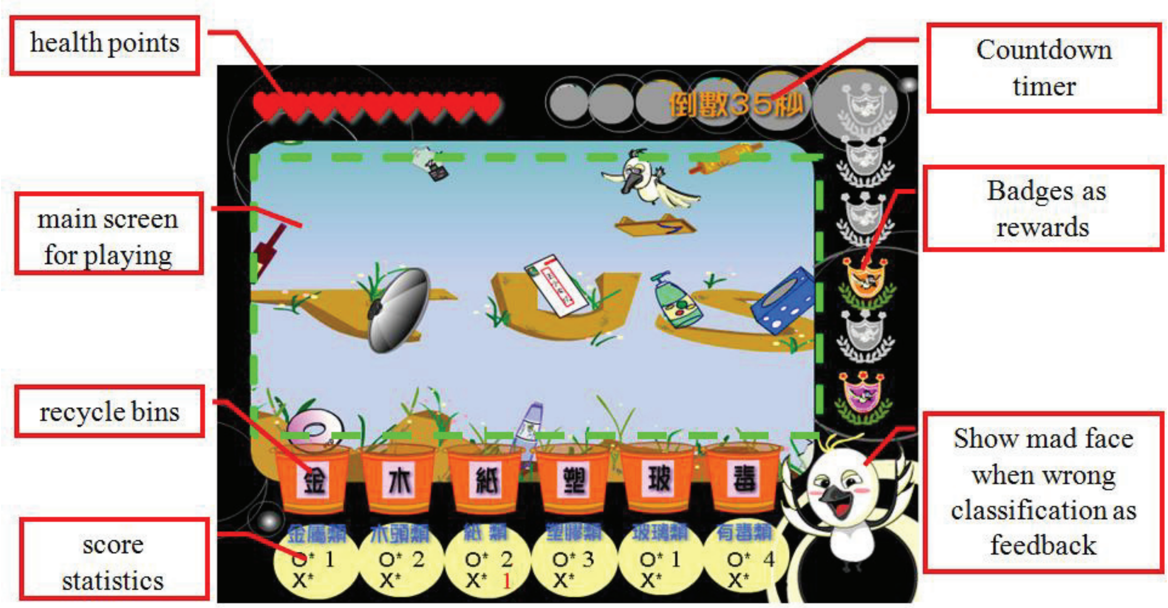

Figure 1. The interface of "Happy Black-faced Spoonbill"

2.2 Design Mechanics

The domain knowledge of the game was fall into environmental sustainability, which encapsulates content knowledge about resources classification and conceptual knowledge of the environmental protection related to environmental sustainability issues. 3R, reuse, recycle, and reduce of used materials has been called on as major policies for environmental sustainability [5]. In addition, knowing how to classify resources (garbage and rubbishes) was deemed as the first step for 3R and for reducing the extremely huge cost managed by public sectors. Moreover, providing a vivid environment for young players to engage and notice the importance of protecting our environment was another focus of this game. Following, game factors will be discussed.

In the web-based drill game, graphic representation was used primarily to mimic authentic objects and living environment to arouse students' attention and concern for environmental issues. Using the mouse was designed as the only method for bird's moving and for selecting objects (resources) in this game because it's easy for novice users and nonreaders or non-typists [5]. In addition, the funny storyline was set up with fantasy atmosphere to further stimulate students to envision themselves in a situation of a black-faced spoonbill that faced an environment with varied kinds of garbage and resources around and to engage in the game task. Mainly, the avatar in the game was a bird, which provides an imaginary experience for players to feel fun. The design of the task was set as intermediate level of difficulty following an expert's suggestion so that students can involve in beneficial challenge and obtain content knowledge of resources classification.

Another factor, discovery, was also designed for players to move around with their cursor on the screen, which encourages them to discover new scene and resources within the main screen.

3. Procedure and Data analysis

At the beginning of the study, participants had received an informal instruction individually for less than 5 minutes about basic features of different kinds of resources, such as medal, wood, paper, plastic, glass, and poison, so that their prior knowledge about resources classification could be controlled as comparably similar to each other. Basic features such as glass as fragile, medal as malleable, and so on were introduced. Then, the students were invited to play the game individually. Following the first trial of the game was an interview conducted to probe players' feedback and understanding toward the game. The reason that interview was adopted in this study was because participants are not able to recognize the 'right' classification and the survey results can not reflect their true behavior, cognitive process, and error patterns [5].

Interview questions were designed to probe different aspects of motivation and attention. For motivation, major questions prompted, 1) Do you like this game and why? 2) Which part of this game you think is interesting and why? 3) Through this game, would you like to learn resources classification better? For attention, major questions included, 1) Were you diffused or concentrated while playing the game and why? 2) What was the most appealing part of the game to you and why? 3) Did you notice the cover story/main playing screen/score statistics and why?

Then each student was asked whether they want to play again the game. The treatment stopped whenever they required quitting the game. Following the game was a second interview session conducted to probe the players' perceived ease of use and usefulness toward the game. Major questions for perceived ease of use and perceived usefulness were, 1) Do you think this game was easy or hard to handle with and why? 2) Do you think this game was helpful in learning resources classification and why? The interview sessions lasted within 30 minutes.

Content analysis was utilized to analyze students' responses to the interview questions. After reading every single response from the 12 participating students and organizing the responses into systemic categories, two coders (researchers) coded each response to each question accordingly. The coders read all of the responses first, coded important keywords until categories emerged from similar codes, and discussed and reached consensus in categories and criteria. Their inter-coder agreements for these analyses were assessed and reported as greater than 0.80. In addition, the two researchers discussed the discrepancies and achieved the final level of agreement.

Results and Discussion

All participants were free to decide how many times to play the game during fifteen minutes so that students had enough time to explore on the game. Students' responses to the interview questions after they finished the game were categorized and summarized in Table 1 to Table 4 based upon main four perspectives, students' motivation, attention, perceived ease of use and perceived usefulness toward the game, consecutively. All numbers in four tables were only represented as the frequency and percentage of agreement to the corresponding question/dimension. For instance, if one boy agrees that he was alert by the main screen, then his response will be counted as one. Besides, The mark of * in Table 2 and Table 3 indicates each sub-category underneath the main category consists of one question. That is, it consisted of 3 different questions for the main category, *Intensiveness* in Table 2, while there were 2 questions for the main category, *Clear and Understandable* in Table 3.

1. Motivation

The study categorized four main aspects of motivation toward the game, such as fun, fantasy, challenge, and learning based on interview data as well as literature review [3]. As students were asked to describe the reasons why they wanted to replay the game, it is found that all students experienced fun in the web-based drill game, except for one girl as shown in Table 1. For example, student #s04 mentioned, *"The game is fun. I like the game because it's more interesting during class.*" Besides, student #s05 described, *"I think the cover story is fun because it can make the whole class laugh*" Also, student #s07 indicated, *"The cover story teaches me about garbage classification and makes me feel the game following (the story) will be fun and hilarious.*" The game offers interesting and novel contexts that stimulate students' motivation to explore unknown environment. Players with fun experience may be more immersed in the learning environment provided by the game. The characteristic of fun proved to be major motivation for students to play and learn.

In this study, all the students played the game at least twice and were motivated to take up challenge. 67 percent of students mentioned that they wanted to play again because they were not satisfied with their performance in the previous trial. For example, student #s09 indicated, *"Since I didn't figure out how to play it well, I did not play it well at the first time. But I really desire to try again once I have the previous experience*." Also, student #s06 pointed out, "*I want to try again, because I want to break the record!*" It is worth of notice that comparably more boys than girls mentioned challenge as a main factor, which motivated them to play the game. During the first trial of the game playing, students may have some unclear concepts in resources classification. However, students may benefit from the following trials to notice and correct their mistakes. The triggered element of the game, challenge, can also be found in students' intention to compete against oneself. For instance, both student #s08 and student #s12 mentioned, "*I want to try again to see if I can make great progress next time*."

58 percent of students described their game playing experience as a novel one which is different from the real world. For example, students mentioned that the feeling of fantasy from the cover story and role-playing experience aroused their interest in playing the game. Student #s08 pointed out, *"It is incredible that a bird can pick up the trash!*" In addition, Student #s09 mentioned, *"I think it is a lot of fun when I saw the bird in the cover story. I wonder what I am going to play later on.*"

The experience of learning was shown to be another dimension of motivation while playing the game. Students did enjoy playing the game and learning when they sense their progression. As show in Table 1, all students mentioned that they were motivated to learn better on resources classification after playing this game. However, the experience of confronting ill-equipped problems will decrease students' motivation. Student #s01 pointed out, *"I do not have confidence in operating that (mouse) better because that (mouse) is hard to control for me.*" Student #s05 also mentioned, *"I think this game is alright but the mouse is hard to control."*

Table 1. Frequency and percentage of the motivation toward the game

	Fun	Challenge	Fantasy	Learning
Girls	4 (80%)	2 (40%)	3 (60%)	5 (100%)
Boys	7 (100%)	6 (86%)	4 (57%)	7 (100%)
total	11 (92%)	8 (67%)	7 (58%)	12 (100%)

Note: n=12 (Girls: 5; Boys: 7)

2. Attention

To investigate players' attention toward the web-based drill game, the interview data were closely examined and compared with findings in the literature [6] and finally coded into three dimensions, which are, 1) distribution (diffused versus concentrated); 2) selectivity (the "what" of attention); 3) intensiveness (alert versus inattentive). As shown in Table 2, there was only one female reported that she was in a medium level of concentration, while most of other children reported that they were concentrated during the play. Among them, one girl #s02 and one boy #s07 mentioned that they were concentrated because the game was fun. Besides, one girl #s04 and two boys, #s09 and #s11, were concentrated because of focusing on classification itself. For instance, student #s04 said, *"I was concentrated since I would like to classify more and reduce the frequencies of my classifying wrong."* Also, student #s09 indicated, *"I was not diffused because this is a classification game and I need to focus on the classification."* Student #s012 revealed, "The reason I was concentrated was because of the homework I have not yet finished."

As for the "what" of attention students had, there were 42 percent of students mentioned that the main screen was appealing to them while there were also 42 percent of children said that it was the classification and statistics areas attracted their attention. For example, student #s02 indicated that the game provided a sense of adventure especially when the bird was flying. A male student even asked, *"It was most appealing to me why the bird can catch the garbage."* The same importantly, students who mentioned that the classification and statistics areas attracted them were those who care about goal and performance achievement. For instance, student #s11 said, *"The most appealing thing to me was that if I can get the score I will be happy."* Even though the number of mentioning the cover story as their selectivity was comparably low, 20 percent of girls and 14 percent of boys still mentioned that the cover story was fun, interesting, and creative. A possible reason that most students did not select the story as their major choice for attention could be their disfavor of birds' droppings in the cover story. As for gender difference, it was found that comparably more male students were appealed to the classification and statistics areas. The findings of intensiveness were parallel to the selectivity of attention as mentioned above. All students were alert by the main screen area and 92 percent of students were alert by the classification and statistics area.

Table 2. Frequency and percentage of attention toward the game

	Distribution	Selectivity			Intensiveness		
	Concentrated	Story	Main screen	Statistics	Story*	Main screen*	Statistics*
Girls	4 (80%)	1 (20%)	3 (60%)	1 (20%)	4 (80%)	5 (100%)	4 (80%)
Boys	7 (100%)	1 (14%)	2 (29%)	4 (57%)	5 (71%)	7 (100%)	7 (100%)
Total	11 (92%)	2 (17%)	5 (42%)	5 (42%)	9 (75%)	12 (100%)	11 (92%)

Note: n=12 (Girls: 5; Boys: 7), * indicates each sub-category consists of a question.

3. Perceived Ease of Use and Perceived Usefulness toward the game

3.1 perceived ease of use

To evaluate students' perceived ease of use toward the game, the interview data were finally coded to three dimensions: easy to handle, intuitive design, and clear and understandable. As shown in Table 3, it was found that 58 percent of students expressed that the game was uneasy to handle with. Especially, student #s09 mentioned, "when I was moving the mouse, sometimes the cursor on the screen will leap out if my movement was too big." Only 42 percent of students thought that the game was easy to handle with. For instance, a male student #s08 said, "it's easy to operate and there is no reason…there is no problem for me to control the bird using the mouse."Girl #s02 said, "It's easy since I played it for three times and I get used to it, so there is no problem for me." It seems to be a problem that students encountered obstacles in controlling the mouse. Especially, a boy #s06 said, "Actually I understand how to handle (it) but the mouse is too big for me…it will fall down if I didn't control it well."

As for the intuitive design of the game, 67 percent of students agreed that the game design was intuitive. For example, male student #s12 indicated, "Because the beak clipart looks just like the tool for holding the resources." In addition, all students expressed that the rules and score statistic areas were clear and understandable. Boy #s12 said, "It's easy for me to understand because there are numbers shown over there and it's clear." When asked about level of difficulty of the game, 17 percent of students said it was very easy, 67 percent of students said easy, and 17 percent of students said the difficulty is moderate.

Table 3. Frequency and percentage of perceived ease of use toward the game

	Easy to handle	Intuitive design	Clear & understandable	
	Easy	Agree	Rules & missions*	Statistic*
Girls	1 (20%)	3 (60%)	5 (100%)	5 (100%)
Boys	4 (57%)	5 (71%)	7 (100%)	7 (100%)
Total	5 (42%)	8 (67%)	12 (100%)	12 (100%)

Note: n=12 (Girls: 5; Boys: 7), * indicates each sub-category consists of a question.

3.2 Perceived usefulness

To evaluate students' perceived usefulness toward the game, the interview data were coded into three dimensions. As shown in Table 4, three dimensions mentioned above are: performance improvement, knowledge acquisition, and comparison of learning effect. First of all, all students reported that the web-based drill game would improve their learning performance. For example, student #s04 mentioned, *"The game will help me learn. Once something I did wrong the first time, I understood that it was not belonged to the category that I thought previously. Therefore, I would try to think whether it belongs to another category and try it again to see if I classify it right this time."*

As for knowledge-acquisition, which can be referred to knowledge learnt and acquired from game playing experience, all students except for one girl mentioned that they understood the principles of classification more clearly and gained some new concepts of classification. For example, student #s06 mentioned, *"The game helps me understand what kind of resources would be harmful to the earth…for example, battery within the poisonous category."*

Finally, as we asked students to further compare the effectiveness between their previous learning experiences of resources classification with the experience of the current game, 33 percent of students mentioned that they experienced equally effective, and 58 percent of students regarded the game as more effective. Student #s12 mentioned, *"When comparing with my previous learning experience, this game was more effective. Because the game contains more resources and it seems to have more classifications, I think it's even harder and that's why it is more effective."* Also, student #s04 pointed out, *"Compared to in-class learning, this game was more effective because the textbook* *consists of more text than pictures usually. So I did not want to read. Therefore, I thought this game to be more fun and I will be more likely to learn through it."*

Table 4. Frequency and percentage of perceived usefulness toward the game

	Performance improvement	Knowledge acquisition	Comparatively more effective
Girls	5 (100%)	4 (80%)	4 (80%)
Boys	7 (100%)	7 (100%)	3 (43%)
total	12 (100%)	11 (92%)	7 (58%)

Note: n=12 (Girls: 5; Boys: 7)

Conclusion

This paper was intended to examine the learning effectiveness of the web-based drill game through query students' motivation, attention, perceived ease of use, and perceived usefulness. From the interview data, we found that the web-based drill game could be useful in helping learners to acquire and practice the targeted content knowledge. Firstly, players with fun experience may be more immersed in the learning environment provided by the game. Also, the fantasy context provided by the game was found to be significantly attractive to students to learn content knowledge. As for players' attention toward the game, most children reported that they were concentrated during the play. The game therefore seemed to be able to catch players' attention. About the selectivity of attention, 42 percent of students said it is the main screen for playing, while there were also 42 percent of students mentioned that the scores statistic area was most appealing to them. It was also found that the classification and statistics areas attracted comparably more boys than girls. As a result, providing fun, points, and rewards thus seemed to be important and attractive in game design for obtaining learners' attention and targeted learning outcomes. Last but not least, the game with ease of use and usefulness features could facilitate students to improve their learning performance, increase knowledge acquisition, and experience more effective learning. The limitation of this exploratory study is the sample size and the restriction of the data to one cram school only, which limits the generalization of the results. However, the design of the web-based drill game in this study was a prototype useful for future modification.

Acknowledgments

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The Design of Multi-User BCI Game System

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Abstract: The purpose of the study is using the Brain Computer Interface (BCI) device as game equipment to develop a multi-user BCI game system (MBCIGS). The MBCIGS includes a multi-user management system and three playing modes of BCI games which are a single user exercise mode, a multi-user practice mode, and a multi-user gaming mode. The multi-user management system is to handle the connection and the message transmission between players, while the three modes of BCI games are to offer the players using BCI devices from the status of practicing to competition. The MBCIGS uses a MindSet as BCI device, an Electro Server as the multi-user platform, and Flash software as client game developing system. Several suggestions are presented in the study.

Keywords: Brainwaves, Brain Computer Interface, Multi-user, Game Design

Introduction

With the rapid development of technology, Brain Computer Interface (BCI) in recent years has been one of the key research agenda. Traditionally, record and analyze brain waves are to use a large measurement machine. As the BCI technology becomes more mature, the way to measure brain waves is not limited to space and size constraints, but emphasizes the use of convenience and comfort in the increasingly widespread. Early BCI uses mainly in people with disabilities so that they do not need to rely on peripheral nerve and muscle, and can send commands through the brain to communicate with the outside world (Pfurtscheller, Guger, Müller, Krausz, & Neuper, 2000). However, because of the new BCI development, applications of today's brain wave research are not only for specific disabilities, but extend to learning and entertainment purposes (Crowley, Sliney, Pitt & Murphy, 2010; O'Hara, Sellen & Harper, 2011). In particular, many studies (Ko, Bae, Oh, & Ryu, 2009; Yoh, Kwon & Kim , 2010; Ryu, 2010) have used mobile BCI devices to develop brain wave games, such as the MindSet headset. The current technology in the single user electroencephalogram (EEG) measurement is not the problem, but multi-user brain wave detection as well as multi-player games in using BCI devices is still needing to be overcome. Therefore, this study proposes a systematic framework to simultaneously detect multi-user brain waves, and to apply to multiplayer games in order to provide a new development direction.

Related work

The function of a BCI is primarily through the use of electronic devices to receive and analyze the brain waves, including δ、θ、α and β. It usually consists of three parts: signal acquisition、signal processing、and device commands (Wolpaw, Birbaumer, McFarland, Pfurtscheller & Vaughan, 2002) (Fig.1).

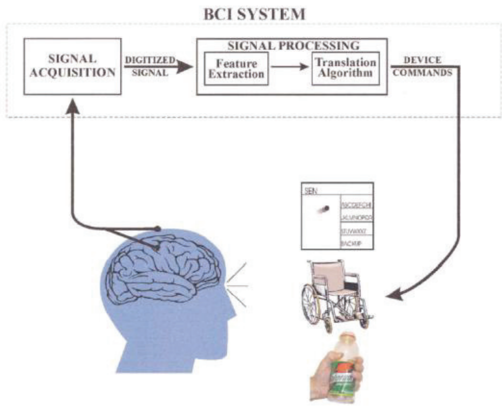

Figure 1 The basic structure of a BCI (Wolpaw et al., 2002)

Because of its special brain-computer features, the applications of using BCI technology have been widely used, such as electronic prosthesis, electronic driving, and emotional cat ears (Pfurtscheller et al., 2000; AutoNOMOS, 2011; Neurowear, 2011) With the same features and more convenient, the MindSet headset (NeuroSky, 2011) also plays a significant substantial advantage in BCI domain application.

The MindSet is non-invasive EEG equipment, and can detect the brain's state of focus and relaxation. With a dry electrode sensor placed on the human forehead, and the reference electrode and circuit ground systems placed in the left ear, the MindSet uses dry - electrode sensors to collect the biological brain signals (α, β, γ, δ, θ-wave), and sends the collected signal into ThinkGear chip, The ThinkGear then filters and amplifies the desired signal, and output to the computer through Bluetooth devices for future application. Crowley, Sliney, Pitt and Murphy (2010) found that the MindSet headset could be a measure of the level of the instrument for focus and relaxation in the Tower of Hanoi called the color test. Ko, Bae, Oh and Ryu (2009) used the MindSet to develop a brain wave game which includes practical and game mode in a single user environment and indicated the value of mobile BCI devices. Base on the needs of user interaction excitation, Alchemytech (2011) offers Zigbee synchronized brain wave evaluation system to asses multi users' brain situation. However, the Zigbee system is only to provide state of brain wave of the observing people, and cannot provide the interaction between users. Thus, in this paper we propose the design of a multi user BCI game system (MBCIGS) to enhance the effectiveness of users' interaction in MindSet gaming environment.

System design of MBCIGS

The MBCIGS system is a client-server multi-user game platform system. The Socket server uses Electro Server 5 (Electro Server, 2011), the client software is to use Flash CS5 with ActionScript 3 (Fig. 2). The function of the MBCIGS system allows users to observe their own as well as others real-time status of brain waves, and to process interactive brain game with each other. The structure of the MBCIGS system consists of two parts: zone and room. There are two kinds of zones: lobby and gaming zone in the system. The lobby is a tutorial system for novel users. The gaming zone divides into three rooms: single exercise mode, multi-users practice mode, and multi-users gaming mode. The single exercise mode is a room where the user can exercise and observe their status of brain waves through the MindSet headset (Fig. 3). The multi-users practice mode is a room where multi-users can practice each other MindSet headset and view their status of brain waves (Fig. 4). Finally, the multi-users gaming mode (Fig. 5) is a room where multiple users can play game through each other MindSet headset and comparing the values of their brain waves.

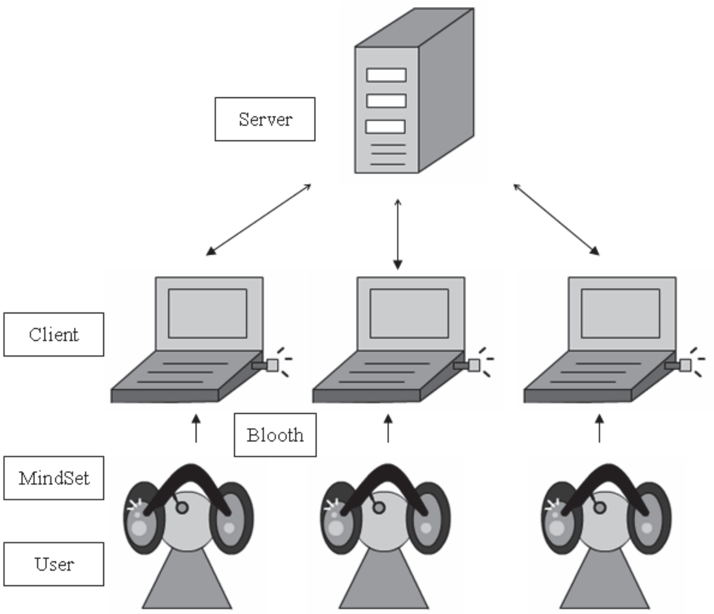

Figure 2 The system structure of MBCIGS

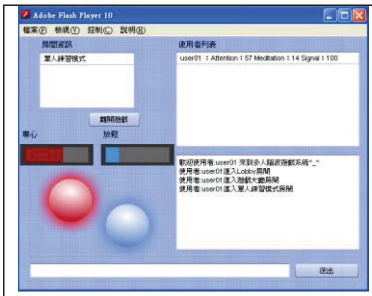

Figure 3 Single exercise mode

Figure 4 Multi-users practice mode

Figure 5 Multi-users gaming mode

The users could login into the MBCIGS system and choose any zone and room to practice their concentration and mediation using MindSet headset. This system, with individualized BCI functions and internet-based multi-user interactive features, will enhance the ability of the learning and gaming activities in the future application.

Conclusion

In order to achieve multi-user BCI game system, the study proposes a feasible solution. In this scenario, the MBCIGS integrates the MindSet brainwave headset, Flash software and Electro server to allow users to practice their learning ability of concentration and to interact with each other through the internet. Because of the hardware detection limitation in the traditional BCI application, the MBCIGS system could expand BCI applications, especially for users in the interactive use of incentive and interest environment, to enhance future learning.

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Save the forests: A pilot study of a role-playing game for environmental education

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Abstract: The purpose of this study was to explore the potential of a PC-based role-playing game for teaching the subject of forest preservation. Four elementary students participated in this case study. The observation and interview were implemented to collect their gaming behaviors and feedbacks about the perceived ease of use, perceived usefulness, and the design elements of the game. The results showed that students viewed the game as an easy and useful learning tool that fulfilled major game characteristics. Suggestions were proposed for the design of the game and future research.

Keywords: Game-based learning, role-playing game, RPG, environmental education, forest preservation

1. Introduction

What makes role-playing game (RPG) attractive is that it provides a unique space where players play the game through the eyes of a game character to experience the virtual world following the storyline of the game. Role-playing has been viewed as an important strategy that allows students to learn a complex issue from different perspectives by playing different roles [2]. Combing with gaming environment, the RPG can be a fun and situational context that engages students to practice given roles embedded with diverse knowledge and values. Currently, the popularity of massively multiplayer online role-playing game (MMORPG) has drawn researchers' attentions to explore its potential for learning [4]. Unfortunately, it is difficult to develop an educational MMORPG with limited budgets, people, and time in educational context because of its complexity of design. On the contrary, a single-player PC-based RPG will be easier to develop by using game authoring tools. Also, it might be easier for teachers to integrate a PC-based RPG to their curriculum because of its limited scale and easy management of students' learning. Even without providing interactions among players, a PC-based RPG that featured with storytelling, premise of the fictitious reality, and narrative experiences can still engage players to the game context and the role they play [5, 7]. However, the potential of using PC-based RPG for learning seems to be overlooked. It is necessary to examine the feasibility and effectiveness of employing PC-based RPG as a learning environment.

With the increasing destroy and threats to the natural environment, how to protect it and achieve sustainability become a critical issue all over the world. The curriculum guidelines of environmental education (EE) for primary schools in Taiwan stress the need for students to understand the relationship between human and the environments, and to develop appropriate attitudes, values, and actions toward the environments. However, most of the content provided in the textbook is factual knowledge with limited scope and provided to students usually by lecturing. Students might be able to remember some factual knowledge but whether they can connect the knowledge to their daily life and develop adequate values and attitudes are remained questionable. As stated by researchers, role-playing that combined with a simulation or a game could present students with an authentic and situated learning environment that promotes students' understanding of knowledge and values from multiple perspectives [6]. With the attractive feature of fantasy storyline, RPG might be a good way to motivate students' learning and make learning relevant to their life both in knowledge and attitude. In this study, a PC-based RPG was developed for environmental education, specifically on forest preservation which is closely related to our lives. The purpose of this study was to pilot test the game empirically and evaluate the degree of acceptance and design factors of the game.

2. Methodology

2.1 Participants

Four elementary students voluntarily participated in this pilot study. Because the game was originally designed for 3rd to 6th grade elementary students, participants across different grades were recruited to test the game. The background information of these participants is shown in Table 1.

Table 1. Background information of the participants

	Player			
	1	2	3	4
Gender	Female	Female	Male	Male
Grade	6	4	5	3
Age	12	9	11	8
Game experience [a]	Moderate	Moderate	Experienced	Inexperienced

[a] The students' game experience was identified based on their own descriptions of game playing history and frequency during the interview.

2.2 Research Design and Procedure

This study employed a case study design to test the feasibility of a self-developed educational game. Observation and interview were conducted to collect individual student's game playing process and feedbacks.

The parents of these students were informed the aim of the study first and the students were arranged to play the game individually. Before they started to play the game, each student was given a short instruction of game operations. The playing process of each student was observed and noted in details including time spent and reactions toward dialogues and attacks. Students were expected and encouraged to complete the assigned game tasks by themselves. Assistance was only provided when students had difficulties to continue the tasks. After each student achieved the game tasks, an interview was conducted to assess students' learning outcomes as well as collect their opinions about the game.

The main interview questions were divided into three parts to evaluate "perceived ease of use," "perceived usefulness," and "game design elements." The first two parts were based on the Technology Acceptance Model (TAM) [3] and the third part was drawn out from the essential factors of game design illustrated by Alessi & Trollip [1]. The interview structure and example questions are listed in Table 2.

Table 2. Interview structure and example questions

Structure	Description	Example Questions
Perceived ease of use	Students' perception about whether it is easy for them to play the game.	Do you think you went smoothly in the course of the game? Did you encounter any difficulty during the course?
Perceived usefulness	Students' perception about whether the game could help them to achieve learning goals.	Did you learn how to protect forest before? Does this game help you to learn (more about) how to protect forest? What are the ways to protect the forest that you learned from the game?
Game design elements	Students' feedbacks toward each element. The elements include goals, rules, competition, challenge, fantasy, and entertainment.	Do you think the game is challenging? What do you think about the degree of the challenge (too difficult, appropriate, or too simple)? Please describe briefly about the challenges you faced in the game and to what degrees the challenges were.

2.3 Game Description

In this study, an authoring tool – *RPG Maker™XP* – was used to develop a PC-based RPG named *Forest*. The game was designed for 3rd to 6th grade elementary students. The only pre-requirement of the players was basic level of Chinese reading ability.

Both gaming and learning aspects were taken into account when the game was designed. First, to immerse students in a situated learning context, a background story was provided at the beginning of the game:

"Forest" is a wizard kingdom of the trees that coexists with human world since ancient times and provides rich woods resource for human life. However, with the increasing demand of woods by human, the woods resource has been overused. While the forests are excessively destroyed in human world, the Glory Tree that supports the life of "Forest" is dying at the same time. The elder elf foresees that the "Forest" will cease to exist in one year. When that happens, human world will be vanished too. The only way to avoid this disaster is to bring back Green Leaves from human world to save the Glory Tree.

In this game, the participants played the role of Essen, who was born to save the "Forest" and human world. Essen was accompanied by Green Wizard to carry out the tasks (i.e., finding Green Leaves in human world). Green Wizard was set to follow Essen's movements automatically. When encountering attacks, a player could control Essen and Green Wizard separately to make a fight.

Second, the content and tasks were designed for students to gain knowledge about forest preservation by achieving the game tasks. Mechanisms of task guiding and task performing were employed to facilitate students' learning. In RPGs, text-based communication is the main channel for players to get information and task guidance. Two types of communication were adopted in this game: one-way knowledge delivery and interactive dialogue (see Figure 1). When the former one was used, the whole piece of learning content was displayed directly in the text box. For example, "*Some people call the forest 'lungs of the Earth' because the trees will absorb large amounts of carbon dioxide for photosynthesis to produce oxygen and to help regulate the temperature of the surface environment*." When the latter one was applied, the learning content was embedded in the dialogue that players would have to obtain the information by conversing with non-player characters (NPCs). The example is as following.

Essen: *Excuse me, sir! What can we do to protect trees from being overused?*
Expert: *Well … I would advise you to reduce the demand for wood.*
Essen: *How to do that?*
Expert: *For example, we do not have to always buy new furniture or wooden items. I like to help my neighbors to fix their wooden furniture so that they can use it for a long period of time.*

(a) (b)

Figure 1. The screenshots of text-based communication: (a) one-way knowledge delivery; (b) interactive dialogue.

The first reading of each learning unit would be rewarded with experience points that could help increase the level of the game character. The mechanisms of task performing defined the actions needed to achieve the tasks. The matching learning goals, game goals, and mechanisms of *Forest* are listed in Table 3.

Table 3. The design of learning mechanisms

Learning Goals	Game Goals	Mechanisms	
		Task Guiding	Task Performing
Learn basic knowledge about forests			
-Functions	Find “Knowledge Palace” in “Forest”. Hit and read all items that embedded with target knowledge so that Essen and Green Wizard can go to the human world to find Green Leaves. (Required task)	One-way knowledge delivery	Find places & Hit items
-Elements	Talk with NPCs in “Forest” to learn about anion and phytoncid. (Optional)	Interactive dialogue	Meet NPCs & Activate dialogue
Learn applied knowledge about protecting forest resource	Build a resource center in human world by inviting three experts to work in the center, and then talk to key NPCs to find a Green Leaf. (Required task)	Interactive dialogue	Find NPCs following directions & Activate dialogue
	Talk with NPCs to learn more about the ways to save forests. (Optional)	Interactive dialogue	Meet NPCs & Activate dialogue

Third, enemy attack was built in the game to provide challenging and exciting experience for students as well as connections with learning goals. Most of the attacks were invisible and triggered randomly by the system. The enemies were either tools or machines that would destroy the forests (e.g., axe, tree-cutting robot, fire-spraying robot, paper-eating machine) (See Figure 2). Fighting with the enemies meant saving the forests. In addition, anion and phytoncid were designed as items that players could collect by winning the fights or from treasure boxes. The mechanisms of anion and phytoncid in the game were similar to their functions in real world that players could use anion and phytoncid to supply blood (i.e., life) and power (i.e., energy) of Essen and Green Wizard respectively.

Figure 2. The screenshot of fighting with a tree-cutting robot in the forest

3. Results and Discussion

3.1 Overview of game playing process

An overview of each student's game playing process is illustrated in Table 4.

Table 4. Overviews of the students' game playing process

	Player			
	1	2	3	4
Total Playing Time (min.) [a]	91	105	94	96
Number of Failures [b]	1	0	2	0
Interaction with NPCs [c]	38 of 48	36 of 48	42 of 48	41 of 48
Battle Frequency [d]	51 of 58	38 of 68	55 of 65	20 of 59
Needed Assistance	Direction	Direction Task Operation	Direction Task	Direction Task Operation Attack

[a] The rest time during the game was not calculated.
[b] The number of "game over" occurred when the main characters failed to survive from the attacks.
[c] The number of NPCs activated by the players among all NPCs.
[d] The number of fights executed by the players among all triggered attacks.

The average time of game playing is 96.5 minutes. The observation showed that all students were attracted to "talk" to more than 75% NPCs in this gaming context. This indicated a great possibility to deliver learning content through NPCs. Generally speaking, students could complete the game tasks without replaying the game too many times. However, all of them need assistance to some degree in different aspects. All students faced some problems of finding right directions to the target places. Task-related clues were also provided to most of the students when they did not know what to do in the next, forgot the task, or missed key NPCs or items. It was observed that the younger the students were, the more the frequency and types of guidance were needed when they played the game for the first time.

3.2 Perceived Ease of Use

All students agreed that the game was easy to operate and play. It was also easy for them to get familiar with the game except Player 4, who had the least game experience among the four students. It was obvious from the observation that Player 4 needed more help in finding target places and items, and took longer time to learn the fighting mechanisms.

3.3 Perceived Usefulness

Students' perceptions about usefulness of the game are reported in Table 5. All the students were also asked to recall as much as they could about the knowledge they learned from the game. Player 4 was a special case that he did not perceive the game as useful in all knowledge learning. As stated by Player 4, he remembered seeing the information somewhere in the game but he did not learn the knowledge. The following analysis was based on the rest of the students.

The basic knowledge about forests was embedded in the "Forest" that students would learn from the first half of the game. Students perceived usefulness differently when learning basic knowledge. All three students had learnt functions of the forests previously and thought the game would help them to enhance formerly studied knowledge and learn new one as well. However, only Player 1 and Player 3 could recall two of the six functions roughly. As for learning the knowledge about elements (i.e., anion and phytoncid), only one student thought the game was useful. Yet, all three students could recall the gaming functions of the elements used in fighting.

Table 5. Students' perceived usefulness of the game to achieve learning goals

Learning Goals			Player		
		1	2	3	4
Basic Knowledge					
Functions	Prior Knowledge	Yes	Yes	Yes	No
	Usefulness	Yes	Yes	Yes	No
Elements	Prior Knowledge	No	No	Yes	No
	Usefulness	No	Yes	No	No
Applied Knowledge					
Forest	Prior Knowledge	Yes	Yes	Yes	No
protection	Usefulness	Yes	Yes	Yes	No

Students were set to learn the applied knowledge about forest protection after they entered the human world. These students talked to most of the NPCs whether those were required or optional ones. They all agreed that the game helped them to learn more about the ways to save the forests. All of them could recall the basic concepts of this applied knowledge such as reuse of the paper and wooden products. It was found that Player 1 could remember the most of the application methods while Player 3 could sometimes describe the learning dialogue in details in addition to recall of those methods.

The above findings suggested that students who were elder or had more game experience could benefit more from this role-playing game. This might be because they had better reading comprehension, or they could pay most of their attention on learning content instead of making effort to get familiar with the game itself. Moreover, students could recall more learning content when they were reminded with specific context in the game. This indicated that this role-playing game could enhance students' learning by connecting learning to a situated gaming context.

In sum, three of the four students stated that they would be motivated to learn more about forest preservation in the future because of this game. Students who mentioned learning useful knowledge from the game also stated that they would apply the knowledge learnt in their daily life.

3.4 Game Design Elements

According to the feedbacks from the students, the game tested in this study had clear goals and rules, provided competition and challenge, and satisfied the expectation of fantasy and entertainment. However, among these elements, students' views about competition were different from what was expected for the design. In this game, the competition came from the attacks of enemies. Only one student (Player 2) thought the amount of attacks was appropriate while the rest of the students felt the attacks happened too frequently. However, the data in Table 4 showed that Player 2 decided to run away from about half of the attacks. She stated that the completion of the tasks was more important than winning the fights to get items. It was also interesting to notice that among students who thought being attacked too often, Player 1 and Player 3 still chose to fight with most of the attacks because they wanted to collect more items and checked whether their special fighting skills were increased. On the contrary, Player 4 escaped from more than half of the attacks because he thought it was a waste of time to fight and he did not want Essen to lose blood. The findings indicated that frequent attacks would disturb younger students' gaming and learning process that might cause negative impacts on their learning achievements.

When considering the challenge aspect of the game, it was too simple for experienced player (Player 3), too difficult for inexperienced player (Player 4), but appropriate for students who had moderate game experience (Player 1 & 2). A common challenge for all the students was finding target places or NPCs in a large scene which could not be overviewed in the game window. As observed in their playing process, students were often stuck in the scene before getting some guidance from the researcher. The challenge was even greater for Player 4 that he mentioned the text was too much to read and he had problems of understanding some of the words.

4. Conclusion

The purpose of this pilot study was to explore whether this educational PC-based RPG could help students achieve the learning goals by providing a situated and motivating learning environment for students. The findings indicated that in general, these students reported positive experience of playing and learning in this game. This game was showed to fulfill major game characteristics as stated by Alessi & Trollip [1]. In addition, the game was viewed by the students as an easy and useful learning tool. According to TAM [3], the potential of this game to be accepted for learning was granted. Moreover, the learning of the students seemed to be promoted by this situated gamine context.

Based on the results of this preliminary study, several suggestions in relation to learners' characteristics, game design, and research design were listed as follows:

- *Learners' characteristics:* Reading comprehension might affect learning effectiveness especially for younger students when the learning content was mainly delivered by text format. There is a need to make the reading easier or use other formats of knowledge representation to enhance the learning of younger students. In addition, previous game experience might also be an important factor to influence students' learning in a RPG that needs to be explored in future studies.

- *Game design:* The results suggested a possibility that students would learn more from interactive dialogue than from one-way knowledge delivery. Future studies will be needed to control possible confounding variables to examine the learning effectiveness of different mechanisms of text-based knowledge delivery in RPGs. To overcome the problem of disorientation in a large scene, a thumbnail could be adopted to help students find target places. Moreover, the design of attacks will need to be adjusted in frequency and mechanism to provide exciting competition without impeding the learning process.
- *Research design:* In this pilot study, all students were only given one chance to play the game. Even though two students needed to re-enter the game after losing the fights, they started the game from the locations they were failed instead of starting from the very beginning. As it was observed, students took about more than one and half hours to complete the game and they all felt tired to some degree during the process. The lack of flexibility for students to decide their playing time and paths might cause the inefficient learning outcomes of a lengthy game, especially for younger students. There are two possible solutions to overcome the problems. First, shorten the length of the game by reducing the scale of the scenes and the frequency of attacks but save all the learning content in the game. How to keep the game challenging and competing will be the issue to consider. The second solution is to allow students to play the game in their own paths and patterns within a given time range. By doing this, methods to collect data sufficiently and efficiently from individual computers will need to be carefully designed.

Acknowledgments

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From Speaking to Acting - Enhancing Interactivities of Learning in the 3D Virtual Worlds

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Abstract: Some common educational activities being discussed for fitting 3D virtual worlds include the following types: interpersonal role-play, oral production, and traditional lecturing [1]. These examples are discussion-based or dialogue-oriented by heavily use of the text-typing or voice communication tools in the virtual scenarios. To take more advantages of the virtual space for enhancing the learning interactivity, this paper demonstrates an example which addresses the interactivities not only among learners by texting but also between learners and learning context. Through configuring the Activity Awareness (AA) model [2] with our designed learning context and activities for teamwork in computer-supported collaborations, we attempt to explore the possibility of enhancing interactivities in the virtual worlds, e.g., a learning task requiring learners to manipulate 3D virtual objects collaboratively. Rather than using commercial platforms like the Second Life, we develop a lightweight yet dedicated system to implement the experiment. Our study demonstrates that the AA model is more feasible for enhancing the interactivity among learners in the learning environment than discussion-based activity is in the 3D virtual learning worlds.

Keywords: Activity Awareness, 3D Virtual Worlds

Introduction

There has been an increasing research interest of the 3D multi-user environment in education since the MMORPG (Massively Multiplayer Online Role-Playing Game) has been introduced to the world, such as the World of Warcraft (WoW) and Ultima Online. However, educators confront challenges when they try to use this kind of 3D virtual worlds as a supplementary virtual learning material. Traditional 2D web pages with learning content, group video conference, asynchronous forum, email or instant messaging system may need to be reconfigured with a 3D rendering engine. Also, some different mechanism may require being reconsidered for 3D multi-user information sharing and distributing system. Resembling a classic type of lecturing class directly in such a virtual world is an easier and popular way. This method could enlarge the number of audience comparing to the restricted physical classrooms; however, it doesn't certainly increase the interactivity that are important for learning community and learning outcomes among learners in the learning context.

To testify and provide other feasible examples to fill the gap, we conducted the AA model to design a thematic learning activity for compromising with the taking of the 3D multi-user virtual worlds as learning environment. By reviewing guidelines and principles of pedagogies, we combined with educational theories and practical system designs to

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establish a collaborative type of learning activity to enhance the interactivity mentioned in the previous paragraph. We implemented a web-based 3D multi-user system, along with a small projectile motion learning activity called virtual parabola festival. The AA model was introduced to design various collaborative learning tasks and system functions in this activity for triggering the interactivity among learners, between learners and the learning context as well as the learning contents. The practice which the AA model could be used to enhance the interaction in the virtual shared activities will be discussed in section 3. Since the platform is created by researchers, the database and the designated learning data could be easily accessed.

Comparing to other similar studies which use existing Second Life or other commercial platforms as experiment environment, our study initiated from the very beginning by asking a fundamental question: What mechanism and principles should be considered for designing a 3D virtual learning system in order to support learning collaborative activities? Not only engaged in theorizing, we also developed a lightweight system for empirical test to confirm the feasibility. We have the experiment executed by the system programmers, educators and testers to verify that the AA models can enhance the virtual learning interactivities in the 3D virtual worlds.

1. Learning examples in the Second Life

Jaeger [1] proposed an evaluation framework for educational activities in virtual worlds based on Media Richness and Task Closure Theories from Management Information Systems. He used three types of educational activities in the Kamimo virtual campus project in the Second Life to find out which type was more appropriate for such kind of learning environment.

1.1 Interpersonal role-play

In this scenario, students were divided into four teams, a buyer team and three vendor teams. Their avatars were gathered in a 3D meeting room for role playing the "Response to Request-For-Proposal" activity. The activity is usually developed in a classroom, and is obviously easy to be represented in the 3D virtual world. Fig. 1 shows that the activity is discussion-based via texting or voice communication. Learners interact with each other rather than between a learner and the 3D learning context.

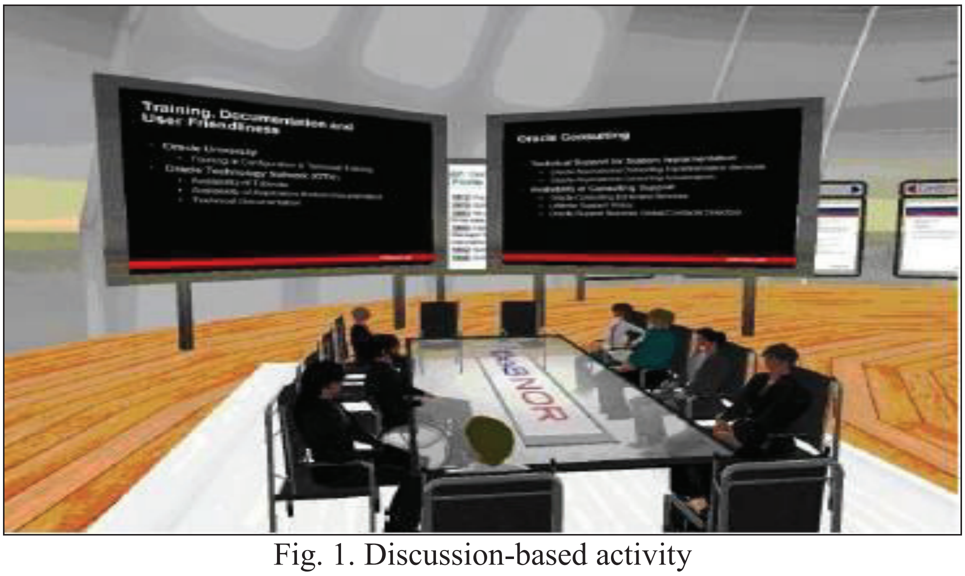

Fig. 1. Discussion-based activity

1.2 Breaking into conversations

This activity demonstrated how to people interaction in a polite way. The main technique was to have a buddy group discuss a topic and sit around a campfire when another buddy group broke into their conversation in a polite way. Moreover, the interactivity still focused on the learners, leaving out the 3D stage settings, objects, and insignificant elements. The scenario could be implemented by replacing the conference table with a campfire shown on the figure 1.

1.3 Traditional lecturing

Some teachers use the Second Life system to display their slides or teaching materials for students as they do in the physical classroom. It is a way of passive learning since there is bare interaction among learners or between teachers and learners.

The results of Jaeger's study shows that "Interpersonal role play" and "Breaking into conversations" have greater potential to be successfully implemented than "Traditional lecturing" in the Second Life. Although the Second Life provides a universal platform for any possible virtual educational activities, there is still time and space to modify various educational activities each time. That is why we must respond to interactions between the system and activity designs.

2. The Activity Awareness Model to Enhance Interactivity in Learning

Carroll et al. proposed a framework of four aspects for understanding the joint endeavor of activity awareness [2][3], which are all important in computer-supported collaborations: common ground [4], community of practice [5], social capital [6], and human development [7]. Based on the general concept of shared knowledge [8] plus a more elaborate view that includes common beliefs, complementary knowledge, social, cultural, and physical concepts [9], the framework shifts the focus from shared concepts to shared activity, and is helpful for designing technology and enhancing team effectiveness derived from interactivity.

Table 1 summarizes the four facets of activity awareness and gives clearer guidance for designing and developing a virtual learning environment which could effectively enhance the interactivity in learning process.

Table 1: Four facets of activity awareness (Carroll, et al., 2006)

Facet	Description
Common ground	A communication protocol for testing and signaling shared knowledge and beliefs
Communities of practice	The tacit understanding of community-specific behaviors shared through enactment
Social capital	The creation of persistent social goods through networks of mutually beneficial or satisfying interaction
Human development	Innovative behavior or decisions entrained by open-ended, complex problem solving, and evolving skills of both members and teams

Collaborative learning contains social knowledge construction, peer interaction, communication and collaboration; in this research, the framework is adopted as a blueprint for developing and implementing a realistic system.

The common ground may be considered as a communication protocol for establishing the co-existing and situated learning atmosphere for learners to share knowledge and beliefs within, like the players in WoW. The learning context and relevant activities provide an opportunity for a community of practice to develop; through the deployment of sticky learning tasks in various scenarios, learners could communicate and interact with others to achieve social capital, eventually enhancing human development for both learners and their teams.

All above considerations could be easily developed in a physical classroom; however, educators seldom elaborate these facets into the 3D virtual worlds. The reason may due to the lack of system programming skills, burden of learning commercial tools, as well as the control of the platform or cooperation with the commercials; therefore, those leave a question for us to verify that if the AA model is really feasible in such new environment.

3. Design of the System and Learning Activity

A space can only become a place when an understood activity is scheduled or ongoing [10], so does the 3D virtual learning space. We designed a thematic learning activity including series of tasks - the virtual parabola festival, to bring the AA model into practice in our small yet dedicated 3D virtual space named the Best Digital Village (BDV). The main activity is deployed in the virtual buildings as series of tasks in the learning scenarios, and two kinds of tasks are designed: those for individuals and those for team collaboration.

3.1 The learning tasks for individuals to interact with learning context

The scenarios and tasks for individuals are as follows: The Town Hall is the reception and administration center wherein the learners can look up other learners' and team profiles. Team management along with information on the "Honor Roll" and "Score Board" can also be obtained from kiosks in this building. Learners who frequently visit and use the kiosks will receive experience points (EP).

The Community Center is the building where learners gather for a summit or discussion, as well as to counsel each other. Chatting or discussing topics with others will earn charisma points (CP). All dialogues will be recorded in a database and can be output in the form of a reporting document sorted by team, date, week, month, and year for further review and analysis. In addition, joining a discussion in the BDV forum on the web portal for asynchronous communication will also earn extra CP.

The Library in the BDV is used to encourage learners to contribute their knowledge. Learners can recommend or upload the related web links or digital multimedia resources to earn EP, so do those who frequently visit and use the resources in the library. Learners can examine every book shelf or digital facility in the library to gain parabola-related information to better understand the important parameters like velocity and angle in a parabolic flight motion.

In the School, there is a classroom within which a parabola knowledge test for scholarship is held, and learners can take the exam and earn extra EP. They can also discuss the answers in online forums to get more CP. Fig. 2 shows the actual screenshots of each scenario described above.

Fig. 2. Actual screenshots of the scenarios: From left to right, top to bottom: Town Hall, Community Center, Library and the Classroom in the School

The Exhibition Center has various zones using interactive 3D parabola-related objects and artifacts that demonstrate how the parabola formula works and is applied in daily life. Learners who visit these zones and interact with the 3D artifacts to learn more about the topic will get EP, and details of these zones are as follows. Concept Zone: This zone is decorated with posters of parabola mathematics, physics, and formula drafts from historic to scientific factors, and is helpful for understanding the evolution and recalling the calculations related to parabola. Entertainment Zone: This zone shows Frisbee, quoits, fishing rod swinging, and many other entertaining parabolic activities. Learners can click on the objects to see how these games are played. Daily-Life Zone: This zone introduces parabolic applications and phenomena in our daily life. Military Zone: This zone gives details of the ancient and modern weapons using the parabolic flight formula. Learners can click on the vivid 3D models to see how they work. Sports Zone: This zone illustrates basketball shooting, pitching, and many other parabolic games. Learners can click on the sports items to see how the parabola formula is applied. The thematic zones are illustrated in Fig. 3:

Fig. 3. Actual screenshots of the different zones: From left to right, top to bottom: Lobby of Exhibition Center, Zone of Concepts, Life with Parabola, Entertainment, Military and Sports

3.2 The learning tasks for team collaboration to enhance interactivity among learners

In the Exhibition Center, the Innovative Artifacts Gallery allows team leaders hold a brainstorming session to create new ideas by applying what they have learned. They put a blueprint or draft on a web page, including a brief description of the ideas, and then upload the information to the gallery.

All teams are required to score and comment on the other teams' ideas and innovations and initialize "peer reviewing" by clicking on the work of each team on the gallery wall, and earn CP during the process. Domain experts are also invited to examine and evaluate the practicality and creativity of each idea, then give each team extra EP. Fig. 4 shows the interior of the gallery along with the scoring and commenting interface, used in the library scenario for learner-contributed materials.

Fig. 4. From top: The Innovative Artifacts Gallery and the interface for peer reviews

The other collaboration task is a catapult simulation game in the Park scenario, which utilizes the virtual game currency as gold converted from EP and CP by rubrics. After all team members earn enough gold, they can get together in the park to play the catapult simulation. Each team involved in the simulation game needs to fulfill the following five roles to coordinate the parameters of the parabola formula. The Commander, played only by a team leader, is responsible for coordinating and negotiating about solutions among teammates; he or she is the only one who can press the "fire" button to launch the virtual catapult. The Observer has binoculars to observe surroundings and is responsible for reporting back the results; the Navigator is responsible for calculating the fire angle parameter. The Controller is responsible for resolving the initial velocity parameter. The Counselor is generally a teacher who can give minor adjustments to the final solution. Thus, a game-based role-playing learning prototype emerges from this arrangement of interactivities, while the learners form a team and achieve a consensus on the solution.

Fig. 5 shows a collaborative firing condition, along with the simulation game flow. The Commander asks for a new target and coordinates teammates to input and confirm the firing parameters. Every time after the commander pushes the button to fire, the observer reports back the position between the target and the point of impact, as well as the firing results, which may be: “perfect,” “excellent,” “not bad,” and so on, each with an appropriate amount of rewarded EP and CP given back to each team member. The team then discusses and decides whether keep playing with the same target until they achieve a bull’s eye, or to give up and ask for another new target. The colored blocks in the flow chart represent the processes where interactivity and social capital should occur.

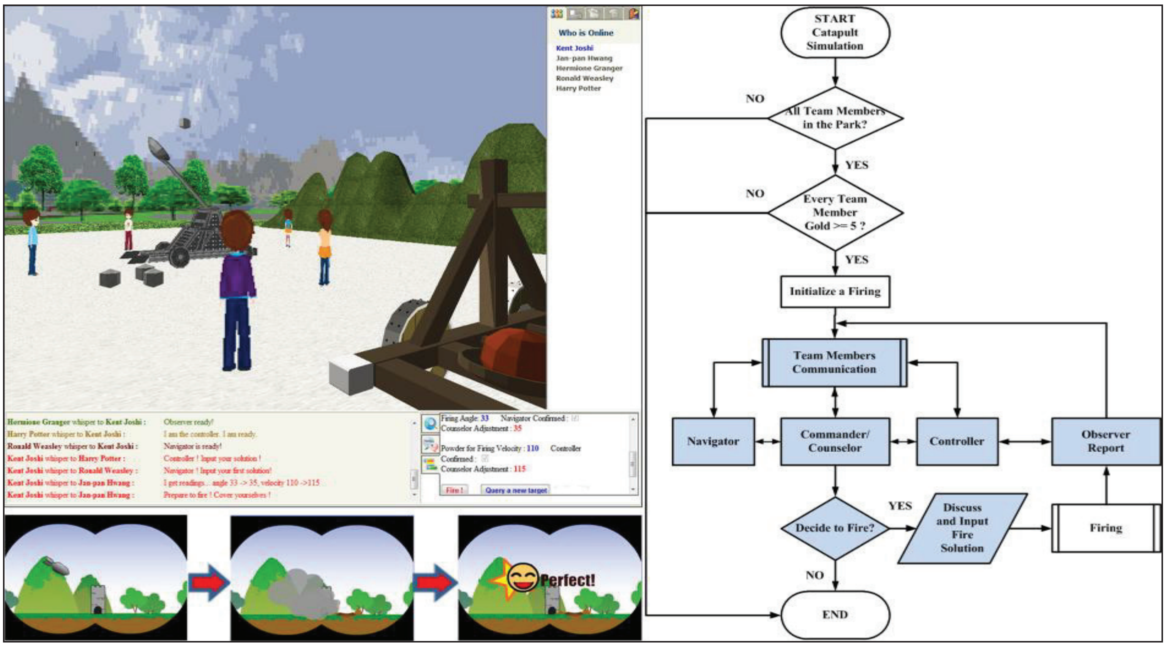

Fig. 5. The catapult game play and the activity flowchart

Discussion and Conclusion

Comparing to the discussion-based activities, the AA model could enhance interactivities among learners and between learners and the learning context in the 3D virtual worlds. Although the AA model is easy to implement and to be testified in a real classroom, it is seldom discussed in the 3D virtual worlds. One reason may be that educators lack the experiences to either develop a complex activity in a commercial platform or learn how to bring the script alive in the Second Life, thus leave the learning context for only background decorated curtains on the stage. We tried to design more interactive activities with our own applied system supports and empirically confirmed that the AA model could be improved and configured for learning in the 3D virtual worlds, not only for science education but also for any other virtual collaborative activities to enhance interactivities in many aspects, increase the bonding of learners, learning context and learning activity, and thus promote the learning performance accordingly.

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Integrating educational computer games in science teaching: In-service science teachers' perspectives

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Abstract: This study explored a group of science teachers' perspectives on integrating educational computer games in science teaching. Through tape-recorded interviews, the participant teachers' perspectives regarding the integration of educational computer games in science teaching were collected and analyzed qualitatively. To ensure the teachers had basic experiences regarding playing science educational computer games, the participant teachers were asked to play a science educational computer game designed for third graders before being interviewed. Some important findings are reveled and educational implications are discussed.

Keywords: educational computer game, science teaching, science teacher

Introduction

Rapid development in information technologies has dramatically influenced the ways of teaching and learning [1]. In recent years, more and more researchers and educators have reorganized the powerful potential of using computers games or online games for educational purposes [2]. As a result, digital game-based learning (DGBL) has been highlighted.

Computer games are powerful educational tools if used appropriately [3]. When using an educational computer game in classrooms, the instructional strategies used by teacher should be crucial for the success of the integration a digital computer game into his/her class [4]. Undoubtedly, teachers' understanding of educational computer games will influence how they make use of this powerful instructional tool. In other words, teachers' perspectives on the integration of educational computer games into science teaching should be one of the important research issues.

In the last decade, more and more researchers paid their attention to DGBL-related issues. However, most of them addressed the effectiveness of the use of educational computer games in students' learning outcomes [4] and their motivation [5]. Not many studies have focused on teachers' understanding or adoption of educational computer games [6][7]. In particular, research aiming to explore science teachers' perspectives on the integration of educational computer games into science teaching. To address this important issue, this study explored a group of elementary science teachers' perspectives on the integration of educational computer games into science teaching.

1. Methods

1.1 Subjects

The subjects of this study are 21 voluntary in-service elementary science teachers (including 9 male and 12 female teachers). Only one of them had a master degree, and the others had undergraduate degrees. Their teaching experiences ranged from three to twenty seven years. The interview has shown that 20 participants have experiences in computer game, only one participant has non-experience.

1.2 Data collection

This study was conducted to explore a group of elementary science teachers' perspectives on the use of digital educational games in science classrooms. To this end, tape-recorded interviews were conducted. To ensure the teachers had basic experiences regarding playing science educational computer games, the participant teachers were asked to play a science educational computer game designed for third graders before being interviewed. This computer game was designed in Hsu, Tsai and Liang (2011) to teach the concepts of light and shadow [8].

After playing the computer game, the teachers were interviewed with the following questions:

(1) What are the differences between educational computer games and computer games?
(2) Are you willing to employed educational computer games in your science instruction?
(3) How will you applying educational computer games in your science classes?
(4) What are the advantages and disadvantages of integrating educational computer games in science teaching?
(5) When employing educational computer games in science instruction, what relevant professional abilities teachers will needed?

1.3 Data analyses

The teachers' narratives obtained from tape-recorded interviews are transcribed. And the data regarding the teachers' perspectives were analyzed qualitatively.

2. Major finding and discussion

2.1 Science teachers' perspectives on the differences between an educational computer game and a computer game

In this study, 12 participants (60%) considered that educational computer games had included science content, principle, learning progress and purpose. For example, a teacher mentioned that "the game of light and shadow is easily to be identified by science educators or experts, but it also invokes young students to think how they pass the game missions by the game's contents."

Besides, the teachers in this study also mentioned some common characters. Six participants (30%) believed educational computer games had included entertaining effect in order to attract young students interested, and provided additional explains and cues to assist players passing the game. Also, 3 participants (15%) mentioned the educational computer game and a game without education have the same user interface and equipment, such as keyboard and mouse; furthermore, vivid sound and video effects attract young students' learning willing.

2.2 Science Teachers' willing to employed educational computer games in science education

After experiencing the educational computer game, 19 participants (95%) expressed that they were willing to employ educational computers games for young students if the games' contents synchronize class progresses. No participant (0%) disagree that the educational game is a positive medium. Besides, only one participant (5%) did not response in this issue.

2.3 Science teachers' ideal application of educational computer games in science teaching

The teachers in this study mentioned the ideal ways for them to apply educational computer games in their science classes. Their responses are summarized as follows:

(1) *Partly employed the game after teacher explained*: 6 participants (30%) considered to use educational games as a review after teachers' instruction.
(2) *Partly employed the game in a class beginning*: 4 participants (20%) consider that the game has an inducement for young students study firstly.
(3) *Partly employed the game as the assessment after a class progress has completed*: 6 participants (30%) mentioned that educational computer games could be used for assessments.
(4) *Fully employed the game in a class*: Only one participant (5%) mentioned that an educational computer game could be used as a learning activity in science classes.
(5) *Supplementary learning materials*: 1 participant (5%) mentioned that educational computer game could be used as supplementary learning materials.

It seems that the teachers in this study showed diverse perspective on how to use educational computer games in science classes.

2.4 Science teachers' perspectives regarding the advantages and disadvantages of integrating educational computer games in science teaching

Regarding the advantages of integrating educational computer games in science teaching, most participants (50%) mentioned that an educational computer game could be used as a replacement of real world, and it could improve young students' confidence and attention in order to encourage themselves. Some participants (20%) also stated that the educational computer game has improved real condition and preparation. Additionally, it assists teachers to understand young students' characteristic.

The teachers also majorly mentioned three disadvantages of integrating educational computer games in science teaching. The first disadvantage mentioned by the teachers is that integrating educational computer games in science teaching may increase their teaching load. For example, although a class has 40 minutes for students learning, the teachers have to add their extra personal time to prepare and training themselves in order to teach students how to learn by playing the educational computer game. The second one is that students may over-rely on playing educational computer game; and, as a result, they may not be interested in other learning materials or teachers' instruction in the classes. Also, they may have addiction in playing computer games. It seems that the teachers may think that compare with educational computer games, their instruction is less attractive to their students. The third is that if an educational computer game is not designed properly, students may have alternative conception after playing an educational computer game.

2.5 Science teachers' perspectives regarding relevant professional abilities for integrating educational computer games in science teaching

The relevant professional abilities for integrating educational computer games in science teaching mentioned by the teachers in this study were:

(1) *Specialized pedagogical content knowledge*: All the teachers mentioned about that. It seems that all the teachers in this study viewed the integration of educational computer games in science teaching as a new pedagogy. Teacher professional development on digital game-based learning may be needed.

(2) *Basic computer skills*: All the teachers mentioned about that. It may due to that the teachers in this study may be not confident of their computer literacy.

(3) *Advanced computer skills*: Five out of twenty-one teachers in this study mentioned that if teachers have advanced computer skills they can develop educational computer games by themselves. Such as one participant described that he would probably design a particular educational game for his students by *Adobe Flash*, if he has the advanced technique in developing an educational computer game.

3. Conclusions

This study investigated elementary science teachers' perspectives on integrating educational computer games in science teaching. This study revealed most of the science teachers in this study recognized the educational entity of educational games, and almost all the teachers in this study were willing to integrate educational computer games in their science classes. Besides, teachers proposed diverse ways for using educational computer games in science classes. They also mentioned the essentiality of specialized pedagogical content knowledge and basic computer skills when conducting computer game-based instruction. In addition, a half of participants believe that the occasion of applying educational computer games are partly employed in a class after teacher explained, or as an assessment after a class progress has completed. The finding of this study may provide some insights for teacher educators and educational designers. For example, teacher professional development regarding integrating computer game in science instruction will be needed. Besides, how to prevent students' alternative conception derived from educational games may be another important issue for educational game designers. Therefore, collaborative work from science teachers and educational computer game developers may be crucial of much importance.

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Preliminary Investigation on a Theoretical Framework for Evaluation of Serious Educational Games

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Abstract: We propose a theoretical framework for evaluation of Serious Educational Games based on systematically reviewing available literatures. The framework we introduce consists of four aspects, game features, immersion, pedagogy, and knowledge. Hopefully, the framework could provide a new perspective that helps researchers and educators to better investigate and understand the effectiveness of Serious Educational Games.

Keywords: Serious Educational Games, Game features, Immersion, Knowledge, Pedagogy

Introduction

Play facilitates cognitive growth by providing children with experiences and opportunities to interact with the world. It is a really serious matter, which has been supported by many theories since the beginning of 1870's (Mitchell & Mason, 1935). Play includes many varieties and settings, and video game play might well be the newest and most popular form that has burgeoned recently. Although people usually perceive video game as merely an entertainment media, its potential in education has nowadays attracted much attention as today's learning generation is extremely video game literate and spend much more time playing video games than participating in other learning activities (Prensky, 2001). The idea of Serious Games that advocates the particular use of simulations and video games for training and/or educational purposes has therefore emerged since 2002 (Gudmundsen, 2006), attempting to bridge reality to virtual reality in numerous dimensions and to combine learning with playing to facilitate the occurrence of learning. Thus far, it is believed that the use of Serious Games will become a new wave for technology-mediated learning (TML) in the near future (Tay, 2010).

Serious Games have a broad definition in that both formal and informal settings are included and the subjects consist of all the masses. Annetta (2008, 2010) further defined Serious Games as Serious Educational Games (SEG) to distinguish non-entertainment games specific to K-20 educational settings. In this paper, we propose a theoretical framework for evaluation to preliminarily investigate how we can harness the power of SEG to engage students and improve their learning achievement.

1. A theoretical framework for evaluation

The goal of commercial video games is merely for entertainment, and people generally don't care about what users learn from playing the video games, except those games involving violence or gender issues. However, the main purpose of SEG is for teaching and learning, so how to evaluate their effectiveness becomes a major consideration for educators and researchers. Unfortunately, research that focuses on the evaluation of SEG are quite few so far. Garris, Ahlers, & Driskell (2002) proposed an input-process-outcome model of instructional games and learning which indicates that game features combined with instructional content are a powerful driving force in triggering the game cycles that are repeated cycles of *user judgment, behavior, and feedback,* which engage players in the game play activities. They concluded that game characteristics can be classified into six categories: *fantasy, rules/goals, sensory, stimuli, challenge, mystery,* and *control*. Their model is an elaborate idea that clearly explains how SEG works. However, they did not emphasize on the evaluation of SEG and how to integrate the instructional content with the game features. Fu, Su, and Yu (2009) developed a scale to assess user enjoyment (flow experience) through using SEG as an indicator for understanding the strength and flaw of the game. A total of eight dimensions are included in their scale: *immersion, social interaction, challenge, goal clarity, feedback, concentration, control,* and *knowledge improvement.* It is a rigorous assessment for evaluating the level of enjoyment provided by SEG; however, they overlooked the instructional aspect. We do believe that user enjoyment plays a crucial role in users' ability to learn through SEG play; however, we think there are still other major components that need to be taken into consideration in order to make the evaluation more sound and complete.

In order to better evaluate the effectiveness of SEG, we introduce a theoretical framework that includes four aspects, *game (game features)*, *individual (immersion)*, *pedagogy*, and *knowledge* (Figure 1). We argue that only a game which takes all the four dimensions into account can be considered a good and effective SEG. The four aspects are discussed in detail as below.

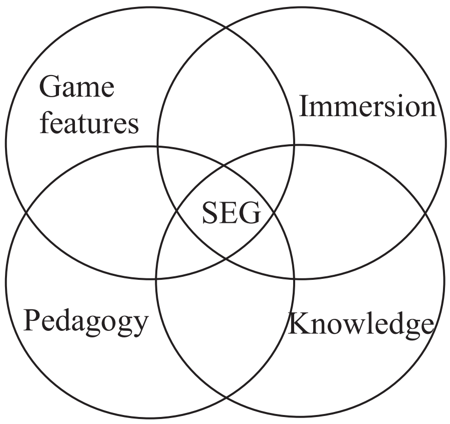

Figure 1. A theoretical framework for evaluating the effectiveness of SEG.

2. Game features

Video games have many unique features that motivate players, and different researchers have different ideas regarding those game characteristics. For example, Malone & Lepper (1987) posited that challenge, curiosity, fantasy, and control are the four important features that intrinsically motivate individuals, whilst Thornton, Cleveland (1990) argued that interactivity should be the essential aspect of a game, and Baranauskas, Neto, and Borges (1999) suggested that the essential game features are challenge and risk (1990). Garris et al.

(2002) argued that although different studies use different terms, these different approaches actually describe similar game characteristics. Therefore, they concluded that any type of games could be described by six key dimensions, fantasy, rules/goals, sensory stimuli, challenge, mystery, and control. Based on these previous studies, we further employ rules/goals, sensory stimuli, imagination, challenge, control, and interactivity as crucial game features for evaluating SEG.

2.1 Rules/Goals

Clear goals and rules should be provided in SEG settings so that the players can know what the ultimate goals of the SEG are and achieve the goals through guidance embedded in SEG. Rules provide SEG with some limitations and players rely on the rules to complete the game. In other words, the rules provide players with scaffoldings to achieve the ultimate goals in SEG. Rules are sometimes set in order to create a specific context in the game, or sometimes they are established as the concepts embedded for learning have particular limitations. Rules also affect the format of competition and as well as the degree of challenge in the games.

2.2 Sensory stimuli

Another reason for explaining why games are so attractive is that games provide players with the distortion of perception. Sound effects, dynamic graphics, dazzling colors, and other sensory stimuli provided by games grab the attention of players, evoke their arousal, and cause great excitement. Hence only the SEG that offers some kind of sensory stimuli would have greater potential in motivating players.

2.3 Imagination

The narratives, scenes, and/or contexts of games are not necessarily real, which provides games with a certain degree of imagination. Because of the feature of imagination, games can simulate specific situations and conditions that are unreal or generally hard to encounter. Imagination allows games to create a virtual world that is separate from real life wherein players are insulated from real consequences. Therefore, players could elaborate their skills and enhance learning outcomes through trial and error without any fear of failure.

2.4 challenge

Challenge of games is related to the degree of difficulty that games provide. If a game is too hard or too easy, players are likely to feel anxious or perceive the game as being boring. Therefore, an effective SEG needs to be designed with different and progressive levels of complexity. Factors affecting the level of challenge of a game include the player’s abilities, how much time is allowed to play the games, whether the rules are clearly specified and the competitors formidable, so on and so forth.

2.5 Control

“Control refers to the exercise of authority or the ability to regulate, direct, or command something” (Garris, et al., 2002, p. 451). Hence, games need to provide players with some extent of authority and control over certain elements of the game and be able to perform decision making in the game world. Moreover, an effective SEG should be developed with an intuitive and friendly user interface so that players can manipulate the objects in the game with minimal frustration. Certain gaming peripheral products can also improve the feature of control as well. For example, using a pedal and a steering wheel makes players feel like they are really driving a car compared to using keyboard and mouse (Cheng, 2009; Cheng, Annetta, Folta, & Holmes, 2011).

2.6 Interactivity

Interactivity plays a crucial role in distinguishing games from other technology-mediated learning forms. Games can provide two kinds of interactivity, human-to-computer and human-to-human. Human-to-computer interactivity relies on immediate feedback provided by the game. The feedback allows players to track their progress and know what to do for the next step. Players can then modify their strategies and review their decisions based on the feedback they receive in-game, so that they can achieve the desired goals successfully. On the other hand, human-to-human interactivity refers to social interactions. Games with functions that allow players to communicate with others provide many opportunities for improving social interactions. Therefore, interactivity allows individuals to actively participate in the learning activity embedded in the game world rather than passively receive the information offered.

3. Immersion

The aforementioned game characteristics have much potential in motivating individuals intrinsically; however, they do not ensure the individual's enjoyment. In other words, players might agree that the games do have certain game features, but they do not necessarily enjoy playing it. Enjoyment is a subjective feeling and hence can vary from people to people. Therefore, we argue that a complete evaluation should also take players' experiences into considerations.

Generally, people would like to use the term 'flow' to describe the state in which individuals are intensely absorbed in an activity. The idea of flow is proposed by Csikszentmihalyi (1990) to describe a positive experience in which individuals perceive a congruence of skills and challenges with a high level of enjoyment and fulfillment. Because this gratifying state is so enjoyable, people are willing to put forth effort to reach and maintain that state, with little concern for their surroundings or what they will be getting out of it, even when it is difficult or becomes dangerous. Csikszentmihalyi concluded a total of nine characteristics of flow: challenge-skill balance, action-awareness merging, clear goal, unambiguous feedback, concentration on task at hand, sense of control, loss of self-consciousness, transformation of time, and autotelic experience. The experience of flow is a major incentive of intrinsically motivated behavior (Schiefele, 2001), which is fundamental to all learning. So far, much research has evidenced that people could experience flow state while engaging in sports, creation, art activities, and even web surfing.

Obviously, video game play provides people with a flow experience in which individuals enjoy and engage themselves as well. Flow is an optimal and extreme state; however, researchers are used to employing immersion instead of flow when it comes to video game play most of the time. Researchers describe immersion as a sub-optimal and non-extreme state as it is the precondition of flow and flow is the extreme state of it. While playing video games, individuals might be very immersed in the gamealthough they might not experience flow (Jennett et al., 2008). Brown & Cairns (2004) employed grounded theory to investigate game immersion, pointing out that immersion actually comprises of three stages, engagement, engrossment, and total immersion, respectively. They further contended that barriers exist among these three stages, and players will not get into the stage until barriers are overcome. Cheng (2011) conducted a research that has evidenced the three stages of immersion as well; therefore, we employ their definitions of immersion to construct our framework for evaluation.

3.1 Engagement

Engagement is the first stage of immersion. Two barriers, access and investment, should be overcome in order to enter this level. Access refers to the gamers' preference and game controls. In other words, players must like the type and/or style of the game they are playing and feel a congruence of their skills and challenges encountered. Once the game satisfies gamers' preference and game controls, they are going to invest time and efforts into the game. As individuals invest much time and efforts into the game, they gradually become more focused and engaged.

3.2 Engrossment

As gamers become further involved and engrossed with the game, they enter into the second stage, engrossment. There are also two barriers that affect if individuals get into this level or not. First, their perceptions of surroundings and physical needs become lower and their emotions directly attach to the game. While experiencing engrossment, the game becomes the most important part of the gamers' attention, so that they become less aware of their surroundings and less self aware. They might not be able to hear people calling or the conversations around them, and they even don't feel hungry or tired. During that time, players' emotions are affected directly by the game and they feel emotionally drained and empty when they stop playing.

3.3 Total immersion

The final stage is total immersion. Gamers have feelings of presence and empathy while experiencing this stage, and will by now totally lose their self-awareness as if their consciousness has transferred from reality to the game world. They will feel entirely attached to the game characters and empathize with their situations. They will be detached from reality to the extent that they feel like they are actually in the game and the game is all that matters. Total immersion is an optimal, extreme state as flow and it is only a fleeting experience.

4. Pedagogy

Evaluating a SEG from a pedagogical perspective considers the instructional methods embedded in the game for supporting learning processes. We believe that the development of SEG without applying well-established teaching and learning theories may cause failure to meet its desired educational goals, and individuals will then merely be entertained by using the games without obtaining any specific skill and knowledge (Gunter, Kenny, & Vick, 2008). We contend that individuals' learning outcomes through using SEG depend heavily on the teaching and learning theories selected. We discuss the pedagogical perspective in terms of context, representation, prior knowledge, reflection, and transfer.

4.1 Context

For SEG, context affects how the given knowledge represented and the learning resources contained in the game world. Moreover, learning through SEG play may occur in both physical surroundings and virtual world at the same time. Therefore, the interaction between players and their context becomes particularly important when it comes to evaluating SEG (Freitas, Rebolledo-Mendez, Liarokapis, Magoulas, & Poulovassilis, 2010). The context created in the SEG not only has to be in accordance with the concepts embedded, but should also provide proper and sufficient experiences for learning.

4.2 Representation

When learners select the presented relevant information, organize partial information to mental representation, and coordinate new verbal and visual representation with prior knowledge, they actively engage in cognitive processing, and meaningful learning occurs (Mayer, 1997). Hence the representation of information deeply affects the occurrence of meaningful learning. Especially for SEG, since misrepresentations of information could lead gamers to perform wrong behaviors in the game consistently (Devetag & Warglien, 2008), proper representations become critical for determining the effectiveness of SEG.

4.3 Prior experience

From the constructivist viewpoint, learning involves the construction of new knowledge upon part of existing knowledge by connecting new experiences and information to prior experiences. However, the design of SEG perhaps presuppose too much prior knowledge on partial learners, causing other learners to feel too difficult to engage with the virtual world (Freitas, et al., 2010). Hence, it is also very important that the development of SEG should consider students' prior experiences and provide them with opportunities to connect their previous experience to the game world.

4.4 Reflection

Another essential instructional element that helps to ensure students in achieving the learning tasks rather than merely play, is to provide students with opportunities to reflectively review their learning processes and analyze their current state of knowledge at all times. As long as student reflections could be promoted in SEG, effective learning occurs and students learn better.

4.5 Transfer

Gunter et al. (2008) developed a RETAIN model to aid with the evaluation of educational games. They argued that knowledge acquired during gameplay can be transferred to other contexts is an important instructional component. Therefore, learning with SEG should not only enable students to learn beyond rote, but also facilitate knowledge transfer to occur. Transfer thus is necessary for evaluation of SEG as well.

5. Knowledge

Finally, a game which has game features and provides players with the experience of immersion might be a good commercial game as players are entertained and fulfilled; however, it will not be an educational game if individual understanding of specific content is not improved, even if it uses profound instructional theories to support learning. One of the major goals of SEG is to integrate certain key principles of given topics into the game to facilitate student knowledge construction. Currently, research has indicated that SEG does improve students' performance in science, mathematics, and computer science (Chuang & Chen, 2009; Echeverría et al., 2011; Gillispie, Martin, & Parker, 2010; Papastergiou, 2009). Therefore, the aspect of knowledge acquisition should be a key dimension to be evaluated as well.

We employ Bloom's revised taxonomy (Anderson, Krathwohl, Airasian, Cruickshank, Mayer & Pintrich, 2001) to define learning objectives of the SEG and to classify student learning behaviors in the game to better understand knowledge and skill acquisition through using SEG. This taxonomy categorizes learning objectives into two dimensions: knowledge and cognitive process. The knowledge dimension consists of four levels: factual, conceptual, procedural and meta-cognitive, and the cognitive process dimension comprises of six levels: remember, understand, apply, analyze, evaluate and create. When a game facilitates students to acquire higher levels of knowledge and to perform higher levels of cognitive processes, it is then considered a well-developed SEG.

6. Conclusions

Although research focusing on the use of games in education has grown rapidly over the past two decades, the effectiveness of the developed SEG is still hard to be evaluated since it is a relatively new technology for learning and theories that support its implications have not yet been fully developed. By systematically reviewing available literatures, the purpose of this paper aims at preliminarily investigating and developing a theoretical framework for evaluating SEG using four critical aspects, game features, immersion, pedagogy, and knowledge. We further attempt to develop an instrument for evaluation based on the framework we introduce in the near future. Hopefully, this framework that focuses on evaluating SEG from four different and crucial dimensions will provide researchers and educators a new perspective to consider in the development of SEG and have a more complete picture regarding the effectiveness of SEG.

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Chapter 3

Real Education in Virtual Worlds

Preface

Virtual worlds have generated much attention and interest among educators and researchers over the last few years. To response the increasing calls for practical evidences of applying virtual worlds in educational settings, the first workshop on Real Education in Second Life was held in conjunction with The 18th International Conference on Computers in Education (ICCE2010). We had a fruitful harvest in the workshop. Researchers and educators from different countries got together to share and exchange experiences in Second Life. To expand the participance and influences, the second workshop on Real Education in Second Life is renamed as Real Education in Virtual Worlds. We have accepted 8 papers from 4 countries. The two-hour workshop will provide a forum where international participants can share knowledge, experiences and concerns on related educational issues in Virtual Worlds and explore directions for future research collaborations.

Organizer
Yu-Ju Lan, *National Taiwan Normal University, Taiwan*

Using Second Life® for teaching genetics laboratory sessions to undergraduates

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Abstract: There is a growing need for new approaches to effective laboratory-based learning. Issues of space, time and resources, lead to pedagogical limitations in the use of practical classes involving student engagement in pre-designed experiments. There remains a need for approaches that help students develop skills such as experimental design and teamwork, whilst effectively combining theoretical and practical aspects of the subject. We describe the processes involved in setting up three genetics-based practical classes in Second Life, a virtual world where students access the information as avatars. First year biological science students and first year medical students have each taken part in different virtual laboratory activities, designed to complement current real laboratory practical sessions. We have evaluated whether or not Second Life is an effective education tool. Initial findings show that many students felt that the virtual laboratories were very beneficial to them, helping them link the practical work with the underlying theory. There was also some improvement in the knowledge gained and retained by the students.

Keywords: Genetics, Second Life, virtual worlds, laboratory, evaluation

Development of 3D virtual math games on Second Life

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Abstract: Mathematical education in elementary school is the key fundamental of math learning. It plays an important role of pupils' future math learning. This study tries to combine information technology and mathematics to build a mathematical learning environment in Second Life. We expect to create a new learning style for mathematical education in elementary school. While Second Life has got a lot of empirical results in education, some researches indicate that students need guidance or teaching aids to learn in such environments. In order to improve the pupil's learning outcomes, this study proposes a problem-based learning approach with teaching aids and embeds mathematical learning materials in the built virtual classrooms facilitating teaching as well as learning.

Keywords: Second Life, problem-based learning, Math game, virtual classroom, teaching aids

Introduction

Mathematical education in elementary school is the key fundamental of math learning. It plays an important role in pupils' future math learning. According to Pólya's idea of *How to solve it* (1945), students need to know the meaning of a question and its goal before they solve a math question. Then, they have to think of strategies and plan a way to solve it. After they solve a question, they need to verify if the answer fits to the question and to think if there is a better answer. Pólya's idea looks simple. However, it is difficult to realize in educational field. Gu (1999) fingered out that even students already have the abilities to calculate a math question, they may still encounter the problem of understanding the meaning of math questions. According to the reasons above, we need teaching guidance to help students to understand the questions and solve them.

Schoenfeld (1985) pointed out that the major goal of mathematical education is to help students become a person with problem-solving ability. After famous Mathematician Pólya published *How to solve it*, *Mathematical discovery* and *Mathematics and plausible reasoning*, mathematics educators attach great importance to the tendency of math education. After all, training students to solve questions is an important task of math education, especially in the changing world. According to the ideas above, the main philosophy of the study is to design a problem-based teaching aids and materials which can help students to think and solve the math questions.

Living experiences are the best materials for students to learn. They learn in the environment which they are familiar with and they learn in daily life. *The Nuffield Foundation* (1965) proposed that I do and I understand at the beginning of the book. The author wrote Xi Wan Zhe Dong De Yi, which is the main concept of *The Nuffield Foundation* (1965), in Chinese in the introduction. Math games therefore become a trend and are improved with the progress of information technology. For example, interactive learning games, which are funny and interesting, can reduce students' fear of math and improve students' learning outcomes. Thus, this study use math games to design elementary math materials.

Since Second Life is easy to use and free to build (Boulos, Hetherington & Wheeler, 2007; Prasolova-Førland, Sourin & Sourina, 2006), it becomes a popular 3D platform in education field (Edwards,2006). Besides, everyone can own his virtual environments, also called Sims, in Second Life. Therefore, many universities and language institutions (such as, British Council, Confucius Institute, Cervantes and Goethe Institute) have their own Sims, and do a lot of researches in SL. Although there are many empirical research results of education in Second Life, few emphases are put on math. Nevertheless, most of the mathematical learning materials are presented in 2D in digital learning. However, some materials are best presented in 3D. Since Second Life can present learning materials in 3D, we decide to do our mathematical teaching experiment in Second Life.

The objective of this study is to develop a new mathematical learning environment, combing information technology with mathematics. We develop 3D virtual math games based on Problem-based learning approach in the popular 3D virtual platform Second Life. The research questions of this study are described below:

1. Whether Problem-based learning approach can guide students in learning mathematics in Second Life?
2. Compare to those who do not study math based on Problem-based learning approach, do students study mathematics in Second Life in this study get better learning effectiveness?

1. Virtual math classroom

Most of the teachings in present are carried out in the classrooms. In this way, teachers will be able to handle students' learning progresses instantly. Besides, students can interact with their teachers closely in the class. However, this kind of face to face teaching has its limitations. For example, students have to go to the classroom to gain knowledge. For minorities or those who live in remote areas, they may not have the chance to gain knowledge because they may not be able to go to the classroom. On the other hand, distance learning breaks the limitation of time and space. Yet, it lacks of presence and sense of interaction. Students cannot immerse in distance learning because they watch educational videos most of the time and discuss with their peers via instant messages. To solve the above-mentioned problems, teaching in virtual environments becomes a trend in recent years. Therefore, we choose Second Life, a popular virtual platform, as our teaching environment. Second Life, a massively multiplayer online social game, is now applied into educational field extensively. It has vivid presence (Biocca & Levy, 1995) and provides the environment for cooperative learning and co-editing (Petrakou, 2009; Bishop, 2009). It is hoped that Second Life can help students immerse in online learning. The learning environments developed by us in Second Life are described as follows.

- Virtual classroom: The virtual classroom which simulates the real world classroom will help students get used to virtual learning environments quickly.
- Virtual platform: Teachers can teach on the platform and switch his slides here.
- Projector screen: Usually, there are one projector and one projector screen in traditional classroom. However, there are ten projector screens in these virtual learning environments. Students can see the projector screens from different directions.
- Podiums: There are podiums in front of students' seats. Students can raise their hands and vote in their seats.

With the help of above 3D learning environments, teachers can teach mathematics by slides, videos, voices or texts in Second Life which provides the environment for distance learning. Besides, Second Life also has vivid presence and sense of interaction.

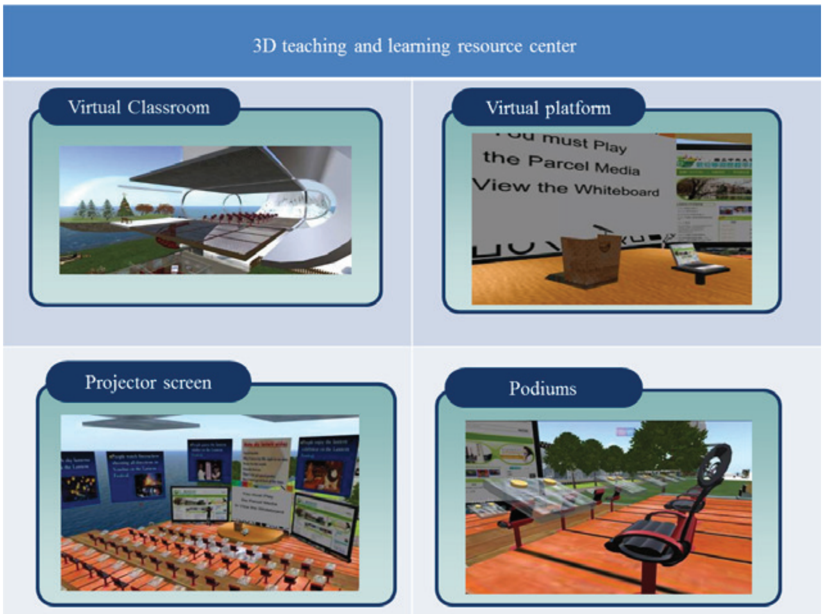


Figure1 Virtual teaching environment

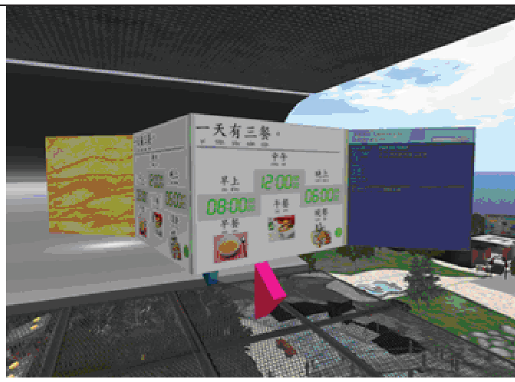
2. Virtual math game

Previous research (Sang Joon Lee , 2011 ; Rovai & Downey , 2010 ; Wheeler , 2006) showed that teachings on online platforms such as Second Life might face the problem that students' learning motivations and learning effectiveness might be decreased because students cannot get learning guidance from teachers. Therefore, it is necessary to develop mechanisms or tools to guide students learning in 3D online environments. For example, University of Sussex designed a lot of learning tasks to increase students' interactions with others in Second Life. These learning tasks were designed based on Problem-based learning approach and Constructivism (Good, Howland & Thackray, 2008). Thus, we develop 3D virtual math games based on Problem-based learning approach in Second Life. These games are carried out in the way of scavenger hunt. We also develop a series of learning aids (table 2) to help students finish scavenger hunt.

Table 1 Scavenger Hunt

Scavenger Hunt	
There are three stages in the mathematical class. Students have to finish one task in each stage. If they can finish these tasks, they can watch movies in the theater in iTELL. The stages are described as follows:	
1. Class teaching	
First, the teacher will teach basic mathematical knowledge in the classroom in Second Life. In this way, students can learn mathematics in a way that is close to their previous learning experiences. In this stage, the teacher will teach with slides and talk to students with voice functions provided by Second Life.	
2.Doing scavenger hunt	
This study will build a test bank for student to do self-path learning. After students finish learning, they will do the scavenger hunt. They will first go to the supermarket in Second Life to go shopping. They will be told what to buy before they actually do the shopping. Then, they can buy the products and do arithmetic practices with the clerks so that they can learn mathematics in authentic environments. In addition, they can review what they have learned by in Second Life after class.	
3. Get awards or certification.	
After students finish their tasks, they can watch a movie in the theater, get awards or get certification.	

Table 2 Introduction to teaching aids

1.Web PPT	
The slides for teaching are uploaded to the web server through the shared media function of Second Life viewer 2. In this way, the instructor can switch their slides at any time and save the charges for uploading slides. In addition, there are spaces for instructors to show their personal websites on the sides of the cube. Instructors can interact with students through these websites.	
2. The settings for buying products in the supermarket	
The products in the supermarket are provided with voices and texts. If students decide to buy a product, they would get an object so that they can pay for the product and practice supermarket checkout.	
3. HUD for collaborative learning	
To make full use of teaching resources in Second Life, we develop a set of teaching aids to assist students in learning. One of the teaching aids developed by us is HUD for collaborative learning. Students can take pictures in Second Life and upload their pictures to a php sever. They can wear HUD for collaborative learning to share pictures with their classmates. Even if students are in different places, they still can see the same picture and discuss it with each other. With HUD for collaborative learning, students can get guidance from teachers and tutors as well as get help from their classmates.	

3. Conclusion and future research

This study aims to promote elementary students' learning effectiveness in mathematics. We design a virtual mathematical classroom, 3D problem-based mathematical materials and teaching aids to assist students in learning mathematics. It is expected that the methods proposed in this study can solve the lack-of-guidance problem and promote students' learning effectiveness. To see whether 3D virtual mathematic games that are designed based on Problem-based learning approach can enhance students' learning effectiveness and whether Problem-based learning approach can assist students in learning mathematics, we design a series of mathematical experiments which will be done in an elementary school. Students will be divided into experimental group and control group. The control group will be taught by traditional teaching methods while the experimental group will be taught by the methods proposed in this study. The experimental results will show that whether the learning methods proposed in this study will enhance students' learning effectiveness.

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Lessons learned from the birth and evolution of a virtual community for educators

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Abstract: Educators around the world are experimenting with the possibilities virtual worlds have for education and learning how to use these new environments efficiently. Virtual worlds have the potential to bring some added value to education and educators can use them to create something that is not possible to do or show in traditional classrooms. Although a lot have been learned about virtual worlds and their potential, a lot more has to be learned before virtual worlds can become an integrated part of education on various levels. The article looks back at the birth and growth of the EduFinland community in the virtual world of Second Life and discusses lessons learned so far during the years of its existence.

Keywords: education, virtual worlds, learning, teacher, student, EduFinland

Introduction

The interest towards educational use of virtual worlds and virtual realities is not a new thing [1, 2, 3], but it has only been since the middle of the last decade that the educational possibilities of virtual worlds and virtual realities have been available to all educators. This was the time when the virtual world of Second Life (www.secondlife.com) and other similar virtual worlds opened. These new three dimensional worlds could be accessed from personal computers and anyone with a bit of practice could build virtual objects and modify the space for their purposes. Soon educators around the world realized the potential these environments could have in education and started experimenting with the possibilities virtual worlds had to offer. To spread information and knowledge and to meet others interested in virtual worlds communities of educators were born.

EduFinland is a virtual community for Finnish educators, a collaborative network, and a collection of islands in the virtual world of Second Life. EduFinland opened its first island in spring 2008 and today, three years later, the archipelago has grown into a lively community consisting of 25 islands and it is the virtual home of more than 50 schools, universities and other non-profit organizations from Finland. EduFinland has been an interesting place to observe how educators and organizations take their first steps in a virtual world and how they learn how to use them for educational purposes.

Many of the steps taken by schools, universities and other organizations entering a virtual world have been repeated over and over again by newcomers. Some of these steps may be seen as a need to understand the virtual environment and oneself, represented by an avatar in this new virtual environment. All the steps indicate how everybody are trying to understand the possibilities and the potential these new three dimensional environments may have in education. Some of the things happening in virtual worlds today remind of the early days of the web, which makes it possible to try to make some predictions of the future of virtual worlds and how they could be used in the future. While other steps and observations have raised some concerns for the future of educational use of virtual worlds and indicated some challenges that have to be overcome before virtual worlds can be fully used in education.

This paper will discuss some of these observations and their implications for the future development and evolution of virtual worlds in education and educational communities in them. The paper will present some examples but also discuss some of the concerns that current developments in virtual worlds have raised. However, the main goal of this paper is to share the knowledge created and the experiences learned in the EduFinland community of educators.

1. Virtual education

People use virtual worlds for a multitude of different reasons. Among the most important reasons are self-therapy (i.e. to increase self-esteem), as a source for instant pleasures, to escape social norms, for self expression and for exploration [4]. Interest towards educational use of virtual worlds has grown significantly around the world in the last few years and several scientific articles report on successful experiments and positive attitudes among students and teachers towards using virtual worlds in education [e.g. 5, 6, 7, 8]. In learning foreign languages virtual worlds have been found to improve motivation [9], while in health care education virtual worlds are perhaps best used in simulations where students can and are allowed to make mistakes in a risk-free environment [e.g. 10, 11, 12]. This is supported by some earlier research that has shown that virtual worlds can be very efficient as experiential learning environments where students can learn through experience and by doing [13]. Virtual worlds offer different possibilities for different disciplines and different topics. Some may use virtual worlds for simulations or to demonstrate something very abstract that would be difficult or even impossible to demonstrate in a traditional classroom while others can benefit from the tools for three dimensional building, but probably all can use virtual worlds to deliver lectures and to organize group discussions.

Lucia et al. [6] wrote that ”*learning is strongly related to the user perception of belonging to a learning community, as well as to the perception of awareness, presence and communication*”. In virtual worlds students feel the presence of other students represented by avatars [7] and they experience a sense of community which in best cases reflects in students teaching and guiding each other [14]. The experienced sense of presence and community in virtual worlds are perhaps the greatest benefits virtual worlds have to offer education. Especially in distance education it is very important that the students feel that they are not alone on the course and that they can meet other students. Another benefit that virtual worlds bring to distance education is that meetings and lectures in virtual worlds can substitute at least some of the face-to-face meetings that would often require that the students travel long distances. This is a benefit that many students have stated as a very positive thing about education in virtual worlds [15, 16]. Although several articles report on the possibilities of the virtual worlds there are only few reporting on dangers and challenges with virtual worlds. Boulos et al. [17] state that many of the same dangers and challenges that exist in the conventional web exist in virtual worlds as well, e.g. gambling, addiction, vandalism, identity and privacy issues, pornography, quality of information. But virtual worlds bring with them some new challenges as well. Hardware requirements and bandwidth issues are real concerns for the development of educational use of virtual worlds [17, 18]. Warburton [18] identified eight barriers in the use of Second Life and state that each of the barriers represents “*a challenge that requires the careful consideration of a number of design possibilities*”. These barriers include technical and economical issues, but also barriers related to the culture of virtual worlds and identity issues in them. Warburton

[18] means that virtual communities can be difficult to find and that it may be challenging to learn the norms and the etiquette of virtual worlds. Educators (and students) are facing several challenges that they have to overcome before virtual worlds can become part of everyday education.

2. Building of EduFinland community

Activity on EduFinland archipelago has grown rapidly after the first island was opened in spring 2008. New islands have been added and currently the EduFinland archipelago consists of 25 virtual islands and the EduFinland group in Second Life has over 400 members, all interested in the educational possibilities of virtual worlds. EduFinland offers educators a low-barrier entry to virtual worlds and a place to start investigating the educational possibilities of virtual worlds. For this purpose EduFinland rents virtual land for educators, provides support and organizes meetings and seminars of different types. Ever since the beginning the goal and purpose of EduFinland has been to gather people interested in the educational and learning possibilities of virtual worlds together and to promote interaction between people and avatars that are interested in similar things. By gathering people to the same area we can better learn from each other's mistakes and successes so that everyone do not have to repeat the same mistakes over and over again. EduFinland has also supported and guided teachers, and avatars, taking their first virtual steps in Second Life. The administrators of EduFinland have organized lectures, workshops, courses and networking meetings to meet these goals. Organizing such events is one of the keys in creating an active community and sense of community in a virtual world.

Many of the educators entering Second Life for the first time have heard about Second Life at a conference or a workshop somewhere or read an article about it and they have become curious about this new world. When they login to Second Life for the first time they are facing the same problem as everyone else: how to find something of interest in this vast virtual world and how to find other people. It can be very frustrating for newcomers to enter an empty virtual world and not immediately find anything of interest. This is where EduFinland comes in. EduFinland aims to be the starting point for people interested in education in virtual worlds and a place to find others interested in similar things. This first contact with a virtual world may be crucial for the future use of it. If the first visit gives a negative impression the person will probably never log in again. This is what EduFinland tries to prevent by creating a positive experience for those visiting Second Life for the first time. One way to succeed with that goal is to create different networking events where people can meet and find others interested in similar things.

Many educators worldwide are experimenting with the possibilities Second Life has to offer. This makes it a great place to meet others and to network. Through these meetings collaboration and perhaps even joint courses can be born. The networking opportunities are not restricted to the teachers alone; students can meet other students too. A student from a university in Finland is probably not likely to meet students from another university from Brazil or New Zealand, but when our virtual spaces are close to each other in Second Life it is even likely that they will meet. Currently the networking opportunities are perhaps the most important reason for educators to enter the virtual world. To promote networking the administrators of EduFinland have organized various networking events, such as Christmas and summer parties, but also seminars with a particular topic. The goal with organizing topical seminars and discussions (e.g. foreign languages, health care, archaeology, etc) is that people interested in that particular topic can enter Second Life and meet others interested in similar things and they can get advice on how to use Second Life in their own courses. The years of development of the EduFinland archipelago have taught that creating networking opportunities and providing guidance and support for newcomers are key factors when building up a vibrant community of educators in a virtual world.

3. Lessons learned

EduFinland has been a place where one have been able to watch closely how Finnish schools, universities and other non-profit organizations have started to use this virtual three-dimensional environment. It has been very interesting to notice that some of the steps and patterns have been repeated over and over again by newcomers. Some of these steps can be seen as attempts to understand this new virtual environment through creation of something familiar and something that can be understood with the knowledge and experience we have. Organizations are trying to bring sense in to an unfamiliar environment and controlling it by building familiar objects. Many organizations start by building a virtual house to protect the avatars from weather and from the view of other avatars. Weather does not change in Second Life and even if it did avatars or the persons behind the avatars would not get cold even if the climate on a certain island was programmed to be rainy and windy. Although there is an urban legend or a virtual legend about an event where the organizers had underestimated the number of attendees and hence they had not reserved enough chairs for all the participating avatars. This meant that some of the avatars had to stand through the whole event. According to the story, some of the people whose avatars had to stand talked with the organizers after the event and told them that they were physically tired because their avatars had to stand for a long time. The connection between the avatars and people behind them is strong and the experiences of the avatars can evidently be transferred to the persons behind the avatars.

To create a house as protection from other avatars' views may indicate that the builder of the house is not very familiar with Second Life, as experienced users of Second Life can easily see through walls and around corners, but building a house may also indicate something else than inexperience. Perhaps we are building houses because they are familiar to us. When we see a house, a chair or a coffee cup in Second Life we know what we can or are supposed to do with it, we understand what the object is and how it works. After all, these objects are familiar to us from the world outside Second Life. We know how to use familiar objects and we do not have to use a lot of time and energy to figure out what we are supposed to do with a certain object. Because of this it is logical and even necessary that we bring familiar objects and things to virtual worlds.

Understanding and controlling the environment should not take a lot of time and energy. We have to keep in mind that the virtual worlds that we use in education are tools just like Adobe ConnectPro or Moodle are and it should not take excessive amounts of time and effort to learn how to understand and use them. The virtual classrooms and other educational areas that we build should not be too complicated or futuristic because the students would have hard time understanding how to use and how to be in them. However, the classrooms should not be plain gray boxes either. In an ongoing research we have studied what kind of impact different virtual environments have on learning. Preliminary results indicate that students both liked more and learned better in an esthetically pleasing virtual environment than in a plain gray room without any stimulating objects. While we are trying to understand and learn more about the use and possibilities of virtual environments, we should build familiar and user-friendly spaces with familiar objects to help us understand and control these new environments better. On EduFinland the environment has been created to resemble summer time in Finland, which has been thought to be esthetically pleasing for most users. The administrators have built shared spaces such as lecture halls and discussion circles that anyone can use. These spaces have been built with accessibility in mind. Offering shared spaces also means that the educators do not have to build their own classrooms because they can use one of the already existing spaces. This has been another key factor when helping educators use virtual worlds.

Another very typical phenomenon that can be seen all over Second Life is that in the beginning everyone tries to build their own spaces. Some complete their building projects with amazing innovations while others soon realize that it may be better that they focus on functions and content instead and leave the building work to experts. Similar development could be seen in the early days of the web. At the end of the last millennium when the web was young everybody tried to code their own websites, with various successes. Today only few persons can actually code their own websites and it has become usual to hire a professional web designer for the job. A similar development can be seen in virtual worlds today. It is becoming more and more usual that organizations hire a professional builder that is an expert in designing and building three dimensional environments. Building in a virtual world is very different from coding web pages because the designer has a three dimensional space to work with. Building in Second Life requires besides mastering of different tools and software also some architectural knowledge. The builder also has to have an eye for interior design and exterior design. It is not enough to know how to build an authentic and esthetically pleasing tree, the designer also has to know where to place it so that the tree so that it looks good and helps people use the space. Already today we need people with these skills and in the future the demand will be even greater. As far as we know, currently there are no schools giving education in these skills, but the situation will hopefully change in the near future.

Some teachers have created so called “dummy-avatars” for their students to use during lectures. The benefit of using ready avatars is that the students do not have to create their own avatars, which saves some time. However, based on the experience from organizing numerous workshops and lectures about virtual worlds we have witnessed that it is through creating their own avatars and by modifying the avatars’ look that students create some kind of an emotional bond with their avatar. This bond between the avatar and the user is important for the sense of presence of others and to fully experience the immersive virtual world and this bond is something that cannot be achieved when using someone else’s avatar. Teachers should reserve enough time for the students to create and modify their own avatars and to slowly take their first virtual steps. On EduFinland we have noticed how newcomers first refer to their avatars as “that avatar” or simply “that”, but after a while this changes and they refer to their avatars as “I” or “me”. Anyone that enters a virtual world for the first time needs some time to explore the environment and to get familiar with their avatar. Only after that the students are ready to take part of lectures or group discussions. Using “dummy-avatars” may be a good option if the students are only attending a single lecture in a virtual world, but it is probably not the best way to use virtual worlds when the environment is used for a single lecture or for just a couple of lectures. It is not justified to use a tool for lectures that takes longer time to learn how to use than the lecture takes. There are other tools and methods that can be used to deliver single lectures and that are easier to use. Also the key benefits of virtual worlds are lost if the environment is accessed with someone else’s avatar and just for a single lecture. When virtual worlds are used in education they should be planned into the course schedule so that the key benefits of sense of presence and sense of community can be fully utilized.

Even though virtual environments successfully support synchronous communication and social interaction and create a sense of community [6], using virtual worlds such as Second Life in education clearly divides the students’ opinions [e.g. 15, 19]. Some of the students see new learning environments as a positive thing and they see the benefits of virtual worlds especially in distance education while other students are afraid that using virtual worlds may lead to decreased classroom education and less face-to-face meetings [15]. There may also be other reasons for the students to even refuse to use virtual worlds (e.g. lack of necessary computer skills, danger of addiction). This is something that every teacher has to be aware of when planning to use a virtual world in education. Should there be other possible ways of attending the lectures or can attendance in virtual worlds be required of every student? Virtual worlds have become such a huge part of so many people's lives (both professionally and for entertainment) that it is important to at least know something about them. Even though some students and teachers would refuse to use virtual worlds themselves, it is important that they are aware of these environments because chances are that someone close to them is already spending time in a virtual world.

4. Challenges to overcome

Another set of familiar things that we currently bring to the education in virtual worlds are the teaching methods we have found useful in traditional classrooms outside Second Life. We know that PowerPoint presentations can support lectures and deliver information in traditional classrooms and hence we bring them to Second Life. We know that different group discussions and various participatory teaching methods work outside Second Life and hence we have brought them to Second Life and we have noticed that they work in Second Life as well. For a long time already educators have been delivering lectures and organizing group discussions in Second Life and these have been working well. Lectures and group discussions are easy to set up and they do not require a lot of work or knowledge about the environment from the teacher or the student. Virtual classrooms are in fact not that different from traditional classrooms if they are used for synchronous meetings [14]. The only obvious difference is that everybody attending are represented by avatars. Traditional methods used in virtual worlds may bring some added value, or as Jones et al. [5] wrote: "*If 3-dimensional online learning environments can approach face-to-face classroom interaction and learning over low bandwidth Internet connections, then this approach merits serious consideration as a method to support interactive online classrooms and course delivery*". However, the three dimensional and freely modifiable spaces offer possibilities to do so much more. So far we have not seen many great examples where the teaching methods used would have been especially designed for a three dimensional virtual environment. We have mostly seen familiar and traditional methods that have been adapted to virtual worlds. There are only few examples where the three dimensionality of space and sound have been fully used to enhance the learning experience. One of the best examples is the already couple of years old Virtual Hallucinations [10]. Virtual Hallucinations is a space where two researchers have created a reality as two patients with schizophrenia have explained that they experience reality. By entering the space people can through their avatars experience the hallucinations that the two patients experience every day. A visit to this immersive space is definitely more educative than reading an article about the hallucinations experienced by the patients. We need more examples of that kind.

Perhaps it is still too early for us to really understand and be able to imagine all the possibilities virtual worlds have to offer education. Perhaps we are unable to think outside the famous box and create new innovative and participatory teaching methods that would benefit from the full potential of virtual worlds. For virtual worlds to become part of everyday education the next step we take must be to come up with ways to fully utilize the potential of these environments and to come up with innovations that support learning and teaching in virtual worlds. Some educators are becoming frustrated with the lack of development and unless we soon see significant development in that area educators will begin to leave virtual worlds.

Technical problems can also create frustration. Moving around in Second Life is not intuitive for most of the users [14] and the user interface of Second Life does not fit into the philosophy of a user-friendly environment very well as it does require some training to master. This problem will hopefully be solved when Second Life can be accessed with a web browser. This will be a much anticipated step of development that educators have been waiting for and it will lower the barrier to try the virtual world of Second Life in education and it will make educational use of it significantly easier. It will also lower the current equipment requirements that are huge obstacles in many classrooms around the world. Computer classrooms rarely have the latest graphic cards and quite often the computers are not able to draw the graphics Second Life requires. In many schools the computer support may be unwilling to install the software for one reason or the other. The policy of the school may prohibit the installation or the hardware requirements of Second Life are not met. Many educators on EduFinland have run into these kinds of problems in their organizations. Bandwidth is a real concern in many countries where the Internet penetration is still low. There are many obstacles in the way of virtual worlds to become an integrated part of education but many educators around the world are working to find solutions for these obstacles.

There are plenty of papers describing educational solutions and possibilities with virtual worlds, but not many questioning the hype and the actual situation. Second Life may not be the best possible tool for lectures and other teaching activities. According to Gilman et al. [e.g. 20] we experience the presence of others in a virtual world through the avatars, perhaps even in a deeper and closer way than when using e.g. video conference tools or telepresence rooms. We are immersed in the environment and we actually feel the presence of others in the same virtual place and this is something that is difficult to achieve with other learning environments. But is this reason enough to use Second life in education? Are the benefits greater than the efforts required to learn how to use the avatar and the environment to even find the way to the virtual classroom? Does the virtual environment bring some added value to the lectures? In some situations a traditional classroom or other teaching methods may be better [21], so why should we use virtual worlds? What kind of additional benefits do they bring? Is learning more efficient in a virtual world? Every educator should ask themselves these questions before organizing a class in a virtual world. It is important to carefully consider how a virtual world should be used in education and what added value using it may bring to the course at hand [22]. If the virtual world does not bring any added value to the course, then perhaps virtual worlds should not be used for that particular course. After all, the content of the course is the most important thing, not the tool that we are using to deliver the course.

5. Hope for the future

Every educator in Second Life and in other virtual worlds are experimenting with the environment and learning how to use it. We are taking the first steps towards a truly virtual education. We have not yet seen how virtual worlds can be used to their full potential, but we are on our way. We have seen some good examples of how virtual worlds can in some cases bring added value to education, but there is still a lot to be learned. Despite the hype and educational potential of virtual worlds it may take a long time before education will become truly virtual, but every experiment and even the mistakes that we make during our journey take us in the right direction; towards an efficient and innovative use of virtual worlds in education. Everything that we have done has taught us something and prepared us to face the future. Everything that we have done has taken us closer to the real innovations and new teaching methods that will integrate completely with virtual worlds utilizing their full potential. Tomorrow will be very interesting.

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Using Social Networks for Language Practice

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Abstract: The Internet has the potential to provide language learners with vast resources of authentic written, audio, and video materials to supplement lessons. Educators can find a vast amount of materials for learners to study during class or for independent learning outside of class to encourage learner autonomy. More recently, however, the immense popularity of social networking websites has created new opportunities for language learners to interact in authentic ways that were previously difficult to achieve. Advances in technology mean that today, learners of a language can easily interact with their peers in meaningful practice that helps foster language acquisition and motivation. That is, tasks that make use of Web 2.0 interactivity can significantly raise students' potential to generate meaningful output and stimulate their interest in language learning.

Keywords: Language learning, social networks, independent learning, meaningful output

Introduction

One of the main reasons for the immense popularity of social networking is the process of potentially maintaining and developing online relationships (Thorne, 2010). It is not only a way to view pictures of friends such as on Facebook, view short messages on Twitter, or post videos on YouTube, it is also of as a form of expression, interaction, and community building. An increasing number of educators and learners are making use of these tools to communicate outside of the classroom. Perhaps it is the emphasis on using the target language as a resource for building interpersonal relationships that differentiates it from traditional approaches to language learning pedagogy and provides an opportunity for success. Innovative and pedagogically effective ways to improve language learning include instructional uses, students' perceived learning gains, instructors' use of the technology, social impact and economic viability for use by the students (Facer and Abdous, 2011). In this workshop, I will introduce some of the pedagogical concepts outlined in this paper and discuss how they can be introduced in a language learning classroom.

1. Language Acquisition

1.1 Language Production

Generating language is an important part of the language acquisition process. Creating student-generated materials such as podcasts or videos is interesting to students and helps them to learn and acquire the language. According to Swain (2007), "The output hypothesis claims that the act of producing language (speaking or writing) constitutes, under certain circumstances, part of the process of second language learning." Thus,

encouraging students to speak and experiment with the language is an integral part of learning.
A Web-based learning environment can promote constructivist learning through authentic activities related to the vast amount of information available on the Internet. Instructors can provide students with access to a substantial variety of tasks available in a combination of formats, such as text, graphics, audio, and video. Moreover, these multimedia resources can contribute to an increase in students' motivation (Woo, Herrington, Agostinho, and Reeves, 2007).

1.2 Learning Constraints

Teachers often feel constrained by the lack of reading and listening materials that students have access to and the acute lack of opportunities in English as a foreign language (EFL) settings for students to practice their English speaking skills in a meaningful way. In Japanese universities, for example, students can commonly take one class (90 minutes) of English conversation per week over a 15-week term. Normally, there are two terms per academic year. Typically, most of the undergraduate students are busy with other classes, part-time jobs, and socializing with their friends. This is scarcely enough time for students to significantly improve their speaking skills. Therefore, it can be challenging to encourage students to practice their English language skills outside of class. To motivate students, it is indispensable to use materials that are relevant to the students' levels and needs. The Internet has helped to alleviate this restriction. More recently, due to the incredible processing power of modern computers and the fast transfer speeds provided through broadband Internet connections, sharing sound and video files has become a reality. Whereas just a few years ago Internet users were limited to reading and writing messages in text, the World Wide Web has come of age, and it is now routinely possible to send and receive the huge amounts of data required for audio and video files. This fact, as well as vast improvement in software development, has made it possible for English for speakers of other languages (ESOL) educators and language learners to make full use of the Internet to assist students with improving language skills.

2. Discussion

2.1 Social Networking Web sites

Social networking Web sites, such as YouTube, Twitter, and Facebook, have become extremely popular among Internet users who wish to share their ideas, videos, and other activities online (Dieu and Stevens, 2007). This contemporary phenomenon has led the World Wide Web in innovation, and the term Web 2.0 specifically applies to these types of services. These Web sites can be accessed easily; they are free and interesting to users. They are new tools for learners of English to express themselves in authentic ways. Teachers can support students with this type of social networking activity by having them practice a speech that they want to record before sharing it with the rest of the online community.

2.1.1 YouTube

A search on YouTube will reveal a number of ESL-related videos posted by teachers and students. These can be shown to students who are not confident about posting their videos on the Internet. The videos can also be used to promote discussions in class. Posting a video is not as difficult as it sounds, especially if computer resources are available to the teacher and students. Before recording the video, learners usually like to practice what they are going to say, thus encouraging language training without forcing the student to conduct repetitive drills. A wide variety of topics can be covered depending on the needs of the learner.

2.1.2 Twitter

Twitter is described as a social networking and microblogging service that users like to use for short messages of 140 characters in length (Tweeternet, 2011). The short format is a unique way of communicating that has captivated the creative minds of millions of users and it is an interesting method for students to keep in touch with each other as well as with the teacher. One possible lesson may start with a teacher telling a story to the learners. Then, the teacher instructs the students to continue the story. Another idea may be for the teacher to ask trivia questions, and the students attempt to answer them in class (ESL Daily, 2011).

2.1.3 Facebook

The most successful social networking site is Facebook. This Web site has hundreds of millions of users and it is an enticing way for students to form an online community. One of the problems, however, is the possibility of privacy infringement as students get more confident in their English writing skills and become more open to talk about their private lives online. It may be necessary for teachers and students to discuss some ground rules for using Facebook before starting to use it. This may save some embarrassment later when photographs are posted online. It is, however, an excellent way to communicate as the content that is posted to the site may motivate learners to share ideas and thoughts that would be very difficult to duplicate in a classroom setting. One way to get around the problem of sharing private information is to create an account with a fictitious name, a drawing of a face instead of a real picture and to develop a pseudonym personality. Using a temporary email account would also alleviate some of the issues of using a current email account that could attract unwanted requests. The character that is presented in the Facebook account could be very realistic and join groups as a real person, thus avoiding some of the privacy issues.

2.2 Podcasting

Developing a podcast is like planning a syllabus (Chartrand, 2009). There are quantitative elements to consider, such as how many lessons, how much time per lesson, and how much material to cover. There are qualitative elements as well: What level of language is appropriate for the learner? What are the goals, objectives, and needs of the learner? Therefore, questions that might be asked when producing a podcast may include: How many podcast episodes will be produced? How long will each episode last? Who will do the recording? These are some of the questions to ask when developing an original podcast for language learning. For example, one can anticipate producing English conversations for beginner, intermediate, and advanced level learners, respectively.

At the beginning level, one can anticipate that the English learner will not have good listening skills, therefore it may be useful to play each conversation three times: the first

time at normal speed, the second time at a slow speed so that the learners can hear each word pronounced clearly, and the third time at normal speed. This may facilitate the learner's understanding before going to the next step. Other levels of learning may need less intervention from natural speech.
Not everyone has the time or technical inclination to embark on the task of creating podcasts. There are, however, a large number of podcasts that could be used in ESOL classes for language input and speaking practice. Here are a few examples that are useful for learning English.

- http://www.breakingnewsenglish.com
  This podcast specializes in current events. It contains excellent materials for use in the classroom, such as warm-up activities, before and after reading-listening activities, a survey, discussion questions, and a writing task. It is read in British English.

- http: / /www.voanews.com/specialenglish
  This Web site from Voice of America contains many news items that are read by a VOA announcer in slow American English, so it is easy to understand for non-English speakers.

- http://a4esl.org/podcasts/
  This is a collection of links to the 30 newest podcasts for ESL learners. It contains a good source of information to see what's new.

3. Conclusion

There are a number of ways to use social networking Web sites to encourage ESOL students to listen and to produce their own materials to share on the Internet. This type of activity used to be very difficult to integrate into ESOL lessons due to costs and technical limitations; however, these barriers have slowly been fading, and it is now possible to use these online tools to improve students' English ability. This is useful, but challenges remain. There is a certain amount of time needed for teachers and students to learn how to use Web 2.0 technology. Even if one is familiar with computers, there is still a need to learn how to use software, to search for podcasts, and set-up accounts with social networking Web sites. Additionally, the privacy issues of using social networking are a cause for concern. The security and privacy requirements of these sites are complicated and not well understood or defined (Ahn, Shehab and Squicciarini, 2011). Thus it may become necessary for teachers to become knowledgeable in security policies on the shared data of students.
A number of students do not enjoy learning with computers and do not attempt to study outside the classroom. But this is likely true no matter what medium is used for instructional delivery. It is sometimes difficult to keep up with all the latest trends and techniques, however, this is a very positive trend for both teachers and students of languages, and learning how to use this technology will allow learners to develop communicative language skills more effectively.
Language learners through new technologies can produce meaningful output. They are easy to use, inexpensive, and readily available through the Internet. Motivational, pedagogical, and affective factors are persuasive arguments for making an effort to

experiment with this technology, and ESOL teachers can contribute significantly to their learners' progress in learning English.

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Computer-assisted Learning of Chinese Language and Culture: about the National Palace Museum Digital Archives

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Abstract: This study proposes utilizing the extensive Chinese cultural resources available in the digital archives of the National Palace Museum, together with the concepts of indicators of Chinese language proficiency and graded vocabulary, as the basis for preparing cultural teaching materials which integrate the Chinese art in the National Palace Museum into Chinese language education. Investigations will be made into how to connect the Chinese art in the National Palace Museum with everyday activities. Combined with Taiwan's high quality digital technology in teaching, this will aid in developing digital Chinese language and cultural teaching materials.

Keywords: Digital learning; Chinese language teaching; digital teaching material; cultural teaching materials; Chinese art in the National Palace Museum

1. Research Background

In recent years, Chinese expatriates and scholars have been calling for the inclusion of the Chinese art in the National Palace Museum in Chinese language teaching, in the hopes that Chinese language learning could include cultural awareness and Chinese heritage, instead of being limited to language acquisition (Tsai, 2011).

This study proposes using the extensive Chinese cultural resources available in the digital archives of the National Palace Museum, together with the concepts of indicators of Chinese language proficiency and graded vocabulary (Tsai, 2009), as the basis for preparing cultural teaching materials with the incorporation of the Chinese art of the National Palace Museum into Chinese language education. This study will link the National Palace Museum to everyday activities, and integrate it with Taiwan's high quality digital teaching technology to develop digital teaching materials for Chinese language and cultural education, in addition to the application (app) design and operation of smart phones.

2. Research Purpose

The main purposes of this research are to:

1. Integrate data from the National Palace Museum digital archives, and establish classifications for Chinese language by daily activities and cultural topics.
2. Prepare traditional and digital teaching materials for Chinese material life and cultural courses for Levels A2 and B1.
3. Develop a National Palace Museum Chinese language and culture app course.

3. Methodology

In terms of *Classical Conditioning Theory* (Pavlov,1927/1960) and Jerome Bruner's *spiral curriculum for teaching and learning* (Bruner,1960). Accordingly, the connection between dominated materials and meaning would be developed as an approach to help learner's language learning; meanwhile, the theory of spiral curriculum is also being considered in material designing. The description of the learning materials are as follows:

3.1 Digital Chinese Language and Cultural Teaching Materials

The basic structure of the content for digital teaching materials is as below:

1. Beginner level (Level A2) conversations
2. Intermediate level (Level B1) conversations

In the text for the above conversations, there will be new words, sentence structures, and small exercises to follow. Among these conversations, another compilation called "speak Chinese, talk culture" contains content that is aimed at Chinese culture, to allow the learner to be able to familiarize his or herself with the Chinese society and culture.

3. National Palace Museum Happy Go!

The content will include comparisons between cultures, and how culture affects lifestyle. As the main aim of this section is to introduce the learners to relics in the National Palace Museum, the introduction content and level of language will be of a higher standard than the other texts in the teaching material.

4. Practical idioms

For learners to quickly understand the idioms and apply them in everyday life, this section couples the selected themes with relevant idioms, and presents them with supplementary images of the scenario.

Figure 1 shows the paper Chinese language teaching materials.

目錄

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A2		B1		學習單	
02	交通工具	42	交通工具	85	交通工具學習單
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10	食物	50	食物	90	食物學習單
14	餐具	54	餐具	93	餐具學習單
18	職業	58	職業	97	職業學習單
22	衣物	62	衣物	99	衣物學習單
26	金錢	65	金錢	100	金錢學習單
30	休閒活動	70	休閒活動	104	休閒活動學習單
34	居家設備	74	居家設備	107	居家設備學習單
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A2 季節

【二、文化課文】

①古代的中國，畫家習慣用簡單的②筆法畫出大自然的③風光；例如，在④「鵲華秋色圖」裡，我們從紅色、黃色的葉子，和⑤光禿禿的樹枝可以知道這是秋天的景色。另外，這⑥幅畫主要使用紅色、⑦青色、黃色等顏色，讓看畫的人⑧一眼就感受到秋天⑨寧靜涼爽的感覺。

【生詞表】

編號	生詞	漢語拼音	詞性	英文解釋
1	古代	gǔdài	adj.	ancient times
2	筆法	bǐfǎ	n.	technique of writing, calligraphy or drawing
3	風光	fēngguāng	n.	scenery
4	鵲華秋色圖	quèhuá qiūsètú	n.	Autumn Colors on the Chiao and Hua Mountains
5	光禿禿	guāngtūtū	adj.	bare;bald
6	幅	fú	n.	a word used to quantify pictures
7	青色	qīngsè	n.	cyan
8	一眼	yìyǎn	n.	a glance
9	寧靜	níngjìng	adj.	tranquil

【句型】

從……可以知道

1.從他的表情可以知道，他正在擔心他的妹妹。

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Figure 1 Table of contents

3.2 *Teaching tools-Apps*

From the Mac OS X Human Interface Guidelines (Mac OS X Developer Library, 2010), it can be seen that the concept of attaching importance to a product as a whole necessitates three important principles: (1) Having a clear theme; (2) attracting attention; and (3) having only one theme. When designing an educational app, the focus is not in whether there are sufficient functions to apply to daily activities, but in providing a good learning experience to the learner. To achieve the above requirements, we believe that the educational apps should develop from the perspective of learners and pay attention to three points, “Visual and operational focus”, “The concept of spatial perception”, “The use of custom design”. Figure 2 shows the interface of APPs.

Figure 2 Interface of Apps

3.3 Learning platform: smart phone

In terms of the functions of smart-phone, CSL learners are able to implement learning Chinese whenever and wherever they are available. This study is specifically approach to human interface, which could help users easily to access learning by smart-phone.

4. Conclusion

This study was aimed at developing Chinese language learning in means of Chinese culture. Therefore, the teaching materials of integrating Chinese culture derived from National Palace Museum with digital technology have been produced to benefit further CSL learning.The cultural resources in the National Palace Museum have been analyzed and reorganized, and a curriculum outline has been created. In addition, the research team extends further and reinterprets digital teaching materials to produce portable learning tool via Apps. This allows the content to appear in a simplified and accessible manner, being simultaneously rich with learning content. As the language teaching materials utilize everyday scenarios as the central focus to execute developmental design, when combined with App tools, it is believed that it will more deeply penetrate learners’ lives.

For further stage, this study will implement experimental study in CSL classrooms to investigate whether the material of National Palace app is available and helpful for CSL learners.

Acknowledgements

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Can Instant Message Agent Enhance Foreign Language Learning?

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Abstract: In today's highly globalized society, English is an important language to communicate with others. But English learning can not be sustained. This study developed an instant messaging system of English learning as the agent to help English learning become an ongoing activity. In this study, 98 college students were divided into a total of three groups, experimental A, B and the control group. The students in group A interact with instant messaging agents for real-time online interactive English tests, the students in group B learn English by the one-way instant messaging agents testing materials, and the control group use traditional learning methods. The experiments were conducted four weeks, and the results of the three different groups made no significant difference in learning outcomes. In addition, this study also discusses about the technology acceptance model(TAM) of using the instant messaging agents for the English language learning; the results showed that learners generally considered this system of the instant messaging agent is easy to use and can help learning English.

Keyword: instant messaging, learning English, instant messaging agents.

Introduction

In today's globally internationalized society, English has become an important communicative tool, but students seem to have poor performance in learning English, and the possibility of such result is that most students study English only for tests, students do not use English in their daily life, we do not have an environment of learning English, and the motivation of learning English is low. Masgoret & Gardner in the 2003 study showed that motivation is an important factor affecting learning. Therefore, we consider it necessary to create the external force to maintain the student's motivation of learning English.

Instant messaging software is very popular in recent years, and its value is real-time and low cost. The learner can be real-time to learn English online through the assistance of instant messaging software, even if the learner is offline, because the system can unilaterally send materials to the learner. The study of Herbsleb et al in 2000 told us that in the workplace of using instant messaging software, it can improve learning efficiency, save time and cost less. According to creating inter-city survey in

2010, Microsoft's MSN (Microsoft Network) launching in 1995 is the most popular instant messaging software. IM agents (Instant Message Agent) provide real-time information for the media inquiry service, and this research uses this system to maintain learner's motivation to increase the interaction between agents and learners. In addition, using instant messaging agents, compared with traditional English learning, can also break the restrictions of time and space.

This study uses instant messaging software, MSN, developing an agent system for helping English leaning, to explore the real-time communication, and also uses one-way delivery of learning materials to see whether it can possibly improve students' learning. Also, by using the technology acceptance model (Technology Acceptance Model, TAM) architecture (Davis, 1989) gets better understanding about learners' acceptance and the effectiveness of TAM.

1. Related Research

Instant messaging software provides users with a peer-to-peer written communication environment via the internet (Rebecca and Leysia, 2002). In addition to passing the text, the software also integrates different functions, such as sending emails and transmitting files. In Goldsborough's study in 2000, it was also mentioned that instant messaging software could become an informal communication channel in an organization.

Instant messaging and communications software agents provide real-time information of inquiry service; therefore, what users need to do is to add IM agent's account in the contact list and then they can query timely information though it. This study uses the MSN instant messaging agents systems, used by more people, and the value of real-time and low cost of this system appears.

Hwang, Huang and Wu in their study in 2009 used timely communication of agents in learning. They developed a platform using MSN Agent for the learning communities to promote interaction among students and increase learning. As a result, although such a system did not significantly enhance the learners' learning, it was found that students could accept this system easily because it was easy to use.

Ajzen & Fishbein's study in 1975 put forward the Theory of Reasoned Action (TRA), trying to understand human behavior and predict it. Davis in 1989, adding the modified technology acceptance model (TAM) which was based on the TRA, offered the information systems technology to predict user behavior. The TAM offered two points, including the perceived usefulness and the perceived ease of use: the perceived usefulness is defined as the user in a particular system can save trouble but increase their level of job performance, and the perceived ease of use is defined as the user in a particular system can save efforts but increase effectiveness. Elena & Detmar in 1999 used TAM to discuss about users' acceptance situation of using e-mails. The results showed that users' acceptance of using emails would influence the perceived usefulness, and furthermore, the perceived usefulness would be trading with the perception of the perceived ease of use. The study of Leader et al (2000) found that TAM fit the case of World Wide Web, showing ease of understanding and ease of finding could predict cognitive easy versatility, and the quality of information could predict the perceived usefulness.

According to the above studies, we might find although MSN agent did not obviously benefit the English learning, MSN could possibly increase interactions in Students' English learning because of students' high acceptance of MSN. As a result, MSN could be expected to be a good tool of elevating motivation of students' English leaning.

2. Research Method

2.1 Experimental Design

The purpose of this research is to understand the learning effect If the agent system is used as a platform for English learning. The Experiment adopting quasi- experimental method is divided into three groups, the experimental groups A, B and the control group included. In group A, agents directly interact with students online, sending tests to the users and giving immediate feedback to them. In group B, agents, not interacting with the users directly, send one-way teaching materials, and give answers and feedback regularly. In control group, the users learn English in a traditional way.

2.2 Experimental Subjects

College students with a total of 98 are divided into three groups, 33 in group A, 34 in group B, and 31 in control group.

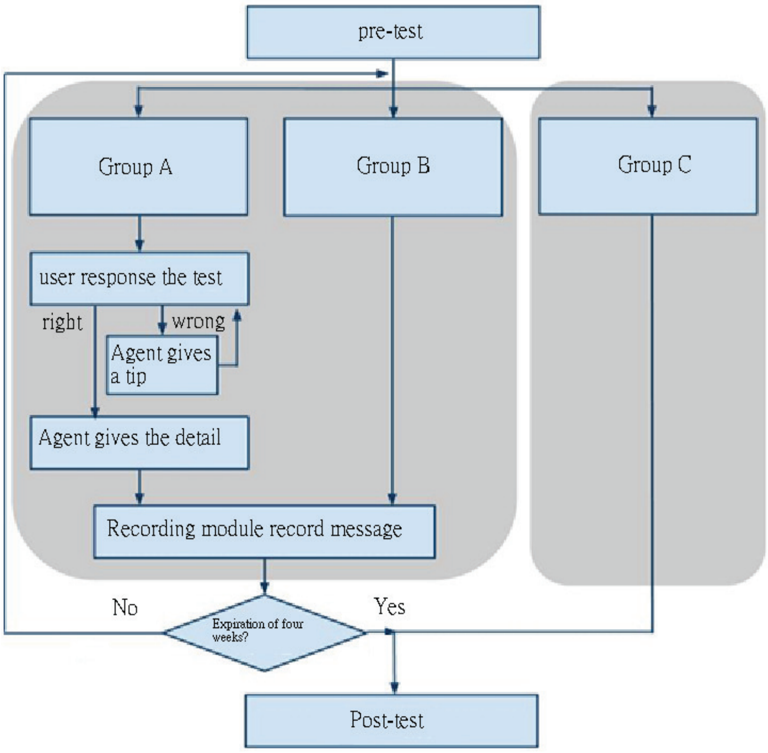

Figure 1, Experimental process

2.3 Research Process

Figure 1 shows the experimental process. We have pre-test before the experiment, then each group take a different learning strategies for English learning. The experiment lasts for four weeks, and we have the post-test later.

2.4 IM Agent English Learning System

This study uses instant messaging agent under C # programming language development system, including three models, messaging, contact management, and conversation recording, shown in Figure 2. The following keeps detailed description of the functions of each module.

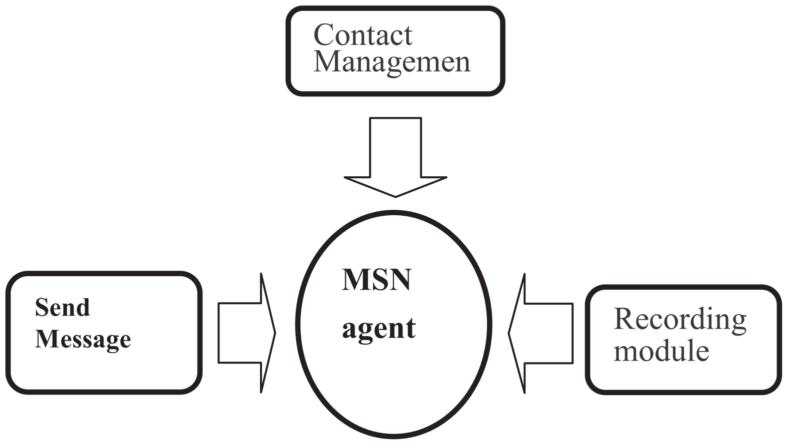

Figure 2, The models of system

The module sends messages in two different ways for the users in group A and B. In group A, the system sends learning materials and tests according to the users' learning status. In group B, the system sends learning materials in a fixed time per day and leaves offline messages to the users if the users are not online. Contact Management module provides a contact list, able to divide users into different groups, make history inquiries of on-line, manage schedule, and add or delete contacts on the list. Dialogue recording module keeps a complete record of the dialogues between the users and the agents for our future reference.

2.5 Technology Acceptance Model

Technology Acceptance Model is divided into four dimensions, including the perceived usefulness, the perceived ease of use, the users' attitude and the users' willingness of using this system. This study adopts Likert scale five-point test and the four dimensions are explored further as following.

First, the Perceived usefulness means the users' feeling of usefulness about English learning after receiving materials and tests sent from agents. This study defines it as "the users think learning materials sent from agents are significantly helpful to their learning." This part of the questionnaire scale is modified from Davis (1989) and Legris et al. (2003).

Secondly, the Perceived ease of use represents the users' feeling of ease to use learning materials sent from this system. In other words, the study defines it as "the learners think learning materials sent from agents are easy to use." This part of the questionnaire is modified from Davis (1989) and Legris et al. (2003).

Thirdly, Users' attitude is about their attitudes toward learning materials sent from agents. This study defines it as "the individual learner preferences of using instant messaging to receive learning materials." This part of the questionnaire is modified from Moon and Kim (2001), and van der Heijden (2003).

Last, users' Willingness of using this system measures the learners' willingness of using this system. This study defines it as "learners are volunteers to use this system for the future further learning. This part of the scale is modified from Moon and Kim (2001), van der Heijden (2003), and Wu and Wang (2005).

3. Results and Discussion

The collected information gets further analysis in this part to verify statistical methods to see whether the results of the experiment proposed hypothesis. Table 1 is about the

average and standard deviation between pre-test and post-test in the experimental group A and B, and control group. Table 2 shows the results of ANCOVA analysis in three groups, A, B and C.
Table 1, compare three results of using different learning strategies in three groups Group N pre-test post-test correction the average standard deviation the average standard deviation

Table 1. average and standard deviation between pre-test and post-test

Category	N	pre-test		post-test		adjust average
		average	SE	average	SE	
Interaction	33	73.4	4.74	84.52	7.85	84.52
One-way	34	71.06	4.31	80.79	7.64	80.79
Traditional	31	73.16	6.86	80.75	7.23	80.75

Table 2. the results of ANCOVA analysis in three groups

source of variation	squared	freedom	average squared	F value	significance
Groups	188.578	2	94.289	1.937	0.15
Error	4235.961	87	48.689		

Table 1 shows the results from three groups of learning. There is no significant difference in scores (F = 2.89, p = 0.093). Although the post-test scores in the Interactive group (M = 84.52) is slightly higher than the one-way (M = 80.79) or the traditional (M = 80.75), it does not differ significantly. It means that different learning strategies do not promise significantly different learning outcomes. The possible reason of causing this result may be due to the too simple test for students, and therefore we can not tell any difference from the results.
Table 3 shows that the independent variables is divided into two groups, test variables are the perceived usefulness, the perceived ease of use, the users' attitude as well as the users' intention of using this system, and this study uses an independent sample t-test to test the differences. From the point of view of the Perceived usefulness, there are significant differences between the two groups, A and B; that is to say, students in group B think this system is more useful than students in group A. About the perceived ease of use, there is no significant difference in terms of two groups, A and B, but the average is greater than 3.45; it indicates that students generally consider timely communication agent is easy to use. About the learners' Attitude of using this system, there is no significant difference between the two groups, but the average is higher than 3.4, which implies that learners recognize the value of this system. From the point of view of Willingness of using this system, no significant difference is shown between groups A and B.

Table 3. Different learning strategies differences

	Group	N	Average	SD	t value
Perceived usefulness	A	25	3.224	.6071	-2.220*
	B	34	3.541	.4900	
Perceived ease-of-use	A	25	3.4450	.47198	-1.731
	B	34	3.6838	.55837	
attitudes	A	25	3.4750	.53033	0.258
	B	34	3.4375	.56512	

intentions	A	25	3.08000	.639295	-0.445
	B	34	3.15074	.576348	

4. Conclusions and Recommendations

In this study, the aim of using this MSN instant messaging agent is to enhance learners' motivation. From the results of the experiments, it is shown that learners generally keep positive thinking about this system, but there are still many deficiencies in this study, waiting for improvement. In terms of interaction in this system, this system uses a simple command input interface for users, and therefore, the interaction between agents and learners is somewhat weak.

Furthermore, speaking of the services in this agent system, the number of passing words through MSN is inevitably limited owning to the restrictions of the MSN instant messaging software. Also, the users in client-side encounter their difficulties of accessing data. In the future research, we believe that through the appropriate library to develop plug-in, embedded Web pages to show materials, and recording more detailed interactions between agents and users are good ways of obtaining more specific results.

Acknowledgments

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The Influences of Online Virtual situated environment to Chinese learning community

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Abstract: This research used online virtual environment to create and develop a Chinese learning community. The research wanted to know if the community can help the Chinese learners enhance their oral Chinese communication skills, and if community can influence members' behaviors of their Chinese speaking and teaching. The research used action research to find out that virtual environment can provide a community, and this community can enhance learners' Chinese competence, and future Chinese teachers' instruction and leading skills.

Keywords: Community, Chinese communication skills, virtual environment

Introduction

Graddol [3] has forecasted in the years of 2050 Chinese is still remaining as the world's largest language. Many Chinese learners, outside of Chinese speaking countries, have trouble to obtain learning resources[11], and many language theory believe that learning language should includes, open, epistemic, and scaffolding features[4] [10]. In this case, we have to ask ourselves: How can we embed the language theory belief into the Chinese learning?

According to the demand of Chinese learning market, many online and virtual learning environments have developed. These environments not only can make up the problems of Chinese learners obtaining learning resources outside of Chinese speaking countries, but also learners can adjust their learning progress independently. These environments open an open, epistemic and scaffolding learning space.

This research believe that online and virtual learning environment can provide the needs for Chinese learning market, and the research also study the theory of language acquisition. Many scholars believe that language acquisition is the innate process[1] [4]. If we can input appropriate language in situation, students' language acquisition can be happened[4]. The research believes that language acquisition can be nature and innate, learning can occur in a situational context.

Therefore, the research follow situated learning theory and try to provide an open, epistemic and scaffolding learning community on virtual environment. The purpose of this study showed as followed:

1. The research wanted to see if the community can help the Chinese learners enhance their oral Chinese communication skills.
2. The research wanted to see the community members' behaviors changing of Chinese speaking and teaching.

1. Literature Review

1.1 Language Acquisition

Different theory showed different ideas of language acquisition. The table 1 showed different beliefs in language acquisition.

Table 1 Different belief on Language acquisition

Theory	Belief on language acquisition
Behaviorism	Language can be acquired by stimuli, reinforcement, and operation[7].
Cognitivism	Language acquisition goes through the meaningful inquisition process. Learners would revise their intrinsic language until their oral presentation can fit the external environment [6].
Humanism	Language acquisition is entirely innate. Language learning is the potential of human development; it is a spontaneous progress [1].
Social constructionism	Society itself would provide the language experience; the society can scaffold learners' language and thought [10].

According the statement above, many scholars believe that language acquisition is the innate and social process[1] [10]. Language acquisition is like the concept of i+1. If we can input appropriate language in situation, students' language acquisition can be happened[4]. The research believes language acquisition can be nature and innate, learning can occur in a situational context.

1.2 Situated Learning Theory

According to the belief of language acquisition, the research followed situated learning theory and tried to provide an open, epistemic and scaffolding learning community on virtual environment. Situated learning theory believes that knowledge comes from situation and interaction[5] [8] [9]. The following table showed each scholar's perspective of situated learning.

Table 2 perspectives of situated learning

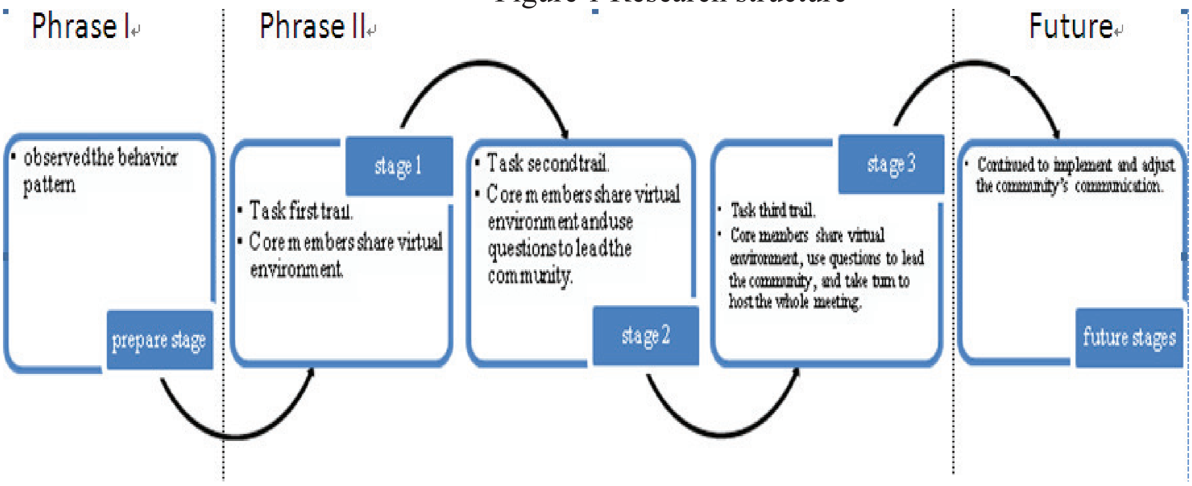
Perspectives	Related terms
Specialized situations have distinctive quality and the instability; therefore, the instructors or educational workers need to make decision in the practical situation [8].	Knowing in action, reflection in action, reflection on action, and reflective practicum [8].
Knowledge cannot occur alone without any situation. If the knowledge is not related to the	Situated action [9]

situation, the knowledge itself would become obscure and lacking details or specifics [9].	
Learning can go through situation to be practical and reflective, but it is more important to have the community in the situation [5].	Community of practice, legitimate peripheral participation, and apprenticeship [5].

2. Research Methodology

This research used action research methodology. The process of action research needs to contain four steps: plans, action, observation, and reflection [2]. According to that, the researcher had developed the structure as followed:

Figure 1 Research structure



The research provided a Chinese learning community, all the conversation is using Chinese to communicate. The community included two groups of people. One group was called core members group. The other group was called peripheral members group. The core members were future Chinese teachers in Taiwan and their background were the universities students who study Chinese language education. The peripheral members were Chinese learners. These learners came from different places, such as Japan, America, and Canada. There were total of five core members and four peripheral members (The researcher is considered the core member and community leader). Before all the peripheral members joined the community, we had tested their Chinese level, most of their Chinese level were considered as Basic to Intermediate level (Test materials followed TOP: http://www.sc-top.org.tw/).

In order to have great communication channel, the community used two technical tools. One is Facebook, the other is Second Life. The Facebook is for asynchronous communication, and Second Life is for synchronous and situational based communication. Each week, the community would have a meeting on Second Life, and the community would have a topic for all of members to interact and communicate.

3. Research results

This research video recorded all the conversation in the Second Life. Each week, the researcher would revise and calculate the frequency of behavior patterns. The behaviors patterns were showed as table 3 and 4.

Table 3 Behaviors patterns for core members

Core members	
Category	**Behavior**
C1: Explanation	B1: Core members can consider other member's level to explain a topic.
	B2: Core members can listen to others' question and make appropriate explanation.
	B3: Core members can understand members' experience to make a related interaction.
	B4: Core members can adjust other's Chinese grammar mistake.
C2: Assistance	B5: Core members can assist other members to use technology.
	B6: Core members can assist other members who have trouble to finish the whole sentences.
	B7: Core members can assist other members to define the new vocabulary.
C3: Leadership	B8: Core members can prepare a topic to share with others member.
	B9: Core members can care about others.
	B10: Core members can jump in the conversation to open a new related topic.
	B11: Core members can use others' experiences to ask questions

Table 4 Behaviors patterns for Peripheral members

Peripheral members	
Category	**Behavior**
C4: Expression	B12: Peripheral members can use telegram sentence to talk (only use key words).
	B13: Peripheral members can type Chinese characters.
	B14: Peripheral members can use complex sentences to talk (they combined two or more sentences together).
	B15: Peripheral members can use simple sentence to talk (the sentence has subject, verb, and object).
	B16: Peripheral members can use an adjective.
	B17: Peripheral members can use Chinese to explain the vocabulary.
C5:Listening and Answering	B18: Peripheral members can answer alternative questions.
	B19: Peripheral members can answer the question which only has one correct answer.
	B20: Peripheral members can answer the question to describe experience.
	B21: Peripheral members can answer the question to describe phenomenon.
	B22: Peripheral members can answer the question which needs them to describe thought.
	B23: If peripheral members don't understand the question, they will show they don't understand
	B24: If peripheral members don't understand the question, they will find the problem and ask again.
	B25: If peripheral members don't understand the question, they

Peripheral members	
Category	Behavior
	won't tell until core members found out.
C6: Initiative participation	B26: Peripheral members will ask question initiatively.
	B27: Peripheral members will share information initiatively.
	B28: Peripheral members will share their thoughts initiatively.
	B29: Peripheral members will share their experiences initiatively.

These behavior patterns were observed and calculated the frequency each meeting. According to the behavior patterns' frequency result and the resaercher's observation, the research have found that different phrases and stages have different behaviors and reactions. The table 5 had shown the different phrases and stages' reactions.

Table 5 research results

Phrases	Stages	Members' reactions	Behaviors patterns
I. Pilot study	Prepare	1. Some members got frustrated to the technical problems. *(I am very angry at my computer now!!).* *(I think I will try again next time).* *(I have no idea how to use Second Life).* 2. Peripheral members used Chinese to introduce themselves *(My name is XXX, I learn Chinese for 2 years, I am a OOO's student, it is very nice to see you all).* 3. Core members did not show much sentences when introducing themselves to the community. *(My name is OOO).* *(I am XXX).*	1. Core members showed high frequencies on B5 (around 16-17 times each meeting), however, other behaviors turn out very low (around 0-2 times). 2. Peripheral members showed some frequencies on B12, 13,15, 27 (around 5-6 times each item).
II. Real Experiment	Stage 1	1. Core members shared the virtual setting on related topic, and they used lecture to interact in the community. 2. Peripheral members did not have much chance to interact in the community. *(Core members: The story of Chinese New year is related to…).* *(Core members: It is a building from Greece culture, it has….).* 3. Peripheral members used private message to tell the community leader their	1. Core members showed high frequency on B8 (above 30 times each meeting), but other behaviors turn out zero. 2. Peripheral members showed a little frequency on B18 (around 1-2 times). Most of these behaviors are yes/no answer.

	difficulty to communicate in the community *(I think it is too hard….).* 4. The community leader decided to have a community meeting and discussed the way of interaction. *(In the meeting, leader asked "Do you think it is interested in this community's interaction?" one of core members answered: "No." The leader reflected "Why do you think it is not interested?" core member: "Because the topic is not related to our life, and also we talk too much") .* 5. After the meeting, the community all agreed to use life-related questions to interact.	
Stage 2	1. Core members started to use questions to lead the community's conversation. *(What is your favorite music? Why?)* *(Do you think there is different than the rock music you just listen? What is the difference?)* *(Do you Second Life avatar dress just like you usually dress?)* 2. Peripheral members began to share a lot of experiences and information to our community. *(I don't like to listen techno music, because my ex girl friend love to listen it).* *(My dad is a great guitar player, I am just ok. Do you all want to listen my guitar music?) And he started to get a guitar to play a song for the community.* 3. The community leader and core members discussed and agreed that core members can start to lead and host the meeting, and community leader will become one of the regular core members.	1. Core members began to show frequencies on B1-B4 (around 8-9 times each items) , some frequencies on B6, 7, 11 (around 5 times each meeting) and B9 (one time in one meeting). 2. Peripheral members stared to have a lot of behaviors on B12, 14, 15, 16, 20, 21, 22(around 4-7 times each meeting), B23, 25 shows their needs (around 2-3 times) and shows some initiative participation, such as B27-29 (around 2-3 times).
Stage 3	1. Core members took turn to host and lead the community by themselves.	1. Most core members' behaviors'

		(Welcome to our community, today we are going to talk about lecture time, what did you do for your lecture time?) 2. Peripheral members still keep the same reaction behaviors from stage2. *(I like to play tennis with my classmates, and we usually play at night).*	frequencies still remained the same from stage 2, but B1-4's frequencies grow (around 15-16 times per items per meeting). 2. Peripheral members' behaviors frequencies still remain the same from stage 2.
Future	Future	The meeting will keep continued, and the behavior patterns and their behaviors' frequency will keep calculated in the future.	

Figure 2 Implemented condition for real experiment stage 2

Figure 3 Implemented condition for real experiment stage 3

4. Conclusion

Learning a second language require many aspects, the researchers believe that virtual environment can help Chinese learners and future Chinese instructors to create a community for practice speaking and teaching, therefore, all of the community members are growing and developing. The main purpose of community practice is when all the community members can grow and develop in the same time, and this is the main reason for this research.

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Learning in Social Interaction: Two Snapshots in EFL Literature Classes

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Abstract: This paper is a longitudinal study reporting how learning communities (LCs) and online learning communities (OLCs) can be used to solve Taiwanese EFL students' lack of social interactions (spoken and written) and academic skills (academic writing and reading) in literature classes (N=40) by involving students in a social process to encourage students-students and students-instructor discussion, interpretation, production and negotiation in English. A 5-point Likert scale questionnaire designed by the university was used to assess students' learning performance and satisfaction levels. The paper concludes with a discussion of the relative contribution of social interactions to satisfy students' learning needs.
Keywords: learning communities, online learning communities, social interactions, collaborative learning, learning management system

1. Introduction

With the intention of overcoming the language problems (English) and difficulties in collaborative learning in EFL Literature classes, the researcher set about implementing an alternate "social interaction model" to teach Introduction to Western Literature for English majors at National Dong Hwa University, Taiwan (NDHU, N=40 out of 45/42, 2 semesters) by organising learning communities (LCs) and online learning communities (OLCs) embedded in the university learning management system (LMS). It focused on developing OLCs based on the same principles for developing face-to-face LCs' spoken communication by capitalising on technology's affordance for written communication. This involved students in learning "social interactions (spoken and written)" which can be viewed as a set of process in achieving group work and academic skills (academic writing and reading). This in fact means each student was required to develop approaches to solve the problems in spoken communication in English and implement a solution to the approaches that would result in the production of a concrete written knowledge in language, literature and critical thinking collaboratively. Each single student's performance was traced and recorded by the LMS and was compared to see how LCs and OLCs help students improve their ability in language problem solving, and how they respond to their LC and OLC tasks.

2 Literature Review

2.1 Social Interactions

Dewey's (1987) belief in the power of social interactions in learning still influences many contemporary educational approaches. However, due to the vast change of educational environment, social interactions are used to question if students can grow personally and learn academically without face-to-face interactions with instructors and peers? Social interaction is defined as participating in social networks, so that higher levels of network participation can be labelled as higher levels of social multiplier. A research by Slevin (2008) indicates that e-Learning and the transformation of social interactions in higher education brought challenges for educators. Despite the difference in the pedagogical mediums, the interactive component and the differences in interactions between the traditional and Web-based pedagogical platforms, a vital need is to assess the effectiveness of interactivity in a web-based course. Students who feel a sense of connectedness and psychological closeness rather than isolation are better prepared to become more actively involved with online learning and the resulting higher order thinking and knowledge building (Baker, 2010; Engstrom, Santo, & Yost, 2008).

2.2 Learning Communities (LCs)

Lave and Wenger (1991) exclaim that learning is a social practice because a learner learns better in social settings and through social interaction which underpins Dewey's (1938) recognition of the importance of the social nature of learning. The growth of interest in learning communities within schools has been accredited to the findings of research in the 1970s and 1980s conducted into "effective schools" and shaped the "concept of school as community" (Larrivee, 2000, p. 18). A learning community not only facilitates the sharing of information or knowledge, but has the potential to create new knowledge that can benefit the community as a whole. However, when emerging research in cognitive science, the importance of the learning context and developing schema permit new learning through making connections with what was previously determined to be valid under specific conditions and contexts. The increased opportunities afforded by learning communities for peer learning and interaction allow for the development of richer, complex ways of thinking and knowing so that students learn at a deeper level (Bransford et al., 2000).

2.3 Online Learning Communities (OLCs)

Rovai (2002) and Carlen and Jobring (2005) suggest that an OLC is based on what groups of people share and do with one another, not how or where they do them. Engestrom (1993) illustrates that an OLC can be seen as a developed activity system in which a group of learners, unified by a common cause and empowered by a virtual environment, engage in collaborative learning within an atmosphere of trust and commitment. Despite an increasing interest and promise in implementing OLCs, a study by Bagherian and Thorngate (2000) show a failure of using OLCs at Carleton University (The *Carleton Hotline for Administration and Teaching*, or CHAT) because they could not recognise any educational values. Between the extremes are several contingent possibilities that different features of the Internet might be pedagogically useful for different combinations of students, course topics, and learning objectives. The challenge educators face first is how to best enable students to communicate, collaborate, and coordinate so as to facilitate knowledge capture and use online. The second issue needs to be taken carefully is the social interactions when the educators look forward to maximise technology integration in education. OLCs are not a network focused on social relationships but on social interactions instead.

3 Context and Methods, Data Source and Instrument, Measures and Discussion

3.1 Context and Methods

In Meyers's (2008) description of best online practices, instructors need to validate student perspectives, as well as acknowledge differing beliefs and biases, and to create a community that helps students become "more engaged and feel more interconnected" (p. 220). In the case of this research, the researcher played a crucial role as proposed by Bonk and Dennen (2003), pedagogical and social managerial, and technological, in developing and engaging students into LCs and OLCs by nurturing the conditions under which they can rise. Socratic seminars and literature circles were the setting for LCs while discussion forums embedded in the LMS were for OLCs. It first dealt with student responses in English of LCs (spoken) and OLCs (written), an exploratory stage to investigate insights of possible development of social interaction within two communities. The second is a confirmatory stage that the researcher investigated (1) if the use of LCs will enhance students' social interactions (spoken); (2) if the use of LCs will help motivate students' interactions in OLCs (written); (3) if the use of the two will meet students' learning achievements (academic reading and writing).

Manski's (1993) social interaction attributes, endogenous, exogenous and correlated social effects were use do answer the research questions. Endogenously, success-seeking learners may try to study hard to gain better grades. Learners may change their learning behaviours as a result of being endowed with their group. That is if a learner cares not only about his outcomes but also about the peer outcomes, he is under the influence of endogenous social effect or interaction because he relies on decisions of others a lot in the same social milieu. If the behaviour of a learner varies with the exogenous peer characteristics (called exogenous social effects), his achievement is related to the background of the reference group. If a learner in the same reference group tends to behave similarly because they are alike, then he is under the influence of correlated effects. Manski concludes that endogenous effects generate social multiplier while exogenous effects or correlated effects do not. The current research, thus, places special focus on students' endogenous engagement for their LCs and OLCs.

3.2 Data Source and Instrument

Data from the LMS was accomplished to investigate students' behaviours and performance on the LCs and OLCs in class. From the raw data the researcher constructed behavioural visualisations and network data sets based on reply relationships. The other data source is a 5-point Likert scale survey designed by NDHU. It was used to assess students' learning performance and learning satisfaction respectively. Since the questionnaire result details are classified, a general discussion is made for discussion instead of a statistical discussion.

3.3 Measures

3.3.1 Finding 1: LC and OLC Bridging and Bonding

Participants were encouraged to share their spoken literary analysis in most literature classes so the LC is something they are used to even though they still suffer from the English language use. Table 1 shows a huge achievement difference LCs and OLCs in two semesters.

Table 1. Total and Average Treads Hit, 2 semesters

	LC Task Hits, Semester 1	OLC Posts, Semester 1	LC Task Hits, Semester 2	OLC Posts, Semester 2
Total /AVG Threads per week	1,056/20	679/13	1,434/28	1,206/23

Since the instructor-researcher emphasised the pedagogical and social managerial aspects of developing OLCs. Students were aware that the LC and OLC tasks needed to be academically fulfilled. High activity participants used the LMS discussion forum both to interact with others (synchronously and asynchronously) and to act as mediators and problem solvers for the OLCs, thus established collaborative learning relationship and encouraged achievement seeking. At the end of the project all of the participants contributed to their LCs and OLCs more than the first semester (see *Table 1* and *Fig 1*). Most participants were positive toward making bonds with other members because they valued the responses from both communities.

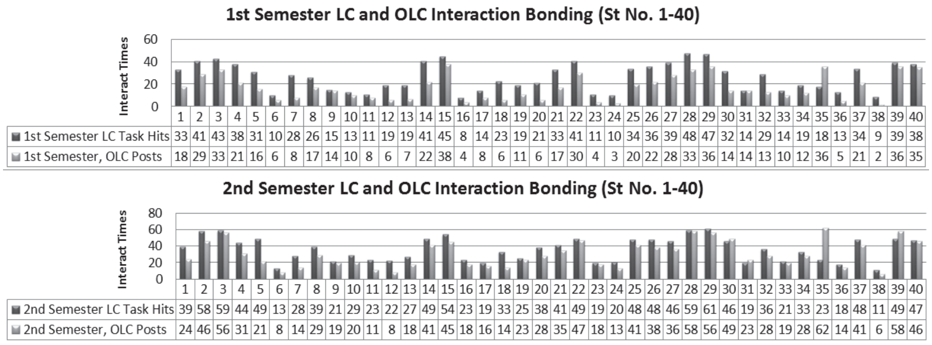

Figure 1. LC and OLC Interaction Bonding, 2 Semesters

It is also found that participants contributed one or a few messages/learning loads to discussion initiated by others, were fairly tied to relative influence of endogenous social effect on time of involving in LCs and OLCs. The R^2 values are 0.9844 and 0.9605 respectively which provide a strongly predictive behaviours correlated with social interactions (see *Fig 2*).

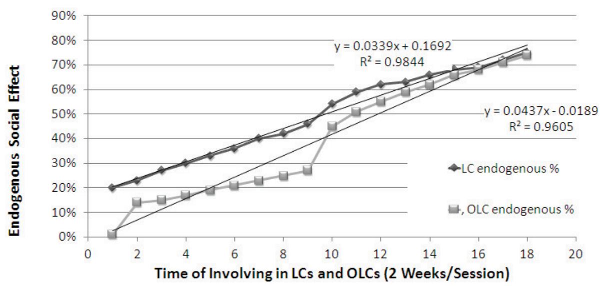

Figure 2. Endogenous Social Effect on Time of Involving in LCs and OLCs, 2 semesters

Because the participants felt a certain amount of unease with the openness of OLC discussion forum due to the reading literacy and language problems (academic reading and writing); therefore, they preferred to work in the LCs instead of OLCs especially in the first semester. The increase of LC and OLC discussion per week supports the ideas of social interactions and endogenous bonding for active learning. By getting used to being involved in both LC and OLC discussion (spoken and written), participants' active post number doubled in the second semester which means they solved their academic performance problem collaboratively. Their structural and behavioural patterns associated with endogenous social effect showed significant influence for their LCs and OLCs. Exogenous and correlated effects did not vary in this research, so the endogenous effects are identified.

Participants were more confident to work within the community and got some peer corrections either for literary or language purposes due to the psychological sense of community. The more they worked in the LCs, the more they would like to post their polished threads to the OLC discussion forum. When participants considered OLCs in terms of the "third place" (face-to-face classroom, the first place, and LC, the second) to gain specific knowledge, they attempted to find significant "sameness" and "differences" for certain threads. The differential effect along two semesters was slightly larger for LCs (point estimate 0.9844, significant at 95% confidence) than for OLCs (point estimate 0.9605, significant at 95% confidence) (please see *Fig 2*). Similarly, the wiliness of working in the OLCs gradually increased from the end of the first semester. Thus, the research questions 1 and 2 were answered. The use of LCs will enhance students' social interactions and also the use of LCs can help motivate students' interactions in OLCs.

3.3.2 Finding 2: Endogenous Social Effects

An important concern in reading Table 2 and Figure 3 is that the interactions between learners and instructors, other learners, and the course content are very different. 46% and 27% of participants showed they were under influence of endogenous social effects. Weak instruments were not a main concern in the estimation of the endogenous social interaction effects.

Table 2. Average Percentage of Interaction Behaviours

	LC endogenous, Semester 1	LC endogenous, Semester 2	OLC endogenous, Semester 1	OLC endogenous, Semester 2
Interaction Behaviours	46%	75%	27%	74%

Socratic seminars and literature circles used for LCs encouraged students' dialogic exchange and engaged them in intellectual discussion by responding to questions with questions. Students got together to examine issues and principles related to a particular content, and produce different points-of-view. Most of the time participants were weaving their learning attitudes among endogenous, exogenous or correlated effects. With the willingness to their OLC discussion, participants showed their endogenous social effects when dealing with the written posts. There is a strong partial correlation between the face-to-face LC with Socratic seminar and literature circle indicator and the potentially endogenous regressor, the OLC discussion confidence rate. Participants got more influence from endogenous effects when working in LCs and OLCs because the course was a core class for English majors which may determine their social status in the department.

Besides, substantially larger endogenous effects were found from second semester mainly because the participants realised the LMS documented all learning process and journals of each student. The small magnitude of this effect is important both from policy and psychological perspectives, given the importance of educational attainment for students in these literature based communities. LMS discussion forum presented similar opportunities and characters to encounter participants in an informal setting and to use what literary knowledge they know to discuss with other students. Through the process of negotiation or mediation, participants were able to find "significant others" that would help their language and literary knowledge development. As well as examining the ways in which OLCs could transform learning, it is as equally important to consider how the technologies were also transformed by the participants through social interactions.

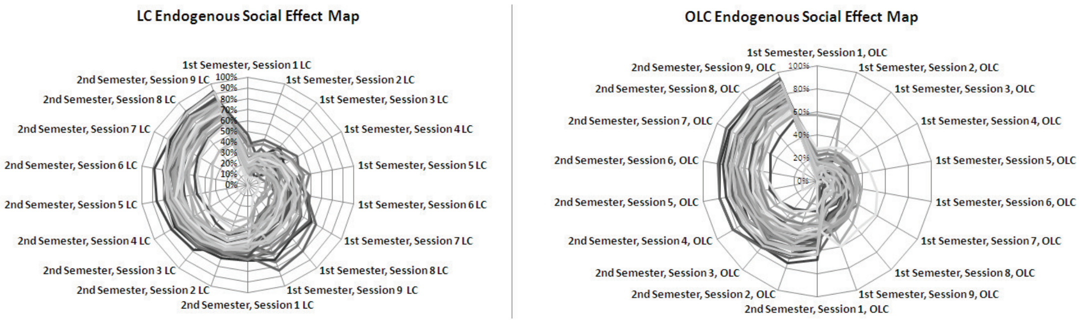

Figure 3. LC and OLC Endogenous Social Effect Map, 2 semesters

3.3.3 *Finding 3: Student Performance and Satisfactions*

The instructor-researcher was evaluated by the students at the end of both semesters required by the university and was scored 4.60 and 4.83 respectively (please see *Table 3*). The results in Table 3 indicate that students who experience with a learning community and online learning community are associated with higher levels of academic effort, academic integration, and active and collaborative learning (see *Questions 17 and 18*). Similarly, learning communities are positively linked into online learning communities with more frequently interacting with community members, engaging in diversity-related activities, and gaining academic achievement that emphasises higher-order thinking skills (see *Questions 20*.)

Table 3. Survey Designed and Collected by NDHU, TW translated by the researcher

Intro to Western Lit, Annual survey, NDHU, TW (at most 0.04 bonus points will be awarded if the class size is over 40)										
Strongly Agree = SA (5), Agree = A (4), Neutral = N (3), Disagree = D (2), Strongly Disagree = SD (1)										
Measure 1: Teaching and Learning Satisfaction	**1st semester**					**2nd semester**				
	SA	**A**	**N**	**D**	**SD**	**SA**	**A**	**N**	**D**	**SD**
1. Provides detailed sequences and scopes of the class.	31	9	3	2	0	34	7	1	0	0
2. Is expert in the subject area and has a cutting-edge grasp of academic development and how students learn.	32	8	4	1	0	36	4	2	0	0
3. Uses materials and displays to maximise student learning of all materials.	29	11	4	1	0	31	6	4	1	0
4. Orchestrates highly effective strategies and materials to motivate students.	33	8	3	1	0	36	4	2	0	0
5. Uses coherence and silky-smooth transitions to get the most out of every minute.	24	13	6	2	0	29	10	2	1	0
6. Designs lessons with clear, measurable goals aligned with unit outcomes.	25	14	4	2	0	33	6	3	0	0
7. Designs lessons that break down tasks and addresses learning needs and interests.	20	11	8	6	0	26	7	8	1	0
8. Clear and consistent evidence that various assessments is used during instruction.	24	13	6	2	0	28	10	3	1	0
9. Designs lessons involving an appropriate mix of top-notch, multicultural materials.	24	13	7	1	0	29	9	4	0	0
10. Has perfect or near-perfect attendance and routines are orderly and efficient and result in minimal time off-task.	27	12	5	1	0	34	6	2	0	0
11. Shows ongoing enthusiasm about teaching and shows a commitment to supporting the development of students.	31	10	3	1	0	35	6	1	0	0
12. Prepares diagnostic and summative assessments to monitor student learning.	27	13	3	2	0	33	6	3	0	0
13. Shows warmth, respect, and fairness for students and builds strong relationships.	27	12	5	1	0	32	5	4	0	0
14. Presents as a consummate professional and observers appropriate boundaries.	28	13	3	1	0	34	6	2	0	0
15. Designs lessons that will motivate students and sweep them up in active learning.	24	14	4	2	1	28	6	4	1	1
	Average Score:4.60					**Average Score:4.83**				
Measure 2: Self Evaluation	**1st semester**					**2nd semester**				
	SA	**A**	**N**	**D**	**SD**	**SA**	**A**	**N**	**D**	**SD**

16. I'll hand in the assignments on time.	22	12	8	3	0		28	16	5	0	0	
17. I always work and collaborate with my team/community for academic achievement.	19	15	8	3	0		28	16	5	0	0	
18. Hours spent to study for this class per week outside the classroom for academic achievement.	**6+**	**4-5**	**2-3**	**0-1**	**X**		**6+**	**4-5**	**2-3**	**0-1**	**X**	
	4	13	19	6	X		3	14	19	7	X	
19. Times absent from this class.	**5+**	**3-4**	**1-2**	**0**	**X**		**5+**	**3-4**	**1-2**	**0**	**X**	
	0	1	12	32	X		2	0	13	34	X	
Rote Memory = RM, Comprehensive = C, Utilizable = U, Analytical = An, Appraise= Ap, Creative = C												
20. Skills learned in this class.	**RM**	**C**	**U**	**AN**	**AP**	**C**	**RM**	**C**	**U**	**An**	**Ap**	**C**
	40	36	17	28	11	16	32	39	27	30	24	16

Since the course was run in the computer lab, apart from the assigned readings in the syllabus, some related open resources were set as assigned reading materials, too. Students needed to read 10% more than the regular syllabus and the working load was also higher than other literature classes which worried the teacher-researcher in the first place. However, with the accomplishment of the weekly tasks for LCs and OLCs, students showed their potentiality in managing knowledge in a different way. Both the teacher-researcher and the participants were creating a rich social and literary interaction environment (see *Questions 16, 17 and 18*). Therefore, the course had been evolved, with new technical aspects added over time to meet the needs of the participants. The annual survey confirms the possibilities offered by the e-medium are changing exponentially, yet the nature of the medium itself, as well as its content, profoundly affects any kinds of pedagogical applications as long as the educators use the medium as a tool not a burden in assisting learning.

3.3.4 Discussion

The research lays the foundation for open discussion on literature teaching in terms of students' social interaction as well as of their academic potentiality. Based on the preliminary results, the LCs and OLCs clearly changed participants' learning attitudes. Item-specific or rote-memory learning outcomes could not satisfy their academic achievement any longer, even though it's the foundation of academic knowledge. Therefore, if both teachers and fellow students can provide students with timely and meaningful feedback on their academic progress and with advice to students in academic distress, appropriate social interactions can be initiated as a learning process instead of knowledge sharing only. During the research time, the teacher-researcher and students easily linked work produced via LMS to learning outcomes and evaluated linked items within the tool in which they were produced. To the extent that LCs with Socratic seminars and literature circles, and OLCs could successfully motivate participants to learn both individually and collaboratively, the strategies can be used to evaluate the success of strategies intended to cultivate desired academic learning outcomes.

Conclusion

Like most EFL learners, Taiwanese English majors' stumbling blocks in literature related modules are the language problems and the abstraction of literary knowledge from the reading assignments both of which will influence their critical thinking performance. Major advances in research and practice in LCs and OLCs led to the realisation that it is a need to shift the focus of educational pedagogy from a teacher-centred approach to a student-centred one to solve the learning problems, language and critical thinking, in literature related classes. The paper makes three sorts of contributions in the effort to decrease anxiety and resistance in studying literature in Taiwan. First, it confirms LCs can help students read and think critically via Socratic seminar and literature circle methods. Second, the specific attention to social interactions between LCs and OLCs distinguishes general discussion from the provisions of endogenous social effects and answered how participants learn through those effects. Last, it provides a foundation for leveraging conceptual resistance and behavioural data to identify possibilities for other learning perspectives.

The research concludes with two general claims: (1) LC is a productive way to encourage social interactions toward learning; and (2) social interactions in LMS settings should be carefully taken care through the intersection of multiple methods. Socrates seminar and literature circles are an important link between LCs and OLCs for the techniques of solving language skill problems and also development of insights and the respects of literary analysis. Those techniques and development can be formalised into rubrics and tested statistically. Not a lot research has brought social interactions into literature classes. The current research might be a new direction and believe that beginning from literary knowledge learning and sharing, item-specific oriented, to literary discussion and analysis learning, collaboration-oriented, that bridges social, information, literary knowledge and computer science. Leveraging the potential of that integration to reveal the hidden learning prospective of social interaction will require both educators and learners' aggressive academic community needs.

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Chapter 4

Human-Centered E-Learning

Preface

The Workshop on Human-Centered E-learning is part of the 19th International Conference on Computers in Education (ICCE2011) that was held from November 28 to December 2, 2011, at Chiang Mai, Thailand.

The Workshop tends to investigate how to use Human Centered Design (HCD) to improve the development of e-learning tools so that these tools can effectively support teaching and learning for different types of users.

The development of e-learning tools should be accessed anytime and anywhere by users. Moreover, as a result of such convenience, a wide range of people have begun using e-learning tools for supporting teaching and learning. Thus, it is important to ensure that such e-learning tools can accommodate diverse users' needs. To address this issue, there is a need to incorporate the HCD into the development of the e-learning tools. More specifically, the HCD is used to not only investigate the behaviors of using e-learning tools between different types of users but also analyze how users' individual differences influence their perceptions for the e-learning tools. After doing so, such investigations can be used as guidelines to develop the e-learning tools to meet users' needs.

The contributions that are presented here cover various topics, such as game-based learning systems, quiz-based learning systems, gender difference, and learning styles. In summary, we attempt to provide answers for the following questions:

- How gender differences affect helping-seeking and supportive behavior?
- How gender differences change social behavior on a coop-competition game?
- How prior knowledge and cognitive styles can be used in a personalized E-learning system?
- How a surrogate competition approach can enhance student learning?
- Do students have the abilities to choose the most-beneficial educational systems on their own?
- What kind of students is suitable to use a group quiz game E-learning system?

We hope that the Workshop will contribute to the global research in E-learning by comprehensively reviewing state-of-the-art E-learning approaches that accommodate users' needs, will help integrating users' needs into E-learning applications, and will give some insight into analytical and architectural aspects of E-learning.

Organizers

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Answering Bee: A Pilot Study of Classroom Group Quiz Game

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Abstract: In this paper, the authors describe the group quiz game system, Answering Bee, which can be used in the classroom to explore the quiz game and its group learning interaction. Answering Bee system is available for four to six players for each group on the plate computer to have group quiz competition game. A pilot study adopted the quantity by the questionnaire of the learner pleasure was applied to understand the students' reaction and the system functions. Twenty senior high school freshmen are involved in this pilot study. The results indicate that the high interactive group students have the positive attitude toward concentration and social interaction when using the system but contrarily the high achievement group students get the positive attitude of the knowledge domain. Besides, the findings also figure out that the male is more acceptable than the female in the digital quiz game learning.

Keywords: Plate computer, group interaction, quiz game, assessment

Introduction

Using technology into the classroom is one of the current study issues, and it improves the current teaching model. Global alliance of one-to-one popularizes the conception of that every student has his/her own computer in the classroom [2]. The devices can connect to the Internet that can increase the students' right of access information and the interaction between teachers and students. The advantages of the mobile devices are innovative, portable, increasing the computing ability, durable and the high popular [5]. These advantages have affected the current situations in the classroom.

There are various activities in classroom, and assessment is one of the important items [1]. In the past, students took a test by using pens and papers. After finishing a test, teachers collected test papers and gave students the scores; students receive only the feedback, the score. However, score can't show what students have really learned. In addition, a large number of tests result in some pressure to students, and make students have low interest and motivation in learning and tests. Digital games have some characteristics of obvious goals, game rules, game condition, and entertainment [6]. These features engage a lot of students to spend ample time on gaming. This century is a "game generation" whose lives are already intervened by a lot of digital games. Therefore, how to combine assessments with games is an important guideline for research. Adopting game features in the tests may let the test become more interesting and improve the students' motivation for the test. Furthermore, teachers can access students' learning conditions by analyzing students' performance in the game, and to give appropriate scaffolding and support [4].

Assessment is an integral and ongoing means to find ways to improve learning and teaching and is the core body to assess need, measure growth and evaluate teachers, programs and curricula [8]. In this study, a group multiple choice game system named Answering Bee is developed and used to explore the possibility of applying assessment to a game-based environment. By embedding the assessment into the group and competitive way to improve students' achievement [3], we can make it effectively and interesting to use the Answering Bee to be a tool of the assessment. Besides, by observing the process records and analyzing what students have participated in, we can find an appropriate way to suit to the learners to motivate and achieve students' performances.

1. Answering Bee System Design

1.1 User Interface Design

Figure 1 shows the Answering Bee system screenshots of which Figure 1-1 is the welcome screen, and Figure 1-2 is the player setting screen. There are two parts of the User Interface Design. The upper part of the screen (as the Figure1-3 & Figure1-4) shows the figure heads according to the numbers from one to six of logging in. Each figure represents an answering pupil. In front of each figure is a table to show the player's name and the start which symbols the code of answering each question. When the player gets the right answer, he/she gets one star; and vice versa, getting the wrong answer, he/she will be out of the game till accumulated three wrong answers.

(1-1) (1-2)

(1-3) (1-4)

Figure 1. Screenshots of Answering Bee System

The bottom part of the screen shows the question and its choices. The player can answer the questions by beating the choices. The right part of the bottom is the figure of the host with the facial expressions of joyful when the player gets the right answers to the questions and with the facial expression of disappointed when the player gets the wrong answers to the questions. The left part of the bottom part shows the facial expressions of the answering players with the happiness when having the right answers and with the annoyance when having the wrong ones. During the process, each one take turns answering the question. Three different of lights, brighter, shadow and black-and-white indicate the status of the players showing on the whole figure as the Figure 1-4. When the players are answering the question, the figure shows brighter light; the left part of the bottom also shows the figure. While the player is off-line, the figure becomes the shadow color. And the loser will be showed by the black-and-white figure. The game will be lasted till all of the rest of the players are out till the last one, the survivor win the champion herein.

1.2 Game Flow and System Architecture

The game flow of Answering Bee composes of three steps. They are:

Step 1. Entering Game: Set the players number and enter the players' names and icons.

Step 2. Game Start: Every player owns three stars and takes turn answering the question by beating the Choices. When the player gets the wrong answer, he/she will lose one star. If the player gets the right answer, he/she will win one point per one question.

Step 3. Game Over: The game is lasting till the other players are out of the game; that is to say, he/she got the wrong answer accumulated three times. At last, the winner wins the champion because he gets the most right answers.

Figure 2 shows the five major parts of the Answering Bee. They are start game, ranking, setting, about us, and exit.

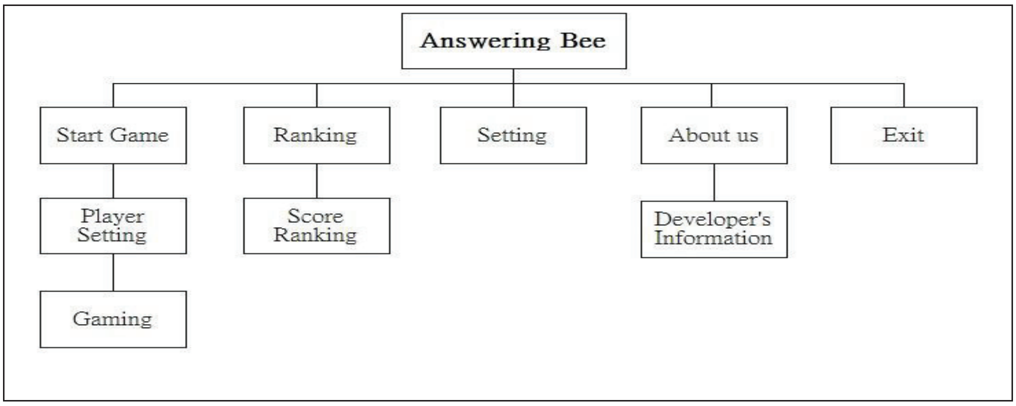

Figure 2. Answering Bee Framework Diagram

The details of the functions are elaborated below:

1. Start Game: Press the button "start" to enter the playing screen. And then set the number of players and each player's name, and choose the item bank.
2. Ranking: The ranking is recorded in the database based on all of the players. Whenever the game is over, the players' scores will be updated.
3. Setting: Teachers set the classes that are ready to play the games and questions in advance and students are open to select the item banks according to students' levels and preferences.
4. About Us: Some developers' information likes contacting ways.
5. Exit: Leave this system.

2. Pilot Study

For understanding students' reaction and system function, a pilot study was conducted. Twenty freshmen of Department of Computer Science at a vocational school in Chiayi County located in southern Taiwan were involved in this pilot study. Among them, twelve are male and eight are female. These students, aged sixteen, who are familiar with using computers, not good at English, and low society background are the volunteers to be the participants and they are grouped to two according to their class performance and interactions by their English teacher who has taught them for one semester. A post-test pleasure questionnaire revised from Su (2006) was adopted. The Answering Bee system developed by our team was installed on two plate computers and applied for the pilot study, and one video recorder was used to tape the students' interactions.

2.1 Procedure

There were three steps in this practice, including "Warm Up," "Playing," and "After Activity." Below is the introduction of each step.

1. Warm Up: The participants are introduced how to use and practice the Answering Bee and are divided into the male (six ones) and the female (four ones).
2. Playing: These two groups play the Answering Bee system with two tablets simultaneously for two times.
3. After Activity: The players fill out the questionnaire.

This experiment is by convenience sampling and divided into two groups, one is high achievement and the other is high interactive; the former plays digital games is less than four times per month and for the average less than one year, and the later plays five to seven times per week for the average for three to five years.

2.2 Preliminary Results and Discussions

Some results were obtained by the questionnaires unfolded in six facets of the learner pleasure which are 1) concentrating, 2) feedback, 3) controlling the game, 4) immersing the game, 5) social interaction and 6) knowledge domain. This study uses five-item Likert-type scale that attempts to estimate the level of learner pleasure as the following: one point for very disagree, two points for disagree, three points for neutral, four points for agree, five points for very agree. The results indicate the positive values of Answering Bee, quiz game assessment as on the Table 1. The statements of the questionnaire are below:
There are two aspects have a remarkable result. The average scores of social interaction in high interaction group were 3.82 and higher than the group of high achievement (3.62). On the other hand, the average scores of knowledge domain in high achievement group were 3.82 and higher than the group of high interaction (3.66).

Table 1. The Results of the Questionnaire of the Learner Pleasure

Item	High Achievement	High Interaction
Concentrating	3.62	3.82
Feedback	3.90	3.97
Controlling the game	3.82	3.80
Social interaction	3.62	3.82
Immersing the game	3.64	3.68
Knowledge domain	3.82	3.66

Finally, the study analysis by the gender by T-Test and indicates that the male has more pleasures than the female no matter what he/she belongs to the high achievement or the high interactive one as the Table 2.

Table 2. T-test of Gender Differences in Two Groups

	Gender	Average	D	T	f	P
High Achievement	Male	4.12	.635	2.503	8	.037*
	Female	3.13	.560			
High Interaction	Male	3.95	.784	1.030	8	.333
	Female	3.51	.346			

$p<.05$

The questionnaire is to investigate the degree of the learning pleasure. Table 1 reveals several interesting issues of high interaction and high achievement, and gender differences. The results reveal that the high interaction students' concentration and social interaction were higher than the high achievement students, but the high achievement students had higher level of the knowledge domain than the high achievement students. The gender makes it different to play the quiz game and indicates that the male with a higher passion than the female.

3. Conclusions

The main purpose of Answering Bee is to alter the form of the assessment by groups to hope to decrease the defeats of the traditional tests and increase the features of the interactivity of the game-based learning. In the near future, the study plans to improve the feedback function to add more features into Answering Bee to make it more active and more fun. Furthermore, Answering Bee is not limited to English subject only, others subjects will be available. Besides, there are two aspects of the Answering Bee for the teachers and the learners. For the learners, this system will record their answering conditions in the database as to analyze their answering weaknesses as well to observe their learning achievements. For the teachers, teachers can realize what students have achieved and learned and then instruct the individualized learning according to each student's weakness and strengthens to motivate and achieve students' performance. Also, another system supplying teacher to add, delete and modify item bank on line will be constructed.

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Gender difference in social behavior change on a coop-competition game

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Abstract

Social cognitive theory indicates that social behavior of participants will change as they interact with others. Interaction in different social environment also results different change degree. The purpose of this study is to identify the social behavior of children during games play in a cooperative and competitive setting. A game named Strike up was developed for the study. The objective of the game is to advance arithmetic practice through five card number calculations and strategies. In order to realize the initiative behavior and change behavior during the game, participants' dialogues were video-taped and its content was later analyzed and interpreted by triangulation. The results of this study suggest that most players tended to express more egalitarian behavior than altruistic, dominating, or individualistic behavior at the beginning. Whereas, female players were more willing to mutually help each other. As playing time going and close to the goal, both boys and girls have more willingness to altruistic play. This implies this type of highly cooperation/ competition game will be a useful tool for children to experience egalitarian and altruistic behaviors.

Keywords: Game behavior; Social behavior change; Coop-competition game.

1. Introduction

Social cognition changes appear to play an essential motivational role in game playing behaviors (Frey et al., 2005; Green & Rechis, 2006). Games children play generally influences social behavior (Green & Rechis, 2006; Milani, Osualdella, and Blasio (2009). Both antisocial behavior and prosaically behavior alike have important implications for social adjustments of children in game playing (Frey, Nolen, Edstrom & Hirschsten, 2005). During the game process, players would mutually help or display hostile behaviors to sustain their enjoyment during play. In game playing, individuals who attribute others' actions as hostile (rather than benign) tend to react with blame and anger when they are hurt (de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). To foster players' enjoyment, games should be developed in a community of caring through cooperative learning (Donohue, Perry, & Weinstein, 2003), and sometimes generate hurting in the competitive situation. Under the cooperative/competitive situation, the caring or hostile behavior may occur which would ensure the interest of every player to continue to play or stop the game.

Most previous researches have focused on investigating novel forms of interaction to encourage collaboration, and techniques of gathering user for designing an enjoyment or playfulness games (Bekker et al., 2003). Wood, Williams, and McNeal (2006) suggest that increased complexity for children's expressed thinking is closely related to the types of behavior patterns interacting with differentiated change of community cultures. Moreover, Yee (2006) studies the model of player motivations in online games and suggests the gender relation to motivations, that reveales male players are higher on competition than females players. Following these excerptions, this study designs a mathematical game named “Strike up” for elementary school 6th grade students to play and to examine their social behavior change in different cooperative and competitive conditions. In line with this, the gender difference of interaction patterns related to the types of social behavior change from initiative to goal stages during game play would be identified.

2. Research Contents and Hypotheses

Social Exchange Theory postulates that social behavior is about working toward maximizing one's own rewards and minimizing one's costs (Burgess & Huston, 1979). In time, individuals begin to rely on social exchanges and the future benefits or opportunities. Participants focus on reciprocity and operate under the norms of equivalence (Laursen & Hartup, 2002). For example, under the equity norm, each participant in a relationship should only receive as much as they give. If there is an imbalance, participants become distressed and work toward restoring equity (Walster, Traupmann, & Walster, 1978) whereas under the norm of equality, players are more concerned with the fair distribution of rewards, which are evaluated equivalent to individual input (Sprecher & Schwartz, 1994). Furthermore, cooperating with opponents can also be beneficial if they operate under the premise of reciprocal altruism – the tendency for an individual to help another only if he or she is helped in return (Sheese & Graziano, 2002). In other sense, the beliefs individuals have about other people’s goals and intentions are important predictors of behavior in playing a game (Frey, et al., 2005).

Children may have different social goals across different contexts and choose to compete or cooperate for different reasons (Green & Rechis, 2006). Hammerstein and

Leimar (2006) referred to "conditional cooperation" as people tend to cooperate if their counterpart behaves in the same way. The efficacy of such reciprocity can be experienced by both parties' social beliefs within relatively short periods of time. In the regard of social beliefs which affect social behavior pattern in playing game, Frey and his colleagues (2005) proposed four categories that reflect behaviors of game participants during decision making: (1) dominating behavior: whereby players select self-high outcome to dominate other members in a team or pair; (2) individualistic behavior: whereby players select self-high outcome to gain the greatest advantage; (3) egalitarian behavior: whereby players select equal-high outcome but self-high outcome is second choice; and (4) altruistic behavior: whereby players select equal-high outcome but self-low or equal-low outcome are second choices. To the current research, the conceptualization of Frey and his colleagues (2005) in regard to game participants' behavior types is adopted as the condition of game change. In brief, game play is one kind of social learning (Bandura, 1986), in playing the game, social behavior can be changed along with the interaction increased. Then, hypothesis 1 can be postulated that "*Will the players'* s*ocially competent behavioral change when they are grouped to play a coop-competition game?"*

2.2. Gender difference in social behavior change

Games vary in the ability of other players to reciprocate, the number of players, the number of iterations, the ability of outside observers to reward and punish selfish behavior, payoffs from cooperation versus defection, and the reputation of other players (Fehr & Fischbacher, 2003). They also differ in terms of stable individual differences of players, such as their age, sex, and culture (Henrich et al., 2005). With this form of social community, the proximate motivational and social dispositions that facilitate relationships and cooperative activities among boys and men should differ in some respects from those that facilitate relationships and cooperative activities among girls and women (Geary et al., 2003). By the elementary school years, there is an evidence to suggest that girls are more sensitive to any inequalities in their relationships and inequalities among females in general (Ahlgren & Johnson, 1979; Winstead, 1986). For instance, achievement of dominance in the peer group might in fact have both immediate and longer-term effects to both girl and boy's social behavior (Geary et al., 2003). To be sure, there are evolutionary influences of sex differences in social behavior (Geary et al., 2003; Wrangham & Peterson, 1996), girls express more enjoyment in game playing (Lin, 2010). Then, in this study, the difference of behavior change between girls and boys in the game contest would be taken into consideration. Thus, the hypothesis 2 of this study can be postulated as “*Is there any significant difference of behavior change between girls and boys in the game*?”

2.3. Game Design

In a broader sense, game theory is pertinent to virtually every dynamic interaction between sentient beings (Wilson, 2006). In line with this, several game rules have been developed to examine subjects’ behavior in cooperative scenarios, which differ in complexity according to the number of participants and repetitions of social exchange. In a dynamic game design, the game scenario should provide players to constantly evaluate and adjust the competition/collaboration strategies, thereby engaging themselves in logical thinking (Kiili, 2005). Specifically, the developmental activities may enable girls and boys to form cohesive and competitive coalitions and thus work out in-group dominance relations (Geary et al., 2003) or with more series competition in game playing. To reiterate, the aim of the study is to investigate children’s social behaviors displayed during the competitive situation, cooperation among participants is required. Thus, researchers developed an evolutionary computer based game, named ***Strike Up***. In this game, six children were divided into two competing teams. The objective for each team is to move their flags from the start point to the end point (326 steps to the goal).

The numbers of steps to be taken at each round is relied on what was randomly drawn from the deck of virtual poker card shown on the screen. Five cards from 1 to 9 are retrieved by each player at each turn, and five card numbers can be used for counting the steps he or she can move The five card numbers counting approach is limited to use +, －, ×, ÷ once in a turn. In order to move forward to win the game, the players have to calculate out the maximum value or best value to step forward. 10 J Q K cards are function cards perform *support* or *set up* functions. Children can use function cards to bonus points or to ‘tackle back’ other opponents (**Appendix** 1).

All participants can contribute positively because the game is designed in a way that children are encouraged to generate their own strategies. Children must take turns to ensure equal distribution of opportunities for each player. In concerning win the game for a team, three members (or all members in the team) should reach the end before the other teams. According to Richard et al. (2002) statement, if any of the teammates is lagging too much behind, giving punishment or bump back by other team members, in this scenario, competitive and cooperative behaviors are overt and are therefore easy to measure.

The other feature of this game design corresponds to Menasche and his colleagues' (2005) principles, which includes: (1) Games are played among teams; (2) Player interaction continues as time elapses; (3) Players can choose from different game modes; (4) Player decisions are associated with valuable movements; and (5) Players adjust game strategies according to game dynamics. The research tool *Strike Up* enables players to interact with content, collaborate with peers, and benefit from player support. It also allows players to decide on game rules and boundaries. Then, the game for this study can be considered as a strategy game with contest and constructive learning situation.

3. Experimental Design

The research tool *Strike Up* is devised to elicit players' display of social behavior patterns as defined by Frey et al. (2005). This study uses evaluation checks to conduct observations and interpretations in order to examine behavior change of players. Analysis focuses on discourse analysis, students' transformative communication and behavior interpretation. Content logs were first created and it describes what happened during the course of video (Jordan & Henderson, 1995). Then, the patterns of emergent discourses were coded. That provided insight on how students' transformative communication occurred. The interaction patterns of social behavior was also observed and interpreted by using triangulation method.

This study includes six 6th grade elementary school students from a local elementary school in Taipei. They were divided into two teams. Three girls are in team A, they are labeled as A1, A2, and A3. The other three boys are in team B, they are labeled as B1, B2, and B3. The experiment was conducted after class hours. The participants played Strike Up as part of after class leisure activity. Three investigators were there to supervise, videotape, and to take field notes. To ensure validity of the study, three investigators read the data recorded from game playing by students to analyze and interpret the interactions among children. Each cooperation-competition scenarios were scrutinized.

3.1. Data collection and analysis

The contents of this game reflect the emphasis of on-line game. Then, the qualitative data can be carried out as exploratory work to identify themes for further exploration in a fuller study. Data analysis within interpretive methodology is complicated by the central assumptions analyzed by such researchers (Sandiford & Seymour, 2007). Miles and Huberman (1994, p. 9) suggested a variety of 'analytic practices' which could be summarized as: coding data, reflecting on data, sorting data, identifying patterns in data, moving towards generalizations and developing or testing theories/conceptualizing (Sandiford & Seymour, 2007). Then, the process of analysis involves different stages as follows: 1) Preparation of data for analysis, 2) Coding and display, 3) Data reduction: Refining 'raw data' into clear text, 4) Componential analysis: Developing interpretations and verification, 5) Theme analysis: Developing interpretations and verification, and 6) Conclusion drawing.

In order to have a better reliability of data analysis, the triangulation method is applied in this study. Reliability has to do with the consistency or repeatability of assessments. Of the numerous types of reliability, estimating the internal consistency among items on an evaluation form and determining the number of responses needed to achieve precise evaluation ratings). Triangulation means an effort to define accurately the topic of study (Sim & Sharp, 1998), then, three investigators were there to supervise, videotape, and to take field notes. They read the data recorded from game playing by students to analyze and interpret the interactions among children. The reliability of data interpretation reached to .90 of this study, thus, those dialogues are based on the consensus from analyzing scenarios of the interaction

4. The Findings

Since children on the same team have varied understanding and expectations for interdependency. Individuals' coop-competition modes also differ. The observation was carried out for three rounds. Play sequence for one round constitute turn taking in the following order: A1-B1-A2-B2-A3-B3. Interactive dialogues in each round were classified into four types of social behaviors based on Frey et al. (2005) proposed theory.

4.1. Dominating behavior in the game

At the beginning of the game, the players with better arithmetic ability would figure out the value of the five number cards much sooner than those with lower arithmetic ability. Those players with better arithmetic ability would also spontaneously help those slow counting members and demonstrate some kind of dominating behavior.

Situation 1: To determine who to start first, the game was started by a game of "scissor, paper, and stone". It would be B1's turn to play but B2 stood beside and try to monitor B1's performance. An excerpt of the conversation is as follows.

B2 （speaks to B3）：”I hope you can draw out 9, 9, 9, and 9.”
B2：”9, 9, 9, 1, 1… how wonderful！”
B2：”9×(9+9).”
B3：”Divided by 1, then minus by 1.”
B2：”No, it should be minus by 1 then divided by 1.”
B2：”Listen to me, you will find out that the value will be the biggest.”
B3：”No, I insist on divide before subtracting.”
B2：”It is the same, either way is OK.”
B3：”But I prefer subtraction followed by division.”(B2 tried to keep privilege) (13’25”~14’00”)

B2’s math ability is somehow better than B1’s (according to the math tests). So, B2 have more confidence in counting and giving someone a hand. Then, it is observed that B2 is a dominating character who tries to enforce others to take his suggestions. The other type of dominating behavior occurred while approaching toward the end of the game Round 4).

Situation 2: It was B3’s turn to play (The card numbers were 2,7,1,5,8. B1 tried 2×（7＋1－5）÷8, yet he was hesitant, then B2 and B1 give some suggestions to him.
B3：”6 divides by 8 is equal to?”
B1：”6 divides by 8 is equal to 6 out of 8.”
B2：”No, the rules require us to round up, so the result is 0.”
B3：”Is 0?”(B3 spoke in a doubtful sound.)
B1：”1 is goody！
B2：”I count out，1 or 0.” (He stood up and insisted his results.)
B3：”Well, the result is…”(Ask B1 to confirm B2’s results)
B3（speaks to B2）：”I don’t want your help. I will count it by myself…”
B1（speaks to B3）：”You can take B2’s idea. You can take B2’s idea.”
B3（speaks to B2）：”No, I don’t want to listen to you.”(B1 used left hand to keep B2 away)
B2（speaks to B3）：”OOXX” (Murmuring dirty words)
B3（speaks to B2）：”Go away or shut up！”
B1（speaks to B2）：”He counts out 1. Perfect！”
B2：”Really?”
B3：”Yes, it is right.”
B3：”So, I can work it out by myself and do better than others.”(Show that he is confident by tapping his chest using right hand)

(13’15”~14’35”)

Denotation: People with a proself inclination are either self-maximizing or competitive and will only cooperate when it is in their self-interest to do so (Van Lange, 2000). People on Machiavellianism display a combination of selfishness and opportunism (e.g., Wilson, Near, & Miller, 1998). From the above discourse, B3 as dominator tends to cooperate less and their cooperative behavior is purely default.

4.2. Individualistic behavior in the game

Those players with better arithmetic ability and more ambition in winning the game will show that they only concerned about themselves in counting or using functional cards.

Situation 1: It was B1’s turn in the secondary round. B1 was counting his five cards to figure out the maximum value or best value (go by short) and B2 drew another five cards to count (A3 will be next player).

B1（speaks to B2）：”I have 6, 7,8,3,7, how to arrange for best movement.”(B1 tries to ask for B2’s assistance)

B2：”6,7,8,3,7…..Very good. But, I have 6,2,5,7,6. I have to figure out the best value.”

B1 （speaks to B2）：”Please help me figure out this first, it is my turn to move.”

B2：”Let me figure out mine, then I will count for you.”

B1：”The scenario will be changed after this turn, the value you count out will be useless, please count mine first.”

B2：”No, after I figure out mine, I will count for you.”

B1：”You help me, then, I will help you.”

B2：”I count out mine already, now I can help you.”

(18’25”~23’00”)

Situation 2: B2 played his turn by figuring out the best value of five cards. After moving his flag to that place which according to the calculation of the five card numbers, he drew the so called “function card” and got J card by which he can move forward 50 steps as bonus or give to one of his teammates to move forward 50 steps. Since B3 was lagging way behind and he wished that B2 could give him a hand.

B3: “B2 please use that card for me, I am so far behind everybody else.”

B2 (making an excuse): “I want that card for myself. Do not be worried; you will get a lucky card during your turn.”

B3: "You should help me; otherwise we will lose the game."
B2: "Don't worry; it is still very far from reaching the end. I would have helped you if I am close to the end."
B3: "… I might always be kicked back, then, it will be too late to rescue me later."
B2: "You are too noisy. I will wait for someone to give me a hand, and then I will help you."
(25' 25" – 28'40")

In order to promote the playfulness in the mathematic game, the cooperation and competition are two very important elements. If the players only approach the game competitively, then it will be very difficult for all members to finish the game. In particular, at the very final stage, the exact value needs to be figured out for the rest steps to the goal, if there are the remaining values after subtracting the steps to the goal, the player will move him or her further backward from where he or she started. Thus, players should realize that cooperation is important as the team needs to win the game together.

Situation 3: As the game went on, most players were having their flags close to the end. This meant that the chance of being bumped back would be increased. In addition, the function card could be used to help others and/or hinder others. If team members were too individualistic, it would be difficult to finish the game.
B2: "I got bumped back so many times; I stayed around the last part of the game for at least 10 minutes."
B3: "You deserved it."
B1: "B2 you should help B3 at the beginning of the game."
B2: "OK. I know I was wrong."
(14'00"-14'10")

Denotation: Individualisms showed that their social strategies are more calculative and adapted to the situation at hand. It is not unlikely that behavior should predominate among individuals with other-regarding preferences (Bogaert, Boone, & Declerck, 2008; Gintis et al., 2003). In line with this, the above discourse indicated that B2cooperation in a social dilemma was more likely to proself before he can help others. B2's willingness to cooperate in one-shot social dilemmas has further been related to individualism in stable personality traits.

4.3. Egalitarian behavior in the game

At the beginning of the game, opposing teams sought possible assistance by exchanging benefits. However, it was uncertain if the other members could be trusted. Exploratory talks were frequently conducted to test each other and to determine whether the other team could be trusted. Mutual improvements were pursued throughout the process with optimistic attitude.

Situation 1: A1 believed that the game was just a game. She did not take it too serious but still tried to seek reciprocally help. At the beginning of game, she ever gave some benefits to B2. It was interesting that one of her teammates (A2) tried to compete to hurt one of opposite teammates, so when A1 got a number, she can decide t to bump back B2 or recalculate out other number to move forward, A2 asked her to take the first action to bump back B2.

A2: "Try to bump back B2."
A1： "Never mind, I will give way to B2, he will repay me later!"
B2： "A2 (Calling her by the name) I will revenge, watch out!"
A1： "Just remember to add 90 steps for me!"
B2： "No way, your friend did this to you, blame her."
B1： "If we get a King, we will set her (A2) up"
……
A1： "Your thoughts are evil!"
B1： "You call me evil! B2 is worse than me!"
A1： "But I just descended him and revenged!"
It is the turn of B2 to draw the function card, and he got the King card.
B2： "K, according to the rules of this game, I will move A2 50 steps backward."
A2： "Please help me, don' hurt me. You can use it to help your teammate B1"
B2： "Ok. I will let you know what revenge is" (B2 set A2 to move backward 50 steps)
(39'40~43'30)

By Round 3, there were more descend short-cut close to the target. The possibility of setting up rivals using function cards increased. The desire for the children to win resulted in attitude inconsistencies and conflicts. Different strategies to handle conflicts reflected the individuals' varied characteristics. It was even possible for the members to alter individual social behaviors in order to solve the conflicts.

Situation 2: In the scenario below, A1 and B1 insisted on keeping promises (Egalitarian) at the beginning of the game. However since B3 wished to win, his attitude was more individualistic at this stage. A1 was displeased and B1 tried to change the mind of his teammate. In the process, B3 altered his social behavior.

B3："J, according to the rules of this game, I got J, I can assign one opponent to the nearest ladder to go up or descend." (B3 assigned A1 to descend.）

B1： "Really?" (His teammate was surprised in B3's decision)

B3："Why not?"

B1："Didn't A1 just descend a while ago?"

B3： "Why can't she (A1) be moved down again?

A1： "Why did you descend me again?"

B3： "Why should I be nice to you? You'd better go down from here."

B2： "Oh, let them both go down, so I can get rid of them both!"

A1： "B3, you shouldn't do that."

B3： "I'd do anything to win, so I don't really want you to go up."

A1： "All right then, you owe me 3 square magnets! It's unfair! You broke your promise! You will be condemned by God!"

B3： "I honestly want A2 to descend some more, but I can't." (A2 is closed to the end)

A1： "Never mind just let her go up. It gets harder the closer she gets." (The rule of this game require the players to find the right numbers to step forward to the end, otherwise, the players have to move backward based on the rest of numbers deducing from the forward steps)

B3： "Ok! I will let A2 go up."。

(Meanwhile, B1 interrupted their conversation and ask B3 to help A1)

B1: "Look! B3 let you go up!"

A1： "Ok, then. We are even B3!

(53'15"~55'50")

Denotation: Not surprisingly, the term "strong reciprocator," commonly used by Egalitarian, refers to those individuals that are inclined to both cooperate in one-shot interactions, and support those who do (Fehr & Fischbacher, 2004). From the above discourse, the study indicated that A1is a strong reciprocator even willing to help a defector when they themselves were merely the opposite party of a fair interaction.

4.4. Altruistic behavior in the game

In a game, not all people share common interests and help one another strategically. In a group, there are those who do not expect returns. After multiple "gives", a positive stimulus is produced within the group. Subsequent mutual help and teamwork attitude are then produced. Based on observed records, A2 is the altruist. The dialogue below shows how she repeatedly assisted her teammates in conducting computations:

Situation 1: At the game, basically, nobody can use calculator to count his or her number cards. Not every participant is good at arithmetic. Those who did better at math would need to wait longer for his or her turn and might feel impatient. As such, it was observed that effort was made to help those who were poor at arithmetic, even for the opponents.

A3: "B3, what cards have you got?"
B3: "8, 9, 3, 8, 1…"
A3: "let me count, 8, 9, 3, 8, 1…"
B2: You can't calculate for the opponents."
A3: "Yes, I can."
(73'23"- 75'15")

Toward the last part of the dialogue during the game, A3 actively helped others but was not dominating. She sought the greatest benefits by calculating on behalf of others.

Situation 2: Also, A2 displayed "self-sacrifice" characteristics in the group. She sacrificed herself to achieve greater good for the group. It is A1's turn, A2 asked others to descend her as shown in the dialogue below:

A1： "Let's calculate together (referring to A3), and see who's better."
B3： "You can't help her calculate!"
A2： "Let's compare if the equation she just wrote is better than mine."
（76'20"~76'53"）
A2： "I descended the least, descend me please." (She tried to work out the most possible ways to get the end for other teammates)
A1： "Why do we descend all the time in the game"? (She seemed to ask all players to give helps to opponents instead of giving hurt)
（77'00"~77'10"）

Toward the end of the game, A2 and A3 even helped their opponents compute. The mutual help mode not only applied among teammates but also between opposing teams.

Situation 3: At the final stage, if players choose not to use negative strategy, due to it was likely that all members of the team would be descended. Then, it would be difficult to get to the end.

A3： "B3, my calculations turn out to be 16."
A2： "16 means B3 has to go back a long way, 12 steps will be better."
A3： "B3 wait a moment, I re-calculate and come up to 10, take a look for you!"
（90'05"~90'30"）

Denotation: After being treated fairly and unfairly in a cooperative/competitive game, altruistic express cooperative emotions more frequently than do dominators or individuals (Schug et al., 2010). From the above discourse, that is, by expressing help emotions in the game playing, A2 and A3 are altruistic cooperators reveal their honest motivational intentions which serve to attract potential interaction partners and deter defection.

5. Discussion and Conclusion

Social behavior changes refer to the phenomena that people seem to care about certain "social" goals, such as a "fair" allocation among members in society, in addition to their own material benefits (Li, 2008).

To answer the first research question: "*Will the players'* s*ocially competent behavioral change when they are grouped to play a coop-competition game?"* The results of this study showed that at the beginning, individualistic behavior displayed frequently in the boys' team and dominating behavior was displayed at the final stage in the boys' team. Evidence of 'conditional cooperation' is identified: when students expect others to contribute, they themselves tend to donate more (Frey & Meier, 2004). In the manifestations of children's game behavior, the interaction frequency increases as they get closer to the target, their altruistic behavior appeared at the final competitive stage in female team. The Strike Up game involved activities in creating coalitions and dominance result in many of the social behaviors of boys that are sometimes viewed unfavorably, this result is agreed to the study of Geary et al. (2003) which indicates that boy are more serious to win then their proself behavior is displayed at the beginning stage of competition, because they do not want to be the suckers (Croson, 2007; Gachter et al., 2003)

To answer the second research question: "*Is there any significant difference of behavior change between girls and boys in the game*?" It is observed that the numbered cards utilized in Strike Up help promote arithmetic competence of children. Function card use also helps enhance interactions between teams. The function cards in the game design can be used to help or to set up opponents. At the beginning of the game, girls mostly interacted in egalitarian mode, or chose to be outsiders. When competition grew fiercer at the end of the game, children changed from egalitarian to individualistic or altruistic. If an altruist is present in a group such as A2, there will be mutual help between groups, and harmony can be maintained. The results are agreed to the studies of Geary et al. (2003) and Trivers (1971) which state that among the proximate mechanisms of cooperation, if they feel guilt for a failure to reciprocate, they will monitor the give-and-take of the relationship and maintain the cooperation. In comparison to girls, the relationships of boys are predicted to be and are more readily maintainable (Whitesell & Harter, 1996).

In conclusion, this study found that that apart from a few unconditional cooperators ("altruists"), most 5th grade male students are *only* willing to cooperate when they expect others to cooperate as well. The most powerful support for the importance of social norms for altruistic behavior directed towards genetically unrelated individuals stems from studies of strong reciprocity. Consequently, people who contribute apparently trust the others after several runs in this game. These results of this study may imply grouping system for allocating different characters of students in the game of *Strike up* to promote the awareness of prosocial behavior and maintain the behavioral intention more stable.

6. Limitation and Future study

This study has been conducted in qualitative method, the case analysis was employed which might not be enough to predict all other cooperative and competitive contest settings, and the quantitative method should further be applied to analyze the research data to imply the better grouping for students to have behavior change.

Social information processing models can be used to explain the development and maintenance of prosocial behavior (Nelson & Crick, 1999). More precisely, relationships based on reciprocal altruism should result in the evolution of proximate social and emotional mechanisms that function to ensure equality of the benefits received from the relationship. This model would be examined in relation to the development of behavioral intention, future study may place at examining the relation between prosocial behaviors and the evolutionary change of 4 types of game behavior in a coop-competitive game.

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Appendix 1: The objectives and rules of Strike up game

A Objectives of the game

1. To improve the four arithmetic operation abilities in players
2. To foster group unity and highlight team work
3. To encourage long-term planning with the design of elevators, for example. Students learned that what seems to be a shortcut may be a trap in disguise.
4. To enhance teachers' understanding of students' personality—may they be conservative or aggressive players— with the design of Safety Area.
5. To train students in making decisions with optimized game strategies.
6. To increase difficulty in using four arithmetic symbols with five Number Cards instead of four.

B Basic game rules

1. The game is played between two teams: Team A and Team B. Each team is composed of 2-3 members, coded as A1-A3 and B1-B3.
2. Every player begins from the *Start.* Players take turns drawing cards in the order of A1 → B1 → A2 → B2, and so on.
4. Player first draw designed *Number Cards* (1 to 9), and create a math equation with these numbers in addition to math symbols including *addition, subtraction,*

multiplication, division, and *parenthesis*.

5. Each symbol can only be used once.
6. Then players round up the number they come up with at this stage before continuing with the calculation and move to that position.
7. Next, players draw one Function Card (10, J, Q, K, and Joker) and calculate accordingly to reveal with the final number of steps for them to take.
8. The process repeats with every player.

C Player advancement

1. *Shortcut*: players must take any elevator they happen to encounter on their way to the finish. Elevators may be going upward or downward depending on game design.
2. *Bumping back*:
   2.1. players from opposing teams may find themselves in close proximity to each other during the game.
   2.2. When a *late comer* approaches to within 5 steps form an *early arriver*, the early arriver would be *bumped off* its leading position and relocated to the late arriver's previous position.
   2.3. This rule does not apply to situations where the late comer approaches by using a Function Card or a shortcut.
3. *Safety Area*: when players stop in a *safety area*, they are exempted from losing their leading position when a late comer catches up.

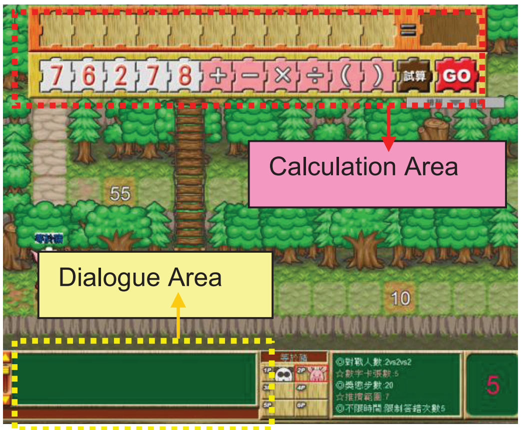
D Function Cards

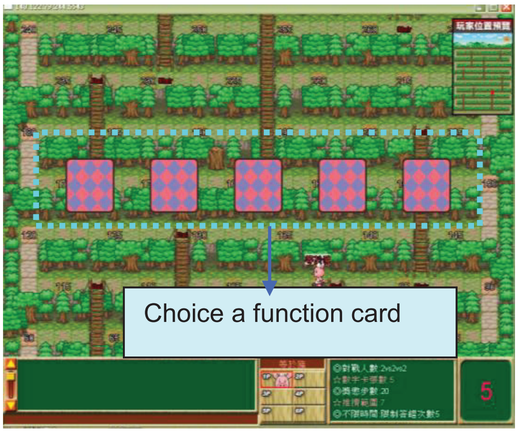
1. *10*: Take the nearest elevator to move yourself up or down regardless of where it goes.
2. *J:* Make one player take the nearest elevator to move up or down
3. *Q*: Go 50 steps forward or backward for yourself.
4. *K*: Make one player go 50 steps forward or backward.
5. *Joker*: The player is suspended from the game for the next round.

E Condition for winning

A team is considered the winning team only when every team member arrives at the finish. Players have to stop exactly at the finish for them to conclude the game.

Appendix 2: The Scene of Strike up game


Calculation Area
Dialogue Area
GO


Choice a function card

Mohd Ayub A. F. et al. (Eds.) (2011). Workshop Proceedings of the 19th International Conference on Computers in Education. ChiangMai, Thailand: Asia-Pacific Society for Computers in Education.

Gender Differences in Help-Seeking and Supportive Dialogue during On-line Game

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Abstract

Gender difference plays an important role of helping-seeking and supportive behavior while the players encounter win or lose situation that will affect the cooperation in the on-line game. Our research team developed a game called Strike Up, and used it to investigate the help-seeking and supportive behaviors displayed by children in the cooperative/competitive scenarios. In Strike Up, players must calculate numbers in a strategic fashion so that they can move their flags to the destination faster than their opponents. Game players' help seeking and supportive types in on-line discussion were categorized by Kappa method and data was analyzed by Kappa method, then Chi-square test was employed to examine the gender difference in different types of dialogues. The discourse analysis indicated that boys exhibited used more negative semantics. Girls appeared to display a more communal or cooperative orientation, as they used more positive, socially supported language. At the beginning of the game, boy were less willing to seek help than girls, yet, at the end, as the pressure of the competition mounted, male players became more eager to find assistance from teammates and were seen to adopt more help-seeking behaviors. The results can be implicated to increase the competition in game design to foster the help-seeking and supportive social behavior.

Keywords: Gender differences, Help-seeking, Social support, Discourse analysis, Interactive behavior.

Introduction

Social constructionists contend that knowledge is developed and sustained through social processes, and knowledge and social actions are intricately linked. Berge and Colins (1995) point out the following: "Talk and discussion provide an opportunity to articulate and explain one's own thing and perhaps to modify one's own ideas, beliefs or self-presentation in response to feedback from others. Incorporation of new data, the testing of arguments, and using one's judgment and reasoning helps move a person toward new perspectives and higher levels of thinking" (p. 183). Weinberger, Stegmann and Fisher (2007) have focused on the acquisition of knowledge and the idea that learners may share knowledge by contributing their ideas through discourse (knowledge sharing), and that other learners integrate these ideas into their own lines of reasoning. Fraser et al. (2005) proposed that social–emotional skills, which involve information processing skills, enhance confidence in one's social skills. It is suggested that playfulness can be enhanced during mathematical games to improve social skills, especially when one seeks to show colleagues the mechanisms of problem solving (Nunokawa & Fukuzawa, 2002; Hanna, 1995). Situations in which colleagues offer reciprocal support in an effort to find possible solutions to a problem will promote their interest in game playing (Nunokawa, 2005). There is some evidence that collaborative discourse and argumentation make learning gains more permanent (Nussbaum, 2008). In line with those excerptions, help-seeking plays an essential role particularly important in computer-based interactive learning environments (Bartholomé, Stahl, Pieschl, & Bromme, 2006), this study generate a game named Strike up which needs the players involve in a cooperative and competitive situation to test their social emotion change.

Research on gender differences in computer game playing suggests that boys have historically been seen as more successful (Greenfield, 1999) and enthusiastic (Mitchell, 1985) than girls, particularly in competitive game play. Carbonaro, Szafro, Cutumisu, and Schaeffer (2010) use an interactive game adventure authoring tool to measure gender difference and find that females scored significantly better than males on higher-order thinking skills. From social cognitive psychology, gender differences appear to be important in help-seeking and support behaviors (Wester et al., 2007). To date most research on help-seeking is restricted to e-learning settings. Due to essential differences between the help-seeking process in e-learning interactive settings and in cooperative-competitive game of these findings would be inappropriate. Thus, there is a need to conduct research on help-seeking in the cooperative-competitive game as an understanding in its own right. As such, this study investigates gender differences in educational game play through exploring following two questions: 1) the different types of help-seeking and supportive behaviors of boys and girls, and 2) the changes in help-seeking and supportive behavior as play proceeds.

Research Contents and Hypotheses

Vygotsky emphasized dialogue. He argued that all cognitive functions originate in social interactions, and that learning is not simply the assimilation and accommodation of new knowledge by learners (Fosnot & Perry, 2005; Vygotsky, 1978). From his perspective, creating meaning involves a process of sharing various perspectives and experiences in communities of practice (Fosnot & Perry, 2005; Vygotsky, 1978). Therefore, learning is derived from rich conversation with other people who have similar or different perspectives based on their own life experiences (Jonassen, 1999).

1. Help-seeking and support in game playing

In Vygotsky's socio-cultural view, mental functioning develops as the learner internalizes and transforms the contents of social interaction (Vygotsky, 1978b, 1981). From a coactive systems viewpoint, individual action emerges as the product of coactions among components, and is not the linear outcome of components acting independently (Mascolo, 2005). Therefore, in coactive game playing, mutual benefits are maximized as learners work together to complete common tasks in a supportive, reduced-stress climate. Thus, learning partners have played an important role in previous interventions that incorporated learning through playing (Homles, 2007). Shih (2007) studied the avoidance of help-seeking in upper elementary school students, and observed that if the goal structure was very clear to the students, more adaptive help-seeking tendencies would be displayed. Nevertheless, from a psychological point of view, a partner's unwillingness to share information with others in social interactions is hardly surprising, given that the transmission of information is often regarded as a loss of power (Kimmerle, Cress, & Hesse, 2007). In addition, giving information is associated with extra time and additional effort. Specifically, it is suggested that the exchange of explanations about strategies learned will increase the level of student interest in the content (Webb & Mastergeorge, 2003). To understanding the willingness to help-seeking or supportive from players' dialogues at different stages, the hypothesis to guide this study is:

Hypothesis 1: Players' would have more willingness to seek help and support others while they encounter highly competitive stage.

2. Gender difference in help seeking and supportive game behavior

Under cooperative conditions in game playing, group members will help each other to some extent in rearing and guarding the player mates (Pen & Weissing, 2000; Weibull & Salomonsson, 2006). Some evidence suggests that boys are much more enthusiastic in computer game than females (Connolly, Boyle, Stansfield, & Hainey, 2007; Gorriz & Medina, 2002). In addition, boys' speech is often directive, and is frequently used to assert power and influence over others (Archer, 1992; MaCcoby, 1998). In contrast, girls tend to engage in more intimate social interactions, turn-taking, and cooperative endeavors (Meece, Glienke, & Burg, 2006). Taken together, boys have been characterized as having a more competitive style of interaction, while girls have a more communal or cooperative orientation (Eagly, 1987; Hartmann & Klimmt, 2006; Leaper, 1994). However, it is also important to note that there are many instances in which girls and boys behave similarly (Underwood, 2004). As those different assertions, the research hypothesis to guide this study is:

Hypothesis 2: Female players would have more willingness to seek helps and support others than those male players.

Game Design

Collaboration has been shown to increase students' knowledge of a wide range of subjects, including biology (Lazarowitz & Karsenty, 1990), mathematics (Fuchs et al., 1997; Webb, 1991), narrative composition (Daiute & Dalton, 1993), and computer programming (Web, Ender, & Lewis, 1986). Based on affordance theory (Gibson, 1977), this study was designed to examine the information-exchange dilemma between game players. Therefore, the game design for this research to analyze players' contribution behaviors represents a particularly stringent test of tools that foster computer-supported cooperation and competition.

To investigate children's behaviors in a competitive situation, a new game that requires cooperation among participants was developed as a research tool for this study. The game Strike Up was adapted from WEST, which was originally developed at the University of Illinois and subsequently revised, based on *Game Design Principles* by Kiili (2005), to increase player engagement. Although the essential elements in WEST were kept intact, some alterations were made to adapt the game for use in this study. The learning theme was changed to four arithmetic operations. In Strike Up, students must calculate numbers to move their flags to the game journey's destination. In the game's competitive mode, players of Strike Up have two choices of mode, 2 vs. 2 vs. 2 or 3 vs. 3. The children must take turns to ensure equal distribution of opportunities for each player. All participants can contribute positively, because the game is designed for children to generate their own strategies according to the rules of game.

Dice were replaced with playing cards (1-9), plus bonus cards (10, J, Q, K) that perform killer functions to increase game complexity. Each card dictates different game conditions. Number Cards are used to indicate numbers used in arithmetic operations, while certain cards are designated as special Function Cards. Some cards limit or increase players' use of four mathematical symbols (+;−; ×; ÷). For example, mathematical parentheses "( )" may be added to adjust game complexity for different players. In terms of game difficulty, the original bumping range was enlarged from 0 to 5 to increase the opportunity of being bumped back and the difficulty of arriving at the destination (Figure 1). In this scenario, based on students' dialogue, competitive and cooperative behaviors are overt and therefore easy to measure.

Strike Up is an internet-based game. Students can enter the game environment by connecting at home or by going online elsewhere. Besides playing the game, players can also interact with other players by entering design dialogue areas, as depicted in Fig 1.

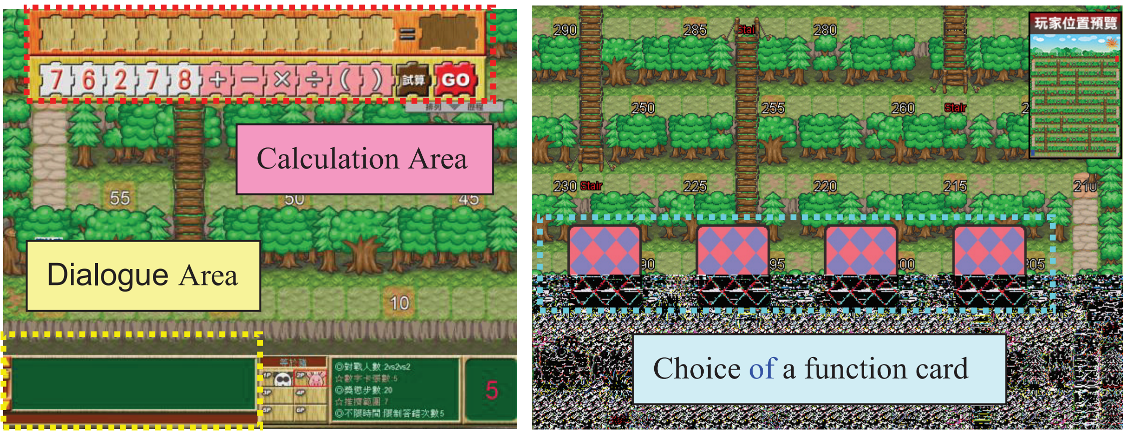

Fig.1 The Strike Up game scene

Research Design

Social constructionists recognize that meaning is constructed through language in context, and this is of particular relevance to this study. Attention to language is the social constructionists' acknowledgement of the significance of discourse (Young & Collin, 2004). Discourse advances thinking and is central to the process of knowledge construction. As ideas are shared and assessed, feedback is received and interpreted, emerging problems are solved, and joint decisions are made (Hennessy & Murphy, 1999). Cognitive presence represents the analysis, construction, and confirmation of meaning and understanding within a community of learners through sustained discourse (Garrison & Anderson, 2003). Through discourse, ideas, solutions, and decisions are made explicit and visible; partners share information and plan together, and engage in joint reasoning, evaluation and decision-making (Mercer, 1995).

Studies have found that different types of verbal interaction support different types of learning (Cohen, 1994). The resulting protocols that guide interaction are briefly discussed below. Discourse is characterized as messages about other messages (de Souza, 2005). Discourse is a process whereby interlocutors explore existing signification artifacts in order to express what they mean (de Souza, 2005). According to Osgood's classification (Osgood & Tanaha, 1965； Osgood, May, & Miron, 1975), language meanings can be grouped into three types: evaluation, potency and activity. Evaluation messages ('good–bad') are related to the judgment of abilities, for example, "you are very smart" or "you are very lousy." Potency messages ('strong–weak') are related to inspiration or discouragement, for example, "you are close to working it out." Activity messages ('do–undo') are related to instructions for doing more or thinking more, for example, "you can try it again."

The study involved playing Strike Up as a competition. The participants in this study were students from three schools. Each school sent twelve students, and students from the same schools were organized into three teams, based on gender. During the competition, verbal communication was forbidden. All communication had to be carried out through the embedded dialogue facility. The game dialogue and processes were recorded, and were subsequently examined for gender differences in the conversation content and cooperation modes. According to the theoretical framework below, this study classified the cooperation modes into Tables 1 and 2 (See Tables 1 and 2).

The connotative meaning of words can be reduced in dimension by factor analytic procedures. Principal component analysis of the students' dialogue extracted three components, which corresponded to the Evaluation, Potency, and Activity dimensions of Osgood and Tanaka (1965) and Osgood et al. (1975). The present study used a content analysis method to analyze children's conversations during the game. After classification of their conversations, a quantitative analysis was conducted. Differences in play based on gender were explored through six discourse types (Table 1).

Table 1: The different types of help-seeking and supportive dialogue

Semantics / Interactive behavior	**Activity**		**Evaluation**		**Potency**	
	Positive	**Negative**	**Positive**	**Negative**	**Positive**	**Negative**

Help-seeking	**1.1**	**1.2**	**3.1**	**3.2**	**5.1**	**5.2**
Supportive	**2.1**	**2.2**	**4.1**	**4.2**	**6.1**	**6.2**

Table 2: The classification categories and examples of help-seeking and supportive dialogue

Semantics			Content	Examples
Activity	1.1	**Positive Help-seeking**	Directly request assistance	Help me. Help me count.
	1.2	**Negative Help-seeking**	Use provocative words	Are you able to figure that out for me?
	2.1	**Positive Supportive**	Directly provide assistance	(9-6)/1*2+1 (8+4)*8-1/2 Look carefully at where the steps of the short-cut derive the bigger sum.
	2.2	**Negative Supportive**	Use challenging words	Why can't you do addition and subtraction before multiplication and division? If you count it wrong again, I will hit you.
Evaluation	3.1	**Positive Help-seeking**	Use praise to gain assistance	Your mathematical ability is the best.
	3.2	**Negative Help-seeking**	Use self-criticism to gain assistance	I am lousy at math, or, I am stupid.
	4.1	**Positive Supportive**	Use praise to provide less assistance	You are great; I only have to tell you a little for you to figure it all out.
	4.2	**Negative Supportive**	Use negative criticism to provide less assistance	You can't figure it out. I really want to

				scold you (stupid!).
Potency	5.1	**Positive Help-seeking**	Express confidence by using self-assertive words	This question is so easy for me to count.
	5.2	**Negative Help-seeking**	Use discouraging and/or unfortunate words	This one is difficult. My card no. is very low.
	6.1	**Positive Supportive**	Use encouraging and/or motivational words	Keep going, the right answer is very close.
	6.2	**Negative Supportive**	Use discouraging and/or unfortunate words	Hurry up! There is no time for you to count. You got bad luck. You really are a joker's sister.

2. Data collection and analysis

In this sense, social support can be defined by the perception of support. These concepts are best measured by observations and reports, by indices of satisfaction, or by scores of perceived support (van Dam et al., 2005). Interpretive discourse analysis (developed from the perspective of an insider) can be used to explore issues (e.g., those relating to role extension) implicit in texts arising from computer data mining, interviews, diary notes, questionnaires, institutional documents, and throughout the literature. Data are subjected to analysis at various stages in the research process. The processes of transcription and participant checking constitute further acts of interpretation. More formal analysis involves deliberately engaging in the act of interpretation and making sense purposefully through the exploration of themes and discourse in various categories (Boyes, 2004). Help-seeking and support related to game playing are accomplished through language. Approaches to language and textual analysis take many forms, and are closely related to issues of representation. To collect conversational data during game playing, students must type their thoughts in the "dialogue area." This text can then provide the data for discourse analysis.

A content analysis research method was used in this study. Before the analysis, all players' dialogue was stored in the computer game, which provided a large amount of dialogue data to be analyzed. Content analyses were focused on the following: (1)

semantics; (2) the relationship between gender and semantics; (3) interactive behavior; (4) the relationship between gender and interactive behavior; (5) the relationship between time and semantics; and, (6) the relationship between time and interactive behavior. In order to obtain consistency between the analyzers, the Kappa method was applied to examine the coefficient of discourse sentence analysis (Fleiss, 1971). The resultant kappa value was .709, which indicated that the analysis of the two focus groups (4 members in each group) reached significant consistency. Thus, all discourse could be classified into the 12 categories shown in Table 1.

Research findings

Data from 36 participants was collected in the Strike Up game. Researchers used a total of 382 sector dialogues. Their contents were analyzed according to the three dimensions: semantic activity, evaluation, and potency. Furthermore, each classification was divided into help-seeking and supportive interactive modes, and was encoded by positive and negative valences. The researchers also observed whether there were any changes in dialogue content as play time increased. Because the game was run three times and took a total of 75 minutes, the timeframe of analysis was divided to three 25-minute segments to check whether there were semantic changes as the game proceeded. The results of this study are illustrated as follows:

1. Semantic use in general

Through the analysis of gender and semantic frequency cross-reference (see Table 3), the category of positive supportive activity was found to have the highest frequency (23.6%). Examples of this category are: “Look carefully at where the stairs are,” “Look carefully!” or “8+4*8-1/2=39.5” (direct formula). These are the statements that demonstrate direct assistance or are more directive-oriented. The second-highest frequency rate, 20.9%, was in the category of positive supportive potency. The statements that exemplified this type were encouraging words such as “Keep going!” Finally, 15.7% of the overall statements were classified as a positive help-seeking activity, which demonstrated direct assistance seeking.

Each of these three types was positive. Overall, 67% of the statements showed a positive tone. This result demonstrates that the participants in this study tended to construct linguistic expressions filled with positive encouragement and assistance.

2. Gender differences in semantic usage

There were significant differences in semantics between the two genders ($\chi 2$ = 19.706, $p < .05$). Table 3 shows that the proportion of statements in the categories of positive and negative supportive potency, were higher in girls than in boys. This suggests that girls tended to express encouraging types of words, such as "Go" or "Hurry up," more than boys did. Boys had a slightly higher frequency of negative supportive evaluation wording than the girls. This suggests that boys tend to use "You are stupid" types of sentences more frequently. Statements classified as positive supportive evaluation were not observed in this study. This means that neither boys nor girls in this study said anything that could be classified as praising another's abilities.

Table 3: The percentage in each classification by gender

Classification			Girl		Boy		Total	
Semantics	Interactive model	Trend	Count	%	Count	%	Count	%
Activity	Help-seeking	Positive	33	8.6	27	7.1	60	15.7
		Negative	2	0.5	2	0.5	4	1
	Supportive	Positive	37	9.7	53	13.9	90	23.6
		Negative	6	1.6	8	2.1	14	3.7
Evaluation	Help-seeking	Positive	5	1.3	2	0.5	7	1.8
		Negative	4	1	6	1.6	10	2.6
	Supportive	Positive	0	0	0	0	0	0
		Negative	7	1.8	18	4.7	25	6.5
Potency	Help-seeking	Positive	9	2.4	10	2.6	19	5.0
		Negative	26	6.8	17	4.5	43	11.3
	Supportive	Positive	48	12.6	32	8.4	80	20.9
		Negative	21	5.5	9	2.4	30	7.9
Total			198	51.8	184	48.2	382	100

3. Interactive behavior in general

Overall, the percentage of interactive behaviors providing assistance (62.6%) was higher than those seeking assistance (37.4%). This demonstrated that the children in this study tended to offer help more often than they asked for help.

4. Gender differences in interactive behavior

There were no statistically significant differences in interactive behavior between girls and boys ($\chi2$ = 1.066, p = .302). As shown in Table 4, the percentages of supportive and help-seeking dialogue were very similar between girls and boys.

Table 4: The percentages of interactive behavior by gender

Interactive Behavior	Girl		Boy		Total	
	Count	%	Count	%	Count	%
Help-seeking	79	20.7	64	16.8	143	37.4
Supportive	119	31.2	120	31.4	239	62.6
Total	198	51.8	184	48.2	382	100.0

5. Semantic changes over time

The time frame for analysis was divided into three periods, each of which lasted for 25 minutes. The interactive dialogue between the players was recorded in the system. The results of Chi-square testing revealed that there were no significant differences in semantics among the three time periods ($\chi2$ = 43.261，p < .05). As shown in Table 5, greater amounts of dialogue were recorded in the first and second periods (counts of 128 and 161, respectively) than in the third period (93). This trend was observed in most of the semantics classifications. The exception was in positive supportive words, where the first time period had a lower count than the second and the third time periods, with a ratio of 17.2/25.5/29.0. This means that direct assistance seeking increased towards the middle and end of the game.

Table 5: The percentages of each semantic classification by time period

Classification			First section		Second section		Third section	
Semantics	Interactive model	Tendency	Count	%	Count	%	Count	%
Activity	Help-seeking	Positive	7	5.5	29	18	24	25.8
		Negative	2	1.6	0	0	2	2.2
	Supportive	Positive	22	17.2	41	25.5	27	29.0
		Negative	5	3.9	3	1.9	6	6.5
Evaluation	Help-seeking	Positive	4	3.1	2	1.2	1	1.1
		Negative	5	3.9	2	1.2	3	3.2
	Supportive	Positive	0	0	0	0	0	0
		Negative	11	8.6	11	6.8	3	3.2
Potency	Help-seeking	Positive	6	4.7	8	5.0	5	5.4
		Negative	17	13.3	21	13	5	5.4

Supportive	Positive	35	27.3	33	20.5	12	12.9
	Negative	14	10.9	11	6.8	5	5.4
	Total	128	100	161	100	93	100

6. Interactive behavior change with time

There were no statistically significant differences in interactive behaviors among the three time periods ($\chi 2$ = 2.910, $p > .05$). The ratios were very similar for the three time periods. This suggests that participants tended to provide assistance at a consistent level from the beginning of the game to the end.

Table 6: The percentage of interactive behavior by time period

Classification	First period		Second period		Third period	
Interactive Behavior Model	Count	%	Count	%	Count	%
Help-seeking	41	32.0	62	38.5	40	43.0
Supportive	87	8.0	99	61.5	53	57.0
Total	128	100	161	100	93	100

Discussion

An article, by Clark and Sampson (2008), addresses a broad array of social factors for creating open discussion. The article specifically focuses on the generation of new ideas in small groups, and finds that rudeness—disagreeing with others in a direct and confrontational way—is less effective in generating new ideas than polite disagreement.

Boyle and Connolly (2009) assert that "understanding the relationship between gender and computer games is extremely important for creating computer games that will function as effective educational tools." This study examined gender differences in dialogue during game playing. In particular, male and female players and their semantic usage in help-seeking and supportive behaviors, and changes in interactive behaviors as the game progressed, were analyzed. The following conclusions are offered:

1. *Interactive behavior in general*: Positive words are very important to motivate teammates to attain the goal state (Custer & Aarts, 2005, 2007). Context-sensitive help functions are especially susceptible to gaming behavior directed at better performance (Bartholomé et al., 2006). In the present study, children tended to use directive or ordering language in the cooperative-competitive game. However, more positive than negative statements were observed in general. The context of this game can generate a

public-goods dilemma (De Cremer, Snyder, & Dewitte, 2001) that accelerates the speed of play to complete the game, which is mainly the result of increasing interpersonal trust as playing time increases.

2. *Gender differences in interactive behavior*: Men and women differ in emotional arousal; women have been reported to use positive expression more frequently (LaFrance, Hecht, & Paluck, 2003; Schirmer, Kotz, & Friederici, 2005). In this study, girls tended to use more encouraging statements than boys, and boys tended to use more negative expressions, such as words with scolding connotations, in playing the game. In the sense, the research hypothesis 2 was supported.

3. *Gender differences in playing stages*: Help-seeking among adolescents has been described as a necessary ingredient in successful coping (Grinstein-Weiss, Fishman, & Eisikovits, 2005). Children's coping includes help-seeking for academic problems, yet they do not always seek help when it is needed, and help-seeking generally declines during early adolescence (Grades 5–6) (Marchand & Skinner, 2007). That result seemed only proved at age related study, from game playing perspective, the other observations of this study show that boys' helping seeking behavior was less at the beginning stage, in contrast, relatively high help-seeking behavior while the other team surpassed. Thus, the research hypothesis 1 was supported.

Concluding Remarks

In summary, the context of the Strike Up game can be helpful in group cooperative and competitive learning. The interactive discussions supported by the context of the Strike Up game also help to improve children's social abilities. The analysis of our study data found that the meaning dimensions described by Osgood and Tanaka (1965) and Osgood et al. (1975) could be confirmed, even some 40 years later in a totally different subject population. We also verified that the activity dimensions explained most of the dialogue. The findings further demonstrated that positive semantic words were nearly identical in female groups of subjects. Self-monitoring of expressive behavior comprises self-observation and self-control, and is guided by situational cues for social adequacy (Gangestad & Synder, 2000). Girls in this study displayed better self-monitoring behavior than boys, from their conversation while playing the game. Thus, the use of internet digital games as a stimulus material for the semantic classification of help-seeking and supportive behaviors in experiments can be considered very reliable.

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A Learning Style Perspective to Investigate Students' Perceptions in Choosing the Most-Beneficial Educational Systems

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Abstract: I n recent years, researchers have been engaged in the development of adaptive learning systems that provide the best way for helping individual students improve their learning performance. Among various personal data in student profiles, learning styles have been considered as being one of the factors that need to be taken into account in developing adaptive learning systems. Several studies have shown that, by taking learning styles into account, learning systems can benefit students more owing to the provision of personalized learning procedures or contents that match the cognitive processes of individuals. However, few studies have been conducted on investigating if students have the ability to choose the most-fit e-learning systems for themselves in terms of the learning style perspective; moreover, it is interesting to investigate the factors that affect students in choosing e-learning systems. In this paper, we aim to investigate these issues by using two versions of an educational gamed developed based on the sequential/global dimension of the learning style proposed by Felder and Silverman. A total of 288 students participated in the study. The experimental results showed that, the choices made by the students were not related to their cognitive process or learning styles; instead, most students chose e-learning systems by intuitions based on personal preferences. Such findings not only imply that students might not have the ability to choose the most-beneficial educational systems on their own, but also reveal the importance and necessity of providing scaffoldings and developing adaptive learning systems for guiding the students to learn in a more effective way.

Keywords: learning styles, cognitive process, human factors, educational computer games, adaptive learning

1. Background and Objectives

The provision of personalized or adaptive learning support for individual students has been recognized as being one of the most important features of e-learning systems [1]. By referring to the personal information, the adaptive learning systems can either present personalized content for individual students or guide them to learn by providing a personalized path [2-3]. In the past decade, lots of personalized or adaptive learning systems have been developed based on various personal information of students, such as their profiles (e.g., gender, age, knowledge level, and background data), learning portfolios, and preferences [4-5]. For example, Huang and Yang (2009) designed a semantic Web 2.0 system to support different types of knowledge and adaptive learning [6]. They found that combining the advantages of blogs and wikis were able to comprehend various types of knowledge and improve students' learning performance. In the meantime, Romero, Ventura and Bra (2009) proposed an advanced architecture for a personalization system to facilitate Web mining [7]. They developed a recommender engine and integrated it into the learning system for recommending to individual students the most appropriate links or Web pages to visit next. Furthermore, Klašnja-Milićević, Vesin, Ivanović and Budimac (2011) proposed a recommendation module of a programming tutoring system, which could automatically adapt to the interests and knowledge levels of learners [8].

Among those factors that affect the provision of personalized learning contents or paths, learning styles have been recognized by researchers as being an important factor [9]. Keefe (1987) stated that "learning style is a consistent way of functioning that reflects the underlying causes of learning behavior"[10]. He further indicated that learning style is both a student characteristic indicating how a student learns and likes to learn, as well as an instructional strategy informing the cognition, context and content of learning [11]. Previous studies have reported that the students' learning performance could be improved if proper learning style dimensions can be taken into consideration when developing adaptive learning systems [9]. For example, Graf, Liu and Kinshuk (2010) investigated the navigational behavior of students in an online course within a learning management system to look at how students with different learning styles prefer to use and learn in such a course. It was found that students with different learning styles used different strategies to learn and navigate through the course [12]. Hauptman and Cohen (2011) examined whether students with a certain learning style would benefit more from earning 3D geometry than other students. Their findings indicated a differential impact of virtual environments on students with different modal and personal learning styles [13].

Although adaptive learning has been widely discussed and has been recognized as being an effective approach for helping students improve their learning performance, few studies have been conducted to investigate whether students can choose the most-fit e-learning systems for themselves. In this study, an experiment has been conducted by providing students two versions of an educational computer game based on the sequential/global dimension of the learning style proposed by Felder and Silverman (1988) to investigate the following research questions [14]:

(1) Can students choose the educational computer games that fit them best from the learning style perspective?

(2) Is there any difference between male and female students in choosing the educational computer games?

(3) What are the factors that affect the students in choosing the educational computer games?

2. Literature Review

There have been several learning style theories proposed by researchers, such as those proposed by Keefe (1979) [15], Kolb (1984) [16] and Felder and Silverman (1988) [14]. Several previous studies have demonstrated the use of learning styles as one of the parameters of providing personalized learning paths or contents. For example, Tseng, Chu, Hwang and Tsai (2008) developed a personalized learning system by taking both the knowledge levels and the learning styles of students into account [3]. Later, Kinshuk, Liu and Graf (2009) propose an adaptive learning approach by analyzing the interactions between students' learning styles, behaviors, and their performance in an online course that was mismatched regarding their learning styles to find out which learners need more help, such that proper learning supports could be provided accordingly [17]. Furthermore,

Bolliger and Supanakorn (2011) examined the effects of learning styles on learner perceptions of the use of interactive online tutorials. Learners were categorized into five learning style categories and four learning modalities. The responses to a questionnaire in terms of survey dimensions were analyzed in order to ascertain differences based on learning style dimensions, gender and class standing [18].
Among those learning style theories, the Felder–Silverman learning style has been widely adopted and has been validated by various studies [19-20]. For example, Filippidis and Tsoukalas (2009) developed a web-based adaptive educational system based on the sequential–global dimension of Felder–Silverman's learning style theory [9]. The adaptive learning system provides different versions of images to present the same content with different detailed levels; that is, a detailed version of the images is given for the sequential learning style students, while a non-detailed version is presented to the global learning style students. Therefore, in this study, two versions of an educational computer game are developed based on the sequential/global dimension for investigating the students' ability and decision-making process in choosing the most-fit learning system.

3. Experiment Design

3.1 Participants

As the educational computer games were developed for an elementary school natural science course, a total of 288 in an elementary school of southern Taiwan voluntarily participated in the study. All of the students were taught by the same instructor who had taught that natural science course for more than ten years.

3.2 Measuring Tools

The measuring tool adopted in this study was the Index of Learning Styles (ILS) Questionnaire developed by Soloman and Felder (2001) [21]based on the learning styles proposed by Felder and Silverman (1988)[14]. The ILS measure consists of four dimensions, that is, sensing/intuitive, visual/verbal, active/reflective and sequential/global, each of which contains 11 items. In this study, the "sequential/global" dimension was adopted. Some of the questionnaire items of this dimension are "I tend to (a) understand details of a subject but may be fuzzy about its overall structure. (b) understand the overall structure but may be fuzzy about details." and "Once I understand (a) all the parts, I understand the whole thing. (b) the whole thing, I see how the parts fits." Choosing "a" indicates that the tendency degree of "sequential" is increased; otherwise, the tendency degree of "global" is increased.

3.3 Sequential and Global Style Educational computer games

In this study, two versions of an educational computer game are developed for the "knowing the plants on school campus" unit of an elementary school natural science course based on the sequential/global dimension of the Felder–Silverman learning style. The objective of the subject unit is to foster the students' competence in identifying and differentiating a set of target plants.
The game was implemented by employing the RPG Maker developed by Enterbrain Incorporation. The background of the game is about an ancient kingdom in which the people are infected by poisoned water in a river. Following the hints from an ancient medical book, the king decides to look for the plants that are able to cure his people.

The game designed for sequential style learners provides a "step-by-step" interface to guide the students of this style to complete the learning missions since they tend to think linearly and learn in small incremental steps [14]. Figure 1 shows the interface of the sequential style game. The learners are guided by this version of the educational computer game to the next mission only after the present mission has been completed.

Figure 1. The sequential style game

On the other hand, the global style game provides a "global mission map" that enables the students to select any mission or jump to any game scene since they tend to learn with holistic thinking processes in large leaps [14]. Figure 2 shows the interface of the global style version of the educational computer game.

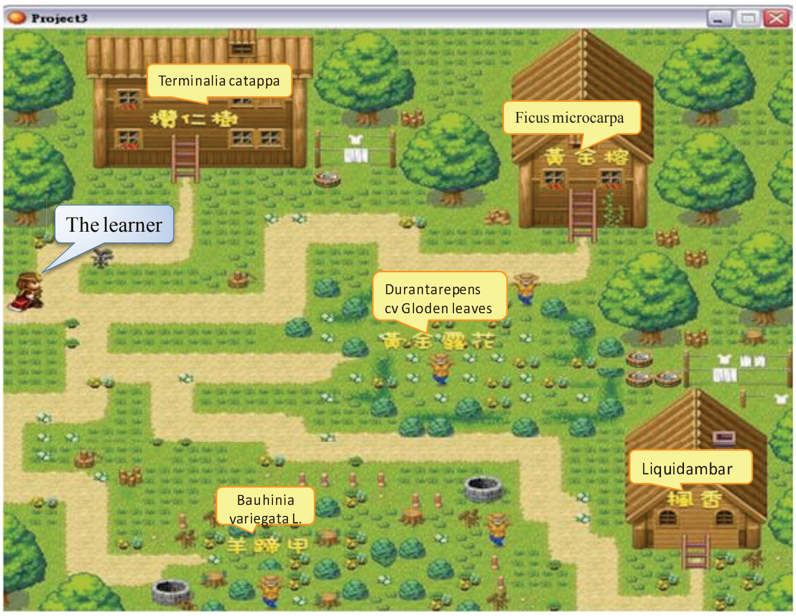

Figure 2. The global style game

3.4 Experiment Procedures

Before the experiment, the students took the learning style questionnaire for categorizing them into sequential or global style. Following that, a one-hour presentation was made by the teacher to show them the two versions of the educational computer game, including the differences and similarities between the two versions; moreover, the students were informed that the two versions of the game had identical content related to the "knowing the plants" unit of the natural science course. After the presentation, the students were asked to make the choice between the two versions of the game and write down the reasons for the choice.

4. Results

4.1 Relationships between students' learning styles and their choices of the e-learning systems

From the learning style questionnaire result, it was found that 134 of the participants were sequential style students, while 154 of them were of global style. Table 1 shows the ratio of the choices made by the different learning style students. It is found that 86.1% of the students chose the global style system, while only 13.9% of them chose the sequential style system; that is, most of the students prefer the global style version of the educational computer game. Moreover, 86.5% of the sequential style students chose the global style system and only 14.3% of the global style students chose the sequential style system.

Table 1. Descriptive data of students' learning styles and their choices of the educational computer game

		Choices of the educational computer game		Total
		Sequential	Global	
Students' Learning Style	Sequential	18 (13.5%)	116 **(86.5%)**	134
	Global	22 (14.3%)	132 (85.7%)	154
Total		40 (13.9%)	248 **(86.1%)**	288

To further investigate the relationships between students' learning styles and their choice of the educational game, the Chi-Square analysis was applied to the questionnaire data, as shown in Table 2. It is found that the correlation between the students' learning styles and their choice of the learning systems was not statistically significant (r = 0.44, p>.05). Consequently, it is concluded that the choices made by the students were not related to their learning styles; that is, the students did not choose the educational games by considering the underlying needs for learning effectiveness.

Table 2. The Chi-Square result of students' learning styles and their choices of the educational games

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	.044	1	.835
Likelihood Ratio	.044	1	.835
Linear-by-Linear Association	.043	1	.835
N of Valid Cases	288		

4.2 Relationships between genders

Table 3 shows the descriptive data of male (N = 158) and female (N = 130) students in choosing the two versions of the educational computer game. It is found that 137 out of 154 male students and 121 out of 130 female students chose the global style system, indicating that both the male and the female students prefer the global style version of the educational computer game. Moreover, it was found that 81.1% of the male sequential style students (60 out of 74) and 93.3% of the female sequential style students (56 out of 60) chose the global style game.

Table 3. Descriptive data of students of different genders in choosing the educational computer games

Gender			Choices of the educational computer game		Total
			Sequential	Global	
Male (N = 154)	Learning Style	Sequential	14 (18.9%)	60 (81.1%)	74
		Global	17 (20.3%)	67 (79.7%)	84
Female (N = 130)	Learning Style	Sequential	4 (6.7%)	56 (93.3%)	60
		Global	5 (7.2%)	65 (92.8%)	70
	Total		40 (13.9%)	248 (86.1%)	288

By applying the Chi-Square analysis, it is found that the correlations between the choices of the educational computer games and the learning styles of male and female students are $r = 0.43$ ($p>.05$) and $r = 0.11$ ($p>.05$), respectively, which were not statistically significant. Consequently, it is concluded that, for both genders, the choices of the educational computer games were not related to their learning styles.

4.3 The factors that affect the students in choosing the educational computer games

In order to investigate the factors that affect the students in choosing the educational computer games, the feedback from the students were analyzed. Table 4 shows descriptive statistics of the feedback from the students in stating the reasons for making the choices. It was found that 73.9% of the participants response that "The game I chose looks more interesting than the other"; 71.7% of the participants made choices because they felt that "The game I chose looks more relaxing"; 65.2% of the participants addressed that "Such an operational interface conforms to my previous experiences of playing game" and 66.7% of the participants stated that "The design of the game seems to be easier to operate".

To sum up, the factors that affect the students in choosing the educational computer games include "interesting", "relaxing", "ease of use" and "conforming to previous experiences", which are irrelevant to the cognitive process of individual students with different learning styles. Consequently, it is necessary to develop adaptive learning systems for guiding the students to learn in an appropriate way, including proving personalized learning interface or paths to present learning content in the most beneficial manner for individual students with different learning styles.

Table 4. Descriptive statistics of factors that affect students in choosing educational computer games

Factors		Global style students who chose sequential style game (N = 116)		Sequential style students who chose Global style game (N = 22)		Total (N=138)	
1.	The game I chose looks more interesting than the other.	86	(74.1%)	16	(72.7%)	102	(73.9%)
2.	The game I chose looks more relaxing.	84	(72.4%)	15	(68.2%)	99	(71.7%)
3.	Such an operational interface conforms to my previous experiences of playing game	74	(63.8%)	16	(72.7%)	90	(65.2%)
4.	The design of the game seems to be easier to operate.	75	(64.7%)	17	(77.3%)	92	(66.7%)

5. Discussion and Conclusions

In this study, we investigate students' perceptions in choosing the most-beneficial educational systems from the perspective of learning styles. The participants were asked selected one of the two versions of an educational gamed developed based on the sequential/global dimension of the learning style proposed by Felder and Silverman. The experimental results on 288 students showed that, the choices made by the students were not related to their cognitive process or learning styles; instead, most students choose e-learning systems based on intuitions or preferences, such as "interesting", "relaxing", "ease of use" and "conforming to previous experiences". Such findings provide a possible explanation to what was reported by Wang and Chen (2010) that choosing educational computer games based on preferences does not benefit the students since the choices did not comply with the students' cognitive process or learning styles [22].

Furthermore, the findings also reveal the importance of providing learning supports and developing adaptive learning systems to help the students learn in a most beneficial scenario by taking the cognitive process or learning styles of individual students into consideration. That is, this study gives an evidence for supporting the development of adaptive learning systems; in particular, for those studies that employ learning styles as a factor for adapting learning content, presentation styles and learning paths for individual students.

On the other hand, although this study showed some significant experimental results, the use of the computer educational games in this study might not be able to represent the common features of most learning systems; moreover, the implication of this study is limited owing to the investigation was conducted on only one dimension of a learning style. In the future, more studies are needed for investigating relevant issues using various learning systems by taking different learning dimensions into account.

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Prior Knowledge and Cognitive Styles in Personalized Learning

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Abstract: In the past decade, a number of personalized learning systems have been developed. Prior knowledge has widely been considered in the development of personalized learning systems. On the other hand, previous research suggested that cognitive styles have great effects on student learning. To this end, this study examine how cognitive styles, affect learners' reactions to a personalized and non-personalized learning systems based on learners' prior knowledge. Forty-four undergraduate and postgraduate students participated in this study. The results show that Serialists show positive reactions to the personalized learning system while Holists demonstrate equal reactions to the personalized learning system and the non-personalized learning system. The implications of these results for the design of personalized learning systems are discussed.

Keywords: Cognitive Styles, Personalization, Prior Knowledge

1. Introduction

Web-based learning systems provide students with multiple ways so that they can develop their own learning approaches. This may be the reason why Web-based learning systems are so popular in educational settings [20]. The reason for such popularity is that the Web-based learning systems offer many advantages over traditional classroom-based training. On the other hand, there is great diversity among learners, who may have heterogeneous backgrounds, in terms of their knowledge, skills and needs [4]. Moreover, learners who have various backgrounds may prefer to interact with the Web-based learning systems with different ways [4]. Thus, there is a pressing need for the development of Web-based learning systems that can support the preferences of each learner [2]. To address this issue, personalization is widely used in the field of Web-based learning. Personalization tailors content, structure and/or presentation to match the preferences of each individual according to his/her characteristics and needs [25] [14] [16]. However, the delivery of personalization is complex because the adaptation to each individual requires the understanding of his/her preferences[1] and prediction of his/her behavior [9]. Therefore, understanding each learner's preferences is an essential issue for the delivery of personalization.

As showed in the previous discussion, students have diverse preferences when using the Web-based learning system. Thus, human factors play an important role in the development of the Web-based learning systems, ranging from prior knowledge [15] [19] to cognitive styles [3] [7]. Among various characteristics, prior knowledge is predominant in personalization, especially for Web-based learning [27]. Empirical evidence has suggested that personalizing Web-based learning systems based on learners' prior knowledge can improve their learning performance [10] [23] [28]. Such systems are useful because they can deliver tailored services in a way that will be most appropriate and valuable to the learners [2]. However, they mainly focus on prior knowledge and ignore the effects of other human factors.

In addition to prior knowledge, cognitive styles also play an essential role in Web-based learning and affect each individual's learning preferences and behavior [5]. Thus, it is not sufficient to provide effective personalization to take into account prior knowledge. In other words, cognitive styles should also be taken into account in the delivery of personalization. Within the area of cognitive styles, Witkin's Field Dependence [29] has emerged as one of the most widely studied human factors. Witkin's Field Dependence has a conceptual link with the other dimension of cognitive style, i.e., Pask's Holism/Serialism. Jonassen and Grabowski [17] describe Holists as preferring to process information in a 'whole-to-part' sequence. However, the different preferences between Field Dependent and Field Independent users can be divided more clearly and logically than the differences between Holists and Serialists. In other words, identifying the different preferences of Holists and Serialists is more complex. To this end, this study investigates Pask's Holism/Serialism, instead of Witkin's Field Dependence.

In summary, the study presented in this paper attempts to investigate personalized Web-based learning systems from the perspective of multiple human factors. In harmony with the main stream of personalization, this study develops a personalized Web-based learning system based on learners' prior knowledge and then examines how cognitive styles affect learners' reactions to this personalized Web-based learning system. The ultimate aim of this study is to incorporate both prior knowledge and cognitive styles into the delivery of personalization because these two human factors are widely applied in the delivery of personalization [22]. Thus, the outcome of this study can not only be used to improve the development of personalized Web-based learning systems, but also provide concrete solutions to personalize other Web-based applications, such as online shopping and search engines. By doing so, the quality of these applications can be improved.

2. Methodology Design

To effectively achieve the aforementioned aim, an empirical study was conducted. This section describes the methodology design of the empirical study, including participants, research instruments, experimental procedures and data analyses.

2.1 Participants

Previous research indicated that there is a need to investigate how to provide additional support for low-prior knowledge learners [6]. Thus, this study focuses on low-prior knowledge learners. More specifically, 44 undergraduate and postgraduate students from some universities in Taiwan participated in our study voluntarily. A request was issued to students in lectures, and further by email, making clear the nature of the studies and their participation. All participants had the basic computer and Internet skills necessary to use a Web-based learning system but they do not any understanding of the subject content of the Web-based learning system described in Section 2.2.1.

2.2 Research Instruments

The research instruments used in this study included (1) two Web-based learning systems used to teach students "Interaction Design", (2) Study Preferences Questionnaire used to measure students' cognitive styles, (3) task sheet used to describe practical tasks that students need to do when interacting with the Web-based learning systems, and (4) post-test used to assess how students have learnt after using the Web-based learning systems.

2.2.1 Web-based Learning Systems

In this study, two Web-based learning systems are developed. Both of them give an introduction to Interaction Design and provide two kinds of navigation tools. One is Keyword Search, which allows learners to locate specific information based on their particular needs. The other one is Hierarchical Map, which provides a global picture of the subject content. Nevertheless, these two Web-based learning systems provide personalization for learners with different levels of prior knowledge. One is for low prior knowledge learners, i.e., a personalized learning system, while the other is for high prior knowledge, i.e., a non-personalized learning system.

The design rationale of the two Web-based learning systems is based on a framework proposed by Chen, Fan and Macredie [6]. Learners with low prior knowledge lack sufficient understanding of subject content so there is a need to provide them with simple design and more visual cues. Thus, the personalized learning system provides a single keyword search so that the learners can make a simple query. Furthermore, keywords searched are highlighted with yellow color in the display of the results so that learners can easily identify whether results are relevant. Additionally, there is a simple tree map (Figure 1), with which learners can construct knowledge step by step. Conversely, learners with high prior knowledge have a great deal of the understanding of subject content so they can accept sophisticated design and fewer visual cues. Therefore, the non-personalized learning system provides multiple keyword search with Boolean operators. Keywords are not highlighted but there is a complete tree map (Figure 2), with which learners can jump from one section to the other section directly.

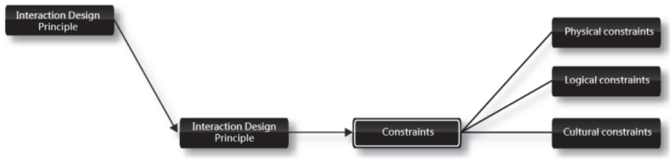

Figure 1. Hierarchical Map (Personalized learning system).

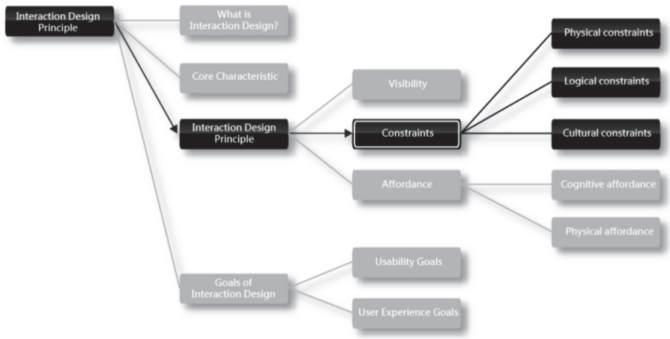

Figure 2. Hierarchical map (non-personalized learning system).

2.2.2 Task Sheet

When interacting with the Web-based learning systems, the participants were given a task sheet, which described the tasks that learners need to perform. To reduce the bias of this study, there are two different kinds of tasks. One is a factual question while the other is an essay question. The former focuses on a single concept and there is only one standard answer for the question. The latter includes multiple concepts so learners have to realize the relationships of various keywords described in the questions. Learners need to complete these two kinds of tasks. The starting time and the end time for each student were recorded.

2.2.3 Post-test

The post-test was designed to assess how much they have learnt from the Web-based learning systems. The post-test was presented in a computer-based format and included 20 multiple-choice questions. Each question included three different answers and an “I don’t know” option but there was only one right answer. The questions covered all eight sections of the Web-based learning program from basic concepts to advanced skills. Students were allotted 20 minutes to take the post-test and were not allowed to examine the content presented in the system at the same time.

2.2.4 Study Preferences Questionnaire (SPQ)

As suggested by Section 1, further empirical studies are needed to examine the differences between Holists and Serialists so the study presented in this paper investigates Holism/Serialism, instead of Field Dependence/Independence. In an attempt to devise a relatively quick and easy measure of Holist and Serialist biases, Ford [12] developed the Study Preferences Questionnaire (SPQ), which is an 18-item inventory for categorizing learners as Holists or Serialists. In this vein, students were provided with two sets of statements. They were asked to indicate their degree of agreement with either statement or to indicate no preferences [12]. As the SPQ has been used in several studies [8] [11] [13] [26], it was chosen for this study, which identified Holists and Serialists by using criteria suggested by the original producer [12]: (a) if users agree with over half of the statements related to Holists, they are identified as Holists; (b) if users agree with over half of the statements related to Serialists, they are then considered as Serialists, and (c) if users agree with half of the Holist statements and half of the Serialist Statement, they are then considered as Intermediate. The reliability of the SPQ is adequate ($\alpha = 0.67$) [21].

2.3 Experimental Procedures

There were two scenarios in this study. One is a personalized scenario, in which learners used a Web-based learning system that matched with their prior knowledge. The other is a non-personalized scenario, in which learners used a Web-based learning system that did not match with their prior knowledge.

Regardless the personalized scenario or non-personalized scenario, learners need to complete the tasks when they interact with the Web-based learning systems. After finishing the tasks, they were required to go into the final step, i.e., the post-test. They needed to take the post-test to evaluate how much they have learned from the Web-based learning systems, which is regarded as their learning performance.

2.4 Data Analysis

In this study, seven attributes were analyzed with data mining techniques, including (1) the total time used for keyword searching, (2) the frequencies of using keyword searching, (3) the total number of movements made, (4) the total number of repeated visiting, (5) the total number of visited pages, (6) the number of pages in each keyword searching, and (7) the number of pages visited each second.

Among various data mining techniques, K-means was used to conduct data analyses for this study because it was widely used to analyze learners' on-line learning behaviors. In particular, our recent studies [7] found that K-means is a useful tool to cluster learners' behavior. However, a major limitation of using the K-means algorithm is that the number of clusters needs to be predefined. In other words, there is a need to identify the most suitable number of clusters to perform the K-means algorithm. Such an issue can be treated as parameter exploration [18], which is used to decide the suitable value of parameters. The parameter exploration is useful when a dataset is not large. Thus, the K-means algorithm is suitable for this study because the dataset was not large. Therefore, the parameter exploration was applied to decide the parameters of the K-means algorithm in this study.

3. Results and Discussion

3.1 Overview

As indicated in Section 2.4, seven attributes were considered in data analyses. The data obtained from these seven attributes had been normalized firstly before utilizing the K-means algorithm because these attributes are not comparable. More specifically, a big difference exists among the range of these attributes. Subsequently, the clusters are created with the K-means and they are divided into two groups, i.e., the personalized scenario and non-personalized scenario, each of which has four clusters. After carefully examining the details of the clusters in each scenario, we found that one cluster can be treated as outliers in each scenario because there are few number of cases. Therefore, only three clusters are used for further investigation in each scenario.

Furthermore, we found that two attributes show differences among the three clusters for each scenario, i.e., the number of pages visited for each keyword search (page/keyword) and the number of pages visited per second (page/task time). Additionally, we also examine corresponding features of each cluster, including post-tests scores, task time and cognitive styles.

3.1.1 Personalized Scenario

Three clusters are applied for the investigation of this scenario. Cluster 1 is the major cluster, which includes almost half of the participants. The trend of each cluster is described below.

C1 (N=10): The number of pages read with each keyword search (page/keyword) is higher than the number of pages read per second (page/task time) and they get the best post-test score (Mean=10.40; Standard Deviation=2.59), regardless the personalized or non-personalized scenario.

C2 (N=6): The trend of this cluster is similar to Cluster 1 in the personalized scenario. However, learners get the lowest post-test score (Mean=9.67; Standard Deviation = 3.61)among the three clusters in the personalized scenario.

C3 (N=5): The trend of Cluster 3 is similar to Cluster 1 and Cluster 2. However, learners in Cluster 3 spend the longest task time (Mean=0.31; Standard Deviation = 0.07) among the three clusters of the personalized scenario.

3.1.2 Non-Personalized Scenario

Like the Personalized Scenario, there are also three clusters considered in the non-personalized scenario. The trend of each cluster is described below:

C1 (N=5): The number of pages read with each keyword search (page/keyword) is lower than the number of pages read per second (page/task time) and they get the best post-test score (Mean=9.60; Standard Deviation = 1.34) among the three clusters of the non-personalized scenario.

C2 (N=7): The trend of this cluster is similar to Cluster 1 in the non-personalized scenario. However, the post-test score (Mean=8.57; Standard Deviation = 3.95) is not only the lowest one in the non-personalized scenario, but also the lowest score among the six clusters. The majority of females appear in this cluster.

C3 (N=7): The trend of Cluster 3 is similar to Cluster 1 and Cluster 2. However, learners in this cluster spend the longest task time (Mean=0.50; Standard Deviation = 0.27), regardless the personalized or non-personalized scenario.

3.2 Learning Performance

This section compares the differences between students' learning performance in the personalized scenario and those in the non-personalized scenario. To address such an issue, the students' post-test scores and task time were used to evaluate their learning performance.

Regarding the post-test score, students in the personalized scenario performed better than those in the non-personalized scenario (Figures 3 to 5). In other words, students can benefit from the personalized scenario to get high post-test scores whereas they may obtain low post-test scores in the non-personalized scenario. In this study, the personalized scenario provides a simple interface while the non-personalized scenario presents a complex interface. This finding suggests that the simple interface is suitable for students with low prior knowledge to help them learn an unfamiliar topic, which in turn, they can obtain high performance. Conversely, the complex interface in the non-personalized scenario can not only make students obtain low performance in the post-test, but also let students waste much time in an unsuitable environment.

Regarding task time, the students in the personalized scenario spent less time completing the tasks than those in the non-personalized scenario (Figure 6). It means that students in the personalized scenario can not only get a high post-test score, but also can use an efficient way to complete their tasks. The results echoes those from the post-test scores, which indicated personalizing instructional material to matches with learners' characteristics can help learners not only achieve good performance but also accomplish their tasks in an efficient way.

After examining Figure 7 and Figure 8, we found that learners among the three clusters in the personalized scenario spend similar amount of time completing the tasks. In other words, there is no big difference among the three clusters. However, there are big diversities among the three clusters in the non-personalized scenario. Leaners in Cluster 2 spent the least amount of task time while those in Cluster 3 spent the most amount of task time, regardless the personalized or non-personalized scenario. It implies that not all of the learners can overcome the challenges caused by non-personalization so unpredictable task time exists in the non-personalized scenario.

3.3 Cognitive Styles

In addition to overall learning performance, we also examined how Holists and Serialists react differently to the personalized scenario and the non-personalized scenario.

3.3.1 Serialists

Regarding the personalized scenario, learners in Cluster 2 and Cluster 3 got lower post-test score. On the other hand, few Serialists appear in these two clusters (Figure 9). Regarding the non-personalized scenario, learners in Cluster 2 and Cluster 3 got lower post-test score. On the other hand, most Serialists appear in these two clusters (Figure 10). These results suggest that the non-personalized scenario has negative effects on Serialists. This is probably because the non-personalized learning system provides a complex keyword search, which can be used to combine to search different keywords. This design approach does not support the needs of Serialists, who focus on only one thing at a time.

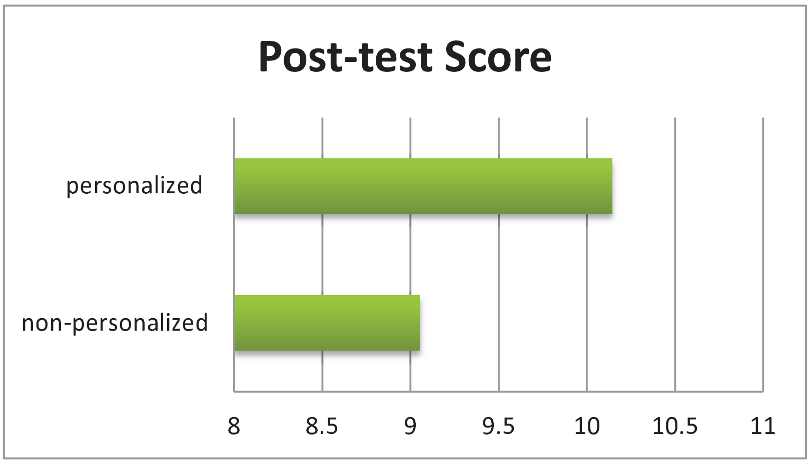

Figure 3. Post-test score (overall).

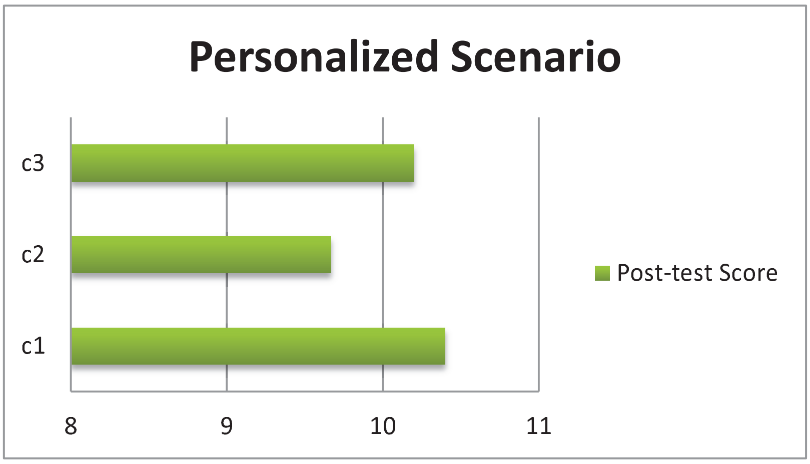

Figure 4. Post-test score (personalized scenario).

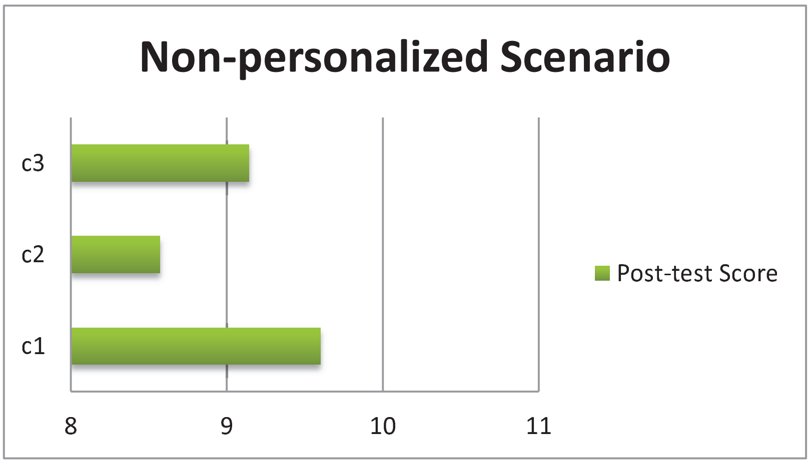

Figure 5. Post-test score (non-personalized scenario).

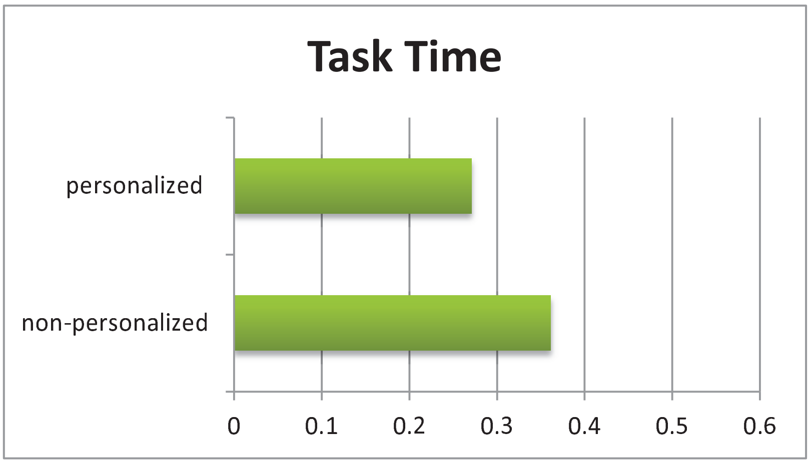

Figure 6. Task time (overall).

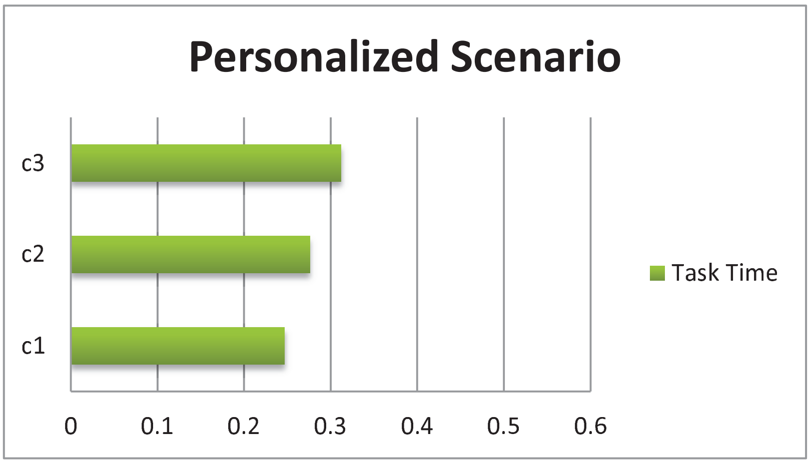

Figure 7. Task time (personalized scenario).

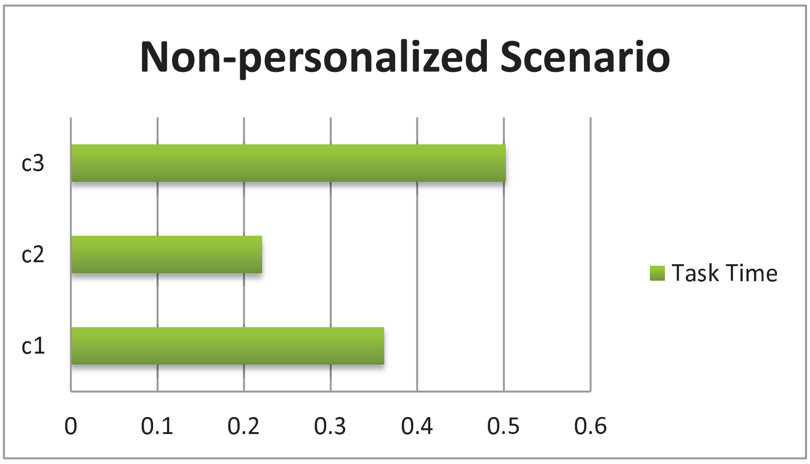

Figure 8. Task time (non-personalized scenario).

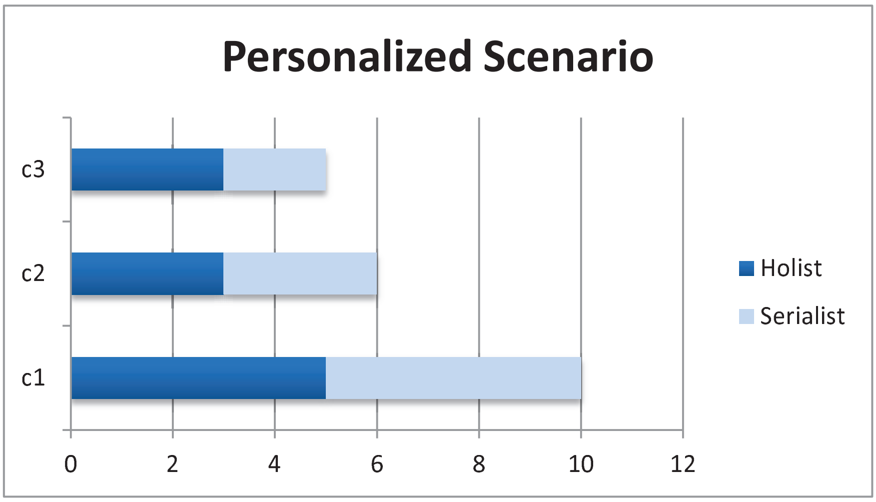

Figure 9. The distribution of Serialsts and Holists in personalized scenario.

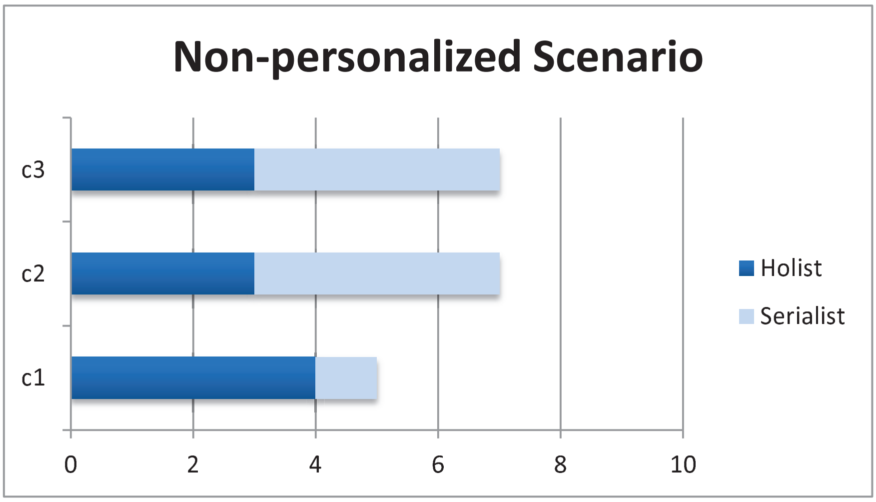

Figure 10. The distribution of Serialsts and Holists in non-personalized scenario.

3.3.2 Holists

As showed in Figures 9 and 10, Holists are evenly distributed in the three clusters, regardless the personalized scenario and the non-personalized scenario. In other words, the Holists do not show strongly different reactions to the personalized scenario and the non-personalized scenario. Only a simple keyword search and a partial hierarchical map are provided in the personalized learning system, where learners can merely get a local picture, instead of an overall picture. In theory, this scenario, thus, cannot satisfy the needs of Holists, who would like to get a global view. However, the aforementioned results suggest that Holists have potential to overcome difficulties that they meet in the personalized scenario. This is probably because the flexibility is included in the personalized learning system. More specifically, hypertext links are applied to connect other main categories and related categories and the hierarchical map is clickable. Thus, the Holists can gradually get the global picture by following the hypertext links or clicking the hierarchical map.

The results presented in Section 3.3.1 and Section 3.3.2 suggest that the personalized learning system can match with the needs of both Holists and Serialists. Thus, Web-based learning systems should not only provide a simple keyword search and a hierarchical map that show a local picture, but also should make best of hypertext links and clickable hierarchical maps so that the needs of different cognitive styles can be accommodated.

The abovementioned findings suggest that Serialists and Holists show different preferences. More specifically, Serialists show positive reactions to the personalized scenario while Holists demonstrate equal reactions to the personalized scenario and the non-personalized scenario. Figure 11 proposes a framework, which summarizes the findings of this study.

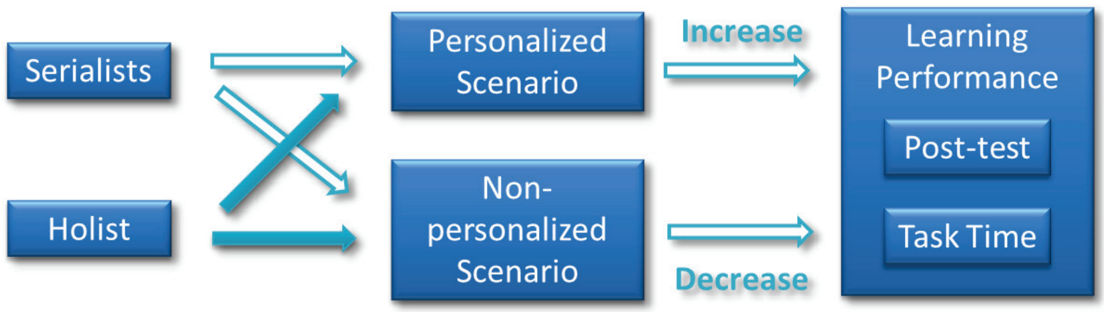

Figure 11. A framework based on the findings of this study.

4. Conclusions

This study examines learners' reactions to the personalized scenario and the non-personalized scenario based on their prior knowledge. In addition, this study also investigates how Holists and Serialist react differently to these two scenarios. Our results demonstrated that the non-personalized scenario has negative effects on Serialists while Holists have potential to overcome difficulties that they meet in the personalized scenario. In brief, Serialists have relatively strong reactions to the personalized learning system based on prior knowledge. The findings described in this paper have shown the importance of understanding the effects of multiple human factors on personalization and non-personalization.

However, this was only a small-scale study. Further work needs to be undertaken with a larger sample to provide additional evidence. Another limitation of these studies is that this study only uses a k-means algorithm to conduct data analyses so further works can consider other data mining algorithms to discover more hidden relationships. Moreover, there is a need to consider other human factors in future. More specifically, this study investigate how cognitive styles affect learners' reactions to a personalized learning system based on learners' prior knowledge. Further works can develop personalized learning systems on the basis of gender differences or cognitive styles and then examine how other human factors affect students' reactions to this personalized learning system. In addition, the results of such works could be integrated with those of this study to build robust user models for the development of effective personalized learning systems that can accommodate learners' individual differences.

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A Surrogate Competition Approach to Enhancing Student Learning

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Abstract: Although competition is a powerful element to enhance students' motivation, but it still has negative influences on learning. To mitigate possible negative influences, some competition models have been proposed but they are merely suitable for anonymous and face-to-face learning contexts. To address such limitations, there is a need to explore other competition models. To this end, this study proposes the concept of surrogate competition, in which there is no direct competition between each student. Instead, each student has a substitute and the competition takes place between each substitute. Based on this rationale, a My-Pet-My-Arena system is developed and an empirical study was conducted to examine the effects of the surrogate competition. The results revealed that the My-Pet-My-Arena system could help students attribute competitive failures to the lack of effort.

Keywords: user-center design, competition, game-based learning

1. Introduction

Over the past decade, digital game-based learning has attracted more and more research interests. It is motivated by the fact that game elements are utilized to help students achieve their learning goals and improve their knowledge and skills [10]. Thus, game elements play an important role in game-based learning. In this vein, some game elements are investigated, such as control, fantasy, curiosity, challenge [23], imaginary, competition, uncertainty [21], goal, decision, cooperation, and competition [27]. Among these game elements, however, competition is seldom taken into account although it is promising and powerful [9]. A possible explanation is that competition emphasizes on the process of social comparison, in which students are exposed to numerous comparative information, which, in turn, influences students' self-concept [25]. Students might be damaged by negative influences, such as the lack of confidence [4] or lower self-efficacy [31] especially when students frequently fail in the competitions.

To mitigate the possible negative influences, previous works has proposed some mechanisms. One is anonymous competition, which provides a scheme to diminish negative impacts resulting from a face-to-face competitive context [34]. In anonymous competition, students' failure would not be revealed to the public so that the damage on students' confidence could be reduced. The other is group competition, in which competition is integrated into cooperative activities in small groups [30]. Since all of members in the group share the responsibilities for competition results, the possible negative influences are thus alleviated. Nevertheless, these mechanisms are applied in limited contexts. The anonymous competition is suitable for an anonymous-based distributed environment, rather than a face-to-face interactive environment, otherwise the effects of anonymity could not be activated. The group competition is also restricted to a group-based collaborative learning context, rather than an individual environment, otherwise the responsibilities could not be shared by group members.

To this end, there is a need to develop effective and flexible mechanisms to address these limitations. Consequently, this study proposes a game-based competitive mechanism, *surrogate competition*, in which there is no direct competition between each student. More specifically, each student has a substitute and the competition takes place between each substitute. Based on this rationale, this study develops a game-based learning system and conducts empirical studies to examine whether students could benefit from surrogate competition. More specifically, the empirical studies seek an answer for the research question of this study, i.e., "*how surrogate affects students' view to the competition?*".

2. Related work

Competition is regarded as a promising scheme for student learning [12] because competition could reinforce the goal structure of learning activities, which, in turn, enhances students' motivation and academic achievement [16]. However, several researchers also indicate that the use of competition might bring negative influences [31], such as the lack of improving scheme [4] and high degree of stress [35].

This is because competition involves a social comparison process, during which participants are compared with each other [22]. Such acute comparison would affect students' motivation, confidence, attitude, and belief in success [25]. Moreover, most of competitions are a zero-or-sum activity, in which one competitor wins the competition and the other, meanwhile, loses the competition. It implies that such competition always results in one competitor's failure, which might cause some damages to the loser. Once the loser further attributes his/her failure to the lack of abilities, he/she might feel frustrated or even helpless in learning [11; 32; 33].

To alleviate these negative influences, several mechanisms are proposed, including personal improving space, computer-simulated agent, anonymous competition, and group competition. Their design rationales and relevant studies are listed in Table 1. The first two mechanisms emphasizes on positive belief while the last two mechanisms are concerned with negative effects. More specifically, the former makes learners understand that preparation would result in competition success, either via learning efforts by themselves or support from simulated agents. Conversely, the latter is to use anonymous or group protective mechanism to reduce possible negative impacts.

Table 1.Mechanisms to support competitive learning

Mechanisms	*Design rationales and function descriptions*
Personal improving space	Offering students chances to prepare themselves before the competition takes place can help students easily understand that preparation is the best way to win the competition [5].
Computer-simulated agent	Computer-simulated agents could scaffold students to improve their learning performance for competition, and even shaping their positive belief on effort [5].
Anonymous competition	Anonymity could be as a protective mechanism for students who lose because their identity would not be revealed in public [36].
Group competition	Group competition could share the responsibility for failures, instead of taking the responsibility by an individual [17; 13; 30].

These competitive mechanisms are useful but they are only applied in limited contexts. For example, the personal improving space and simulated learning companions seem to be only suitable for individual learning; the anonymous competition and group competition appear to be suitable merely for anonymity-based and group-based settings. It is difficult to apply them for more general learning contexts. A possible explanation resulting in these limitations lies within the fact that these mechanisms belong to direct competition: competitors compete against each other by their academic performance directly. In this vein, surrogate competition is thus proposed in this study based on the perspective of indirect competition: each student owns a surrogate, and the competition happens between these surrogates. This is because such surrogate competition offers more flexibility so that the competition between students can be more relaxed. Due to such benefits, we incorporate surrogate competition into a learning system and conduct two empirical studies to investigate whether such an approach is useful to students.

3. Surrogate competition

3.1 Design rationales of surrogate competition

Figure 1 illustrates the differences between direct competition and surrogate competition. Unlike direct competition, where students use avatars to compete against each other, surrogate competition allows students to use surrogates on behalf of them to attend the competition. The main difference between direct competition and surrogate competition lies within the fact that the former involves the participation of two avatars while the latter is mediated by two virtual pets. More specifically, the direct competition involves students' self-image or self-identity to compete against each other. Conversely, the surrogate competition uses agents without self-image or self-identity to attend the competition, instead of themselves.

The aforementioned difference suggests that the surrogate competition is able to change students' views to competition. This is motivated by the fact that students often attribute their failures to the lack of abilities in the direct competition. Thus, the belief that they are "stupid" or "dumb" might be shaped, which, in turn, results in the negative influences. Nevertheless, the surrogate competition could help students shift their failure attributes from the lack of abilities to the lack of effort so that the negative influences might be less damaged.

Due to such benefits, surrogate competition is considered in this study. More specifically, virtual pets attend competition on behalf of students. Students play as the role of master so that effort in training virtual pets could be regarded as the most dominating factor to win in the competition. Therefore, these virtual pets could reflect students' learning status. This is achieved by using an Open Learner Model (OLM) where students' learning status is collected. The OLM is regarded as a manipulated model, which is accessible by students themselves so that they could observe, edit, and even negotiate with computers about their learning status [2; 3]. An additional benefit is that nurturing and caring virtual pets can facilitate human-computer interaction [18] because students play as their masters. By doing so, students could develop a long-term relationship with virtual pets, which could sustain their motivation, and further to facilitate interaction with their OLMs [7].

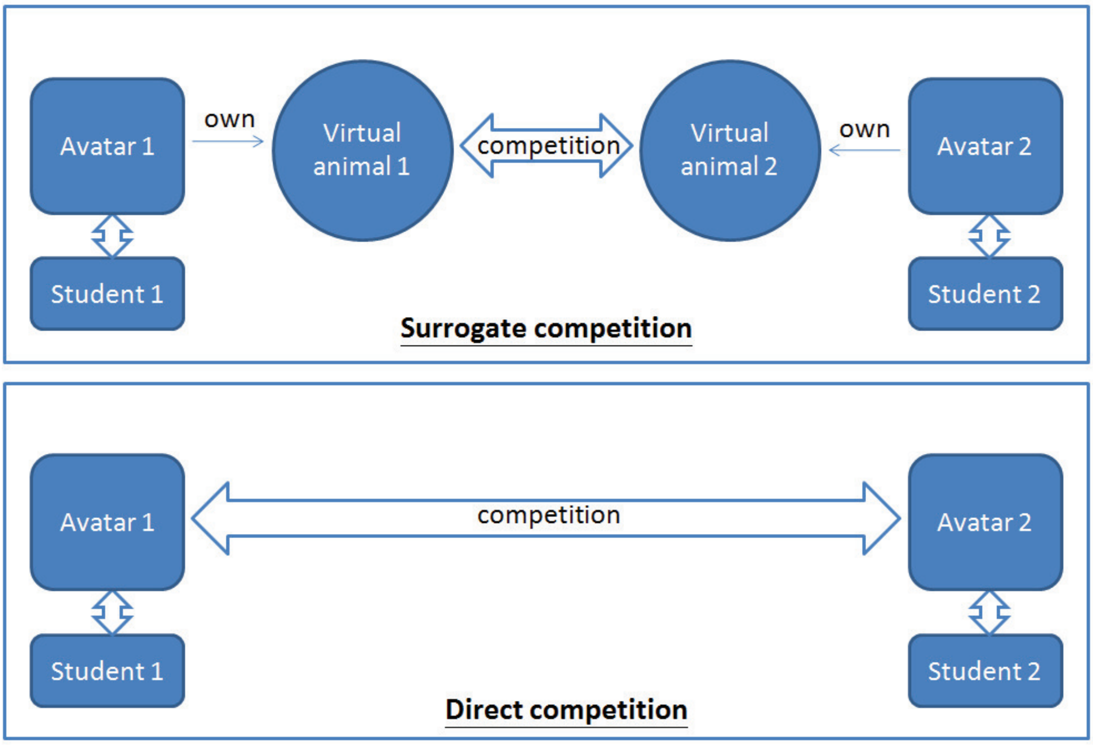


Figure 1. Concept of surrogate competition compared with direct competition

3.2 My-Pet-My-Arena system

3.2.1 Three design perspectives on computer-human interaction

In addition to providing the benefits of surrogate competition, My-Pet-My-Arena system also brings several new design perspectives on computer-human interaction. How much learning effort students made is influential to their achievement [6; 29]. Thus, the first perspective emphasizes on students' effort-making belief. More specifically, virtual pets are used to enhance the computer-human interaction in the My-Pet-My-Arena system so that students can believe that there is a positive relationship between effort and success.

Subsequently, the second perspective lies within the fact that the My-Pet-My-Arena offers several "caring" functions for students to care their virtual pets. Such caring functions, which attach students' emotion, can sustain a long-term "master-and-pet" relationship. By doing so, students' motivation can be maintained, which, in turn, the computer-human interaction can be enhanced. The third perspective lies within the fact that virtual pets and OLMs are integrated as an information representation model within the My-Pet-My-Arena system. Through virtual pets, this model not only could actively remind students of what they have learned and have not mastered, but also be as a motivator to encourage students to interact with the My-Pet-My-Arena system.

3.2.2 System development

The My-Pet-My-Arena system consists of four components. The first one is nurturing component, whose purpose is to develop students' attachment to the My-Pet. This intention can be realized by two functions: feeding, and caring. Regarding feeding, the system allows students to play as a "master", who is responsible for the My-Pet's satiated needs. In particular, the system presents them with a "satiated" attribute, which refers to whether the My-Pet is satisfied or not. By doing so, students can buy pets' food to feed the My-Pet.

Since students are as a giver and their My-Pets act as a receiver, the master-and-pet relationship would be established.

Regarding caring, the system aims to further enhance students' sense of being a "care-giver", who not only satisfies My-Pets' satiated needs, but also their healthy status. To this end, this system provides students with different pets' products. Students could use these products to look after their pets. Likewise, when students take good care of their pets, another "healthy" attribute would be presented. By doing so, students would experience how to take good care of their My-Pets, in which students' attachment to their pets can be enhanced.

The second one is learning component, which is the only part concerning Chinese idiom learning and My-Pet would offer students learning feedbacks (see Fig. 3). More specifically, to improve students' mastery of Chinese idioms, two functions are offered. The first one is to make students understand their learning progress. This function could be realized by presenting the mastery level for a specific Chinese idiom so that students know which topics they have mastered and have not mastered yet. The second one is to encourage students to improve their learning progress in a joyful way. To this end, this system offers a "pet-training" game context, in which students' effort made for improving mastery is further linked to the My-Pet's "effort" attribute. Thus, when students improve their mastery level, the "effort" value would be also promoted. Meanwhile, students can obtain virtual coins as rewards for buying pets' food and products. By doing so, students might feel that they are doing something helpful and meaningful to their My-Pet, instead of boring tasks.

In addition to the two components aforementioned, the My-Pet-My-Arena system contains the third component, i.e., the competition component. The intention of the competition component is to shape students' positive belief in effort-making. To this end, a pair-wise version of surrogate competition is developed so that the "effort" attribute could be regarded as a key factor that determines the competition result [8]. To realize this function, the rule of the surrogate competition is designed as several rounds, each of which a My-Pet can get an effort score based on the "effort" value. It implies that the more "effort" value the My-Pet has, the greater the chance that the My-Pet would win the competition. The surrogate competition continues by turns until one of the My-Pet which obtains the highest score wins the competition.

To further enhance students' sense of being a master, another component is developed. To this end, an avatar component is added in this version 2. This component is realized by offering the function of customizable avatars, in which students can choose virtual characters to adjust their appearances and decorations so that students feel that these avatars are on behalf of them within the virtual world. By doing so, students can see their avatars who play as the master to look after and train their My-Pets. Thus, the sense of being a master can be enhanced.

4. Experiment

Although the results of Experiment One had showed that the My-Pet-My-Arena could enhance students' learning achievement, level of effort-making, and motivation, it was unclear how surrogate affects students' view to the competition when compared to other direct competition mechanisms. To address this issue, Experiment Two was conducted to investigate whether the surrogate competition could bring positive effects as direct competitions and meanwhile alleviate the negative effects.

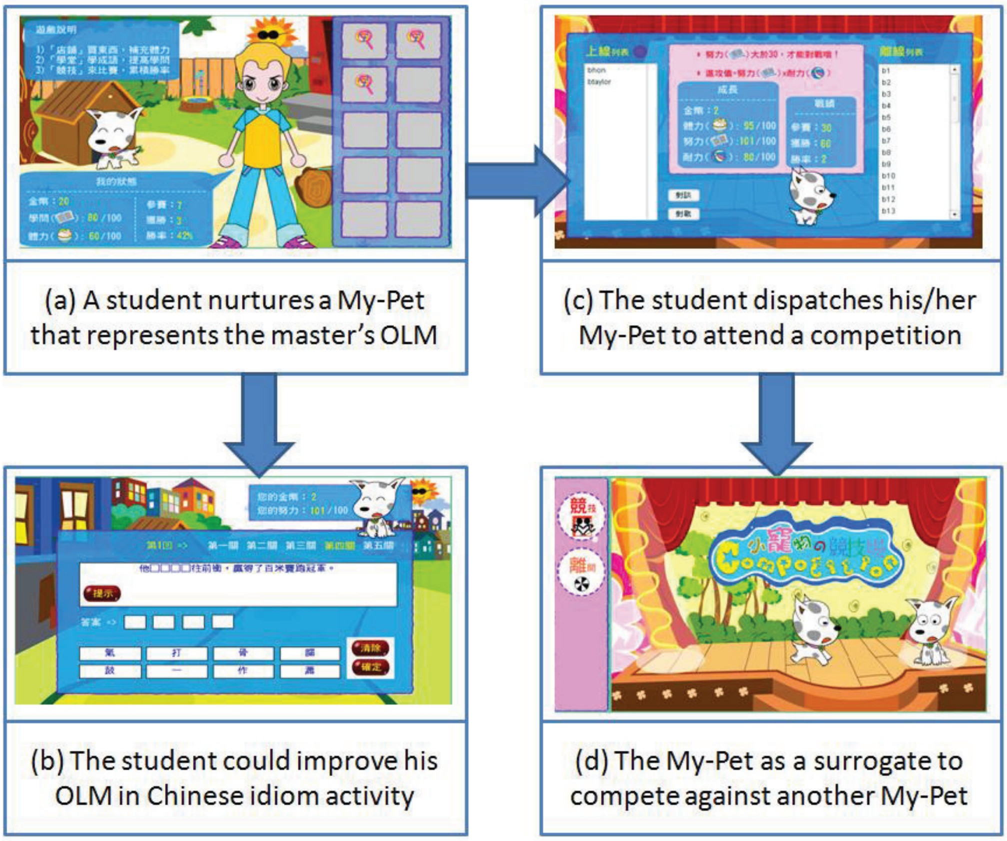
4.1 Instrument

4.1.1 Two system versions

To answer the second sub-research question, how surrogate affects students' view to the competition, two systems were used in the experiment. One was My-Pet-My-Arena system, which is an example of surrogate competition. The other was My-Competition system, which is an example of direct competition. By comparing these two systems, we can identify the differences between direct competition and surrogate competition.

More specifically, the My-Pet-My-Arena system is developed to enhance participants' impression: they are playing as the role of masters. Although participants with this version owned their avatars (see Fig. 2a), they used My-Pets to reflect their learning status in Chinese idiom and dispatch their My-Pets to attend the surrogate competition on behalf of themselves (see Fig. 2a, 2b, 2c, &2d). Accordingly, they could prepare these surrogates, and even regard them as buffers of the competition. Due to this fact, the My-Pet-My-Arena system is classified as an example of surrogate competition.

Regarding the My-Competition system, all participants had avatars, which could be on behalf of the participants to participate in the competition. More specifically, the avatars reflect their OLMs in Chinese idiom (see Fig. 3a). Thus, participants could improve the status of Chinese idiom to strengthen their avatars (see Fig. 3b) so that they can compete against each other via their avatars (see Fig. 3c and 3d). Although participants also had My-Pets, these My-Pets could not do anything and just stay there. Thus, the participants still need to be directly involved in the competition. This is the reason why this system is categorized as one example of direct competition.



(a) A student nurtures a My-Pet that represents the master's OLM

(c) The student dispatches his/her My-Pet to attend a competition

(b) The student could improve his OLM in Chinese idiom activity

(d) The My-Pet as a surrogate to compete against another My-Pet

Figure 2. My-Pet-My-Arena system

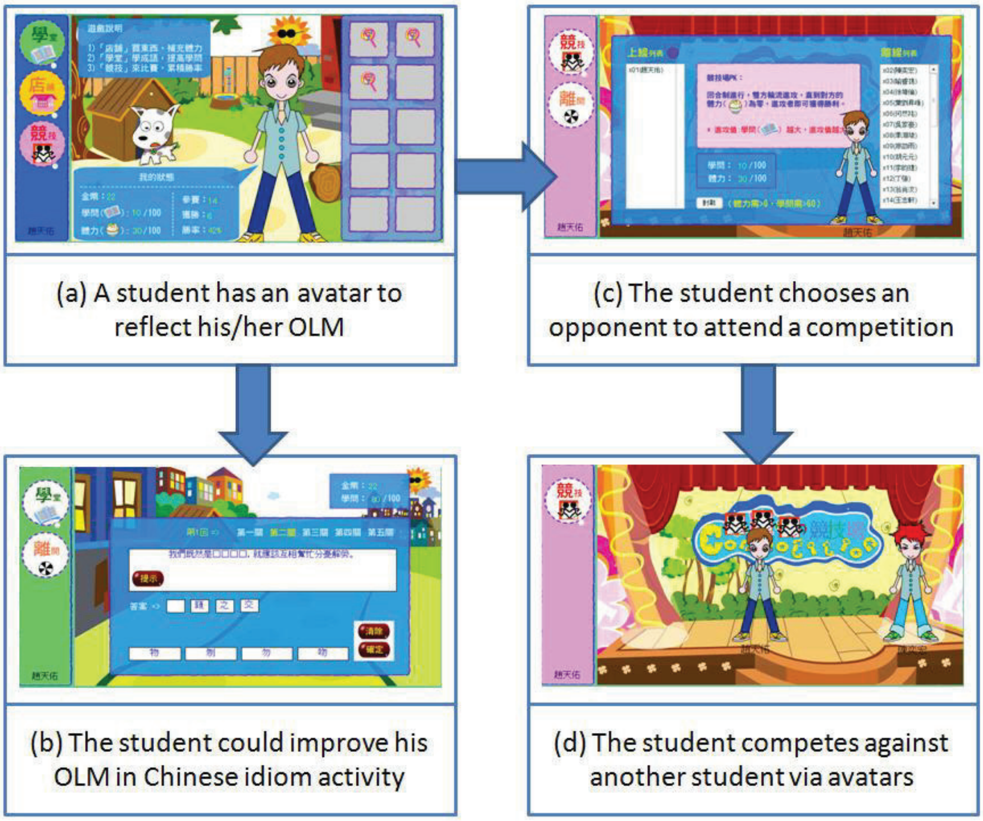


Figure 3. My-Competition system

4.1.2 Attribution questions

As described previously, it is difficult to find a suitable questionnaire for surrogate competition. Thus, two attribution questions developed by the first author of this paper were used to measure students' attribution for the two groups. As shown in Table 2, one question was used when students win the competition, and the other one was used when students lose the competition. Each question provided four options and the participants chose the one matching with their thought.

Table 2. The two attribution questions

The attribution question when winning
I win the competition because (1) I have good luck (2) I spend more effort in learning Chinese idiom (3) I spend more effort in improving pets (4) I actually have better learning ability in learning Chinese idiom
The attribution question when losing
I lose the competition because (1) I have no good luck (2) I do not spend more effort in learning Chinese idiom (3) I do not spend more effort in improving pets (4) I actually have worse learning ability in learning Chinese idiom

4.2 Participants

A between-subject quasi-experiment was used in the experiment and the participants consisted of two classes in an elementary school. The two classes are randomly assigned to two groups. Table 3 shows the different interventions and the distribution of participants in each group.

Table 3. The setting of the two groups

	Intervention	Participants	Gender (male: female)
CG	My-Competition system	29	19:10
EG	My-Pet-My-Arena system	31	17:14

4.3 Procedure

Each group had two 50-minute sessions to use the system over the period of two weeks. At the beginning of the session, participants were told that they could freely use the system. This allowed participants to use the system in a natural condition. During each session, each participant approximately had six to ten times to attend the competition so that each one could have both winning and losing experience. This could be helpful to increase the validity of the collected data. During each competition, students were able to freely choose their opponents so that their choices were based on their preferences. In other words, students know whose avatars or pets they are competing against. At the end of each competition, both groups need to answer the attribution questions to express their attributions.

4.4 Data analysis

The independent variable of the experiment is the different settings of the two systems whereas the dependent variables of the experiment are participants' attribution when they won and lose the competition. To obtain a stable attribution, we calculate the mode (i.e., the number that appear most frequently) of their attribution as the primary attribution. For example, if a student' attributions are "luck", "luck", "luck", "ability", and "luck", the mode is "luck" because it appears four times. Besides, the mode could ignore the extreme or unstable data caused by participants' mistaken operation or other reasons.

In addition, participants' attribution should be stable during such a short period of time. Thus, when a participant's mode finally has multiple numbers, the used data analysis method is described as follows: (1) If the student's mode contains two numbers, it implies that the student has a *relatively* unstable attribution status. Since this is not an extreme case when compared to others, we still accept this case and count the two numbers, respectively. (2) If the student's mode contains three numbers or more, it implies that the student has a *very* unstable attribution status because there is a lack of careful consideration. Thus, we exclude these students from our data analysis. The Chi-squire test, which is suitable to analyze categorical data, is further conducted to validate whether the result has significant difference.

4.5 Result and discussion

4.5.1 Students' attribution when winning

This section presents the results of students wining the competition. Table 4 illustrates the final results of students' attribution, which exclude unstable cases described previously. Regarding CG, the number of students' attribution to effort made in learning (n=15) was relatively high than that to luck (n=9), ability (n=5), and effort in training pets (n=2). The result from a Chi-squire test indicated that this difference was statistically significant (χ^2 = 12.226, df=3, p<.01). Since the students in CG used the My-Competition system, it meant that My-Competition system could facilitate students' major attribution to effort-making in improving learning.

One possible interpretation for this result was that the My-Competition system involved the representation of avatars to enhance their presence and participation. More specifically, because people tend to regard the behavior of their self-images as themselves [26], the avatars enhanced students' feelings of telepresence [28]. In particular, while the students could clearly observe what they did and what the consequence was, the cause-and-effect relationship between effort-making and the competitive success was enhanced, which, in turn, fostered the attribution to their effort in improving learning. To our surprise, two students in CG attributed their success to effort in training pets. Although students owned My-Pet in the My-Competition system, the My-Pet could not do anything and stay there. Thus, such a choice, which is a very small portion (n=2), might be due to the attraction of pet animation or unserious consideration. To this end, there is a need to verify this issue with further works.

Table 4. Students' attribution between two groups when winning

	Luck	Effort		Ability
		Improving learning	Training pet	
CG	9 (29%)	15 (48%)	2 (7%)	5 (16%)
EG	5 (14%)	11 (29%)	16 (43%)	5 (14%)

Regarding EG, the number of students' attribution to effort made in training pets (n=16) was relatively high than that to effort in improving themselves (n=11), luck (n=5), and ability (n=5). This difference was statistically significant (χ^2=9.162, df=3, p<.05). Since the students in EG used the My-Pet-My-Arena system, it implied that My-Pet-My-Arena could facilitate students' major attribution to effort-making, instead of other causes (i.e., luck and ability). One possible interpretation for this result was that the My-Pet-My-Arena system enabled students to play as the role of pet-master, which further enhanced students' sense of being as well as the responsibility of taking care of the pets. This is the reason why they chose this attribution. In addition, some students might be aware of the fact that spending efforts in training pets can actually improve their learning status. This might be the reason why some of students attributed their success to the effort made in improving learning.

Furthermore, when comparing the students' attribution between CG and EG, it could be found that the major attributions in CG were effort in improving learning (48%) and luck (29%), whereas the major attributions in EG were effort in training pets (43%) and effort in improving learning (29%). A Chi-squire test further indicated that this difference was statistically significant (χ^2=12.213, df=3, p<.01). Such a difference implied that the students who used the My-Pet-My-Arena system tended to attribute their competitive success to their effort (72%=43%+29%, in improving learning and in training pets). Conversely, the attribution of the students using the My-Competition system focused on effort (48%, in improving learning) and luck (29%). In other words, My-Pet-My-Arena system could ensure that most of students attributed their competitive success to effort.

A possible reason was that the difference resulted from the different system instruments: My-Competition system only used the avatars whereas the My-Pet-My-Arena system used both the avatars and virtual pets. Previous studies had indicated that the use of avatars could be helpful to self-disclosure [15] because avatars can facilitate the linkage between users and onscreen characters, which, in turn, increased the sense of participation [20]. Nevertheless, the difference between these two systems lie within the fact that My-Pet-My-Arena system also used virtual pets to promote their identity of playing as the role of master, which further motivated students to do something for their pets.

Consequently, the My-Pet-My-Arena system had more influences on students' positive attribution to effort than My-Competition system.

4.5.2 Students' attribution when losing

The results of students losing the competition are illustrated in Table 5, which excludes unstable cases. Regarding CG, the number of students' attribution to effort made in improving learning (n=18) was relatively higher than that to luck (n=8), ability (n=4), and effort in training pets (n=4). A Chi-squire test further showed that this difference was statistically significant (χ^2=15.412, df=3, p<.01). Since the students in CG used the My-Competition system, it meant that most of students who used the My-Competition system majorly attributed their competitive failure to their effort made in improving learning. This result was similar to that in students' success attribution. One possible explanation was that the My-Competition system enabled the embodied avatars to stand for students' presence and participation. In particular, students could clearly observe what they did and what the consequence was, which further reinforced the positive relationship between the effort and competitive outcomes (i.e., whatever they won or failed in the competition). Thus, students tended to attribute the competitive failures to their effort in improving learning. Beyond our expectation, four students in CG attributed their failures to effort in training pets, which should not appear in the My-Competition system because the My-Pet could not do anything and just stay there. Such a choice from a very small portion of students might be due to the attraction of pet animation or unserious consideration, which needs to further verify in further works.

Table 5. Students' attribution between two groups when losing

	Luck	Effort		Ability
		Improving learning	Training pet	
CG	8 (23%)	18 (53%)	4 (12%)	4 (12%)
EG	9 (23%)	10 (26%)	17 (43%)	3 (8%)

Regarding EG, the number of students' attribution to effort made in training pets (n=17) was relatively higher than that to effort in improving themselves (n=10), luck (n=9), and ability (n=3). This difference was statistically significant (χ^2=10.128, df=3, p<.05). Since the students in EG used the My-Pet-My-Arena system, these results implied that the My-Pet-My-Arena system could foster students' major attribution to effort-making (both in training pets and in improving themselves), instead of other causes (i.e., luck or ability). The result was also similar to that in students' success attribution. One possible reason was that the students' identity within the My-Pet-My-Arena can be enhanced so as to be a good master and be more responsible for their pets. Thus, they tended to attribute their competitive failures to effort made in training pets. In addition, some students might be aware that the purpose of training pets is actually to improve their learning status. This might be why some of students attributed their failures to the effort made in improving learning.

Moreover, when further comparing the students' attribution between CG and EG, it could be found that the major attributions in CG were effort in improving learning (53%) and luck (23%), whereas the major attributions in EG were effort in training pets (43%) and efforts in improving learning (26%). A Chi-squire test indicated that this difference was statistically significant (χ^2=10.241, df=3, p<.05). It implied that the students with the My-Pet-My-Arena system tended to attribute their competitive failure to their effort (69%=43%+26%, in improving learning and in training pets). By contrast, students using the My-Competition system emphasized on the attribution to effort (53%, in improving learning) and luck (23%). In other words, My-Pet-My-Arena system allowed most of students to attribute their competitive failure to effort, instead of other factors.

A possible interpretation was that the difference in students' attribution resulted from the different system instruments (i.e., My-Competition and My-Pet-My-Arena). More specifically, although the two systems involved the use of avatars, My-Pet-My-Arena system used virtual pets to promote their identity of playing as the role of master, which further reminded students of being responsible. Previous studies have found that pets play a significant role in children's lives [19], and it is children's instinct to approach these pets, taking good care of them [24]. This might be the reason why the existence of the pets in EG could facilitate students' failure attribution to effort in training pets, instead of another uncertain factor, i.e., luck attribution in CG.

5. Conclusion

With respect to the second sub-research question—*how surrogate affects students' views to the competition?*, Experiment Two was conducted to compare the differences between My-Pet-My-Arena and a direct competition system. The results revealed that the My-Pet-My-Arena system could facilitate most of students to attribute their competitive outcomes to the effort that they put, rather than other factors, no matter when they win or lose in the competition. However, due to the limitations of this study, further studies are required. In particular, although this study showed positive effects of surrogate competition on students, it was merely a short-term study. There is a need to examine the long-term effects of surrogate competition in the future.

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Chapter 5

Open Technology, Open Standards and Open Knowledge in ICT-Enabled Learning

Preface

Open technology and open standards play key roles in today's growth of ICT-based education. Open technology and open standards are not just technical components but provide an open infrastructure to share open knowledge to evolve technology enhanced education. This workshop is the successor of the ICCE 2010 workshop with the same topics and will provide an opportunity to share information on the cutting edge activities such as R&D towards open technology and standards, open systems implementation based on the open standards, application and practice of open knowledge sharing on open technology-based platforms, open knowledge exchange between e-learning systems and neighboring fields such as e-Books, games, digital libraries, knowledge management, human resource development, and informal learning based on the open technology and standards. It is our great pleasure to be able to organize this workshop with the distinguished papers under the above mentioned scope. We hope this meaningful event will be an opportunity to deepen the understanding of this cutting edge field and encourage further research activity in the future.

Organizers
Kiyoshi Nakabayashi, *Chiba Institute of Technology, Japan*
Yusuke Hayashi, *Nagoya University, Japan*
Jon Mason, *InterCog Pty Ltd, Australia*

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Usability Evaluation on an Affective Mobile Platform Based on Social Computing

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Abstract: In recent years, people's impression of web2.0 has been changed by many social networking rising abruptly, especially Facebook. It has become the most popular site for most of the Internet users. Facebook's CEO, Mark Zuckerberg, has also announced that there are over five-hundred million members visit Fcebook for a day. It means many people use Facebook to socialize with their friends. With Facebook's graffiti wall, you can post news, photos, or favorite links. By pressing the "like" or replying message on your graffiti wall , you can easily know there are many of your friends concerned about you.
But only through the content which was published on the graffiti wall is difficult to find out users' emotions. So, if we can build an affective social computing platform on Facebook, analyzing and evaluating the contents what user posted on their graffiti wall, sending the relevant emotion result let user's friends know, it may help them understand what is user's emotion easily ,and this may help your friends know what is your situation recently that they can have some corresponding to you, and this behavior is what we want to see. We hope to use this platform to help improving you and your friends' friendship. This study is focus on three major as following: (1)Using Internet to have Community and interaction .(2) How to build a platform combining affective computing on Facebook(identify symbols including text and voice), then let users decide whether update their emotion status on Facebook's graffiti wall or not.(3) Setting up our platform on mobile device. Such as: Android、iPhone…etc. We used Android smart phone in this project.

Keywords: Mobile Device, Social Network, Affective Computing, Facebook, Android

Introduction

Due to the Internet boom, people who use computer are growing to a enormous number . Many people will use computer no matter how old they are; And using time is also being longer and longer. For those results, many different communities had been built on Internet. Those communities which were built on Internet have a new name, "Social Network".
Facebook, which is the leader of social networks in recent years. According to checkFacebook.com (Facebook's official website) shows that, Facebook had already have

624,682,160 users, and is continuously growing. The data said that: Taiwan's Facebook users have more than ten million people. What a enormous number!
You might have a question for Facebook, how did Facebook get so many users? Here is the reason :Facebook has a function called ”user's emotional state”, this one is really attract teenagers; You can make friends on Facebook or comment a post by "like". If your friends change their emotional state from "In a relationship" into "single", there must have a lot of curious friends to ask "What's going on" or something else. But sometimes ,they are already heart-break, and don't want to be bothered cause they are in a blue. So, we think Facebook might need an affective computing platform which can let users talk about themselves then make analysis. When user's emotion state come out, sharing on the graffiti wall .This may help people understand each other more clearly.

1. Typographical Style and Layout

1.1 Web2.0 and community computing

Facebook can be regarded as the representation of Web2.0 and social computing .Web2.0 and social computing have many definitions; Macaskill and Owen had a definition :"To allow users to have access rights to get, provide, description, tags, comments and labels with a variety of Internet web media formats such as text, video, music, photos, graphics on the website platform".

1.2 Affective computing

Affective Computing has four dimensions: (1) Perception: the system in terms of a mechanism for emotional input. (2) Modeling: to establish the classification of emotional relationship with the relevant variables. (3) Expression: emotional output mechanism. (4) Communication: to describe the emotion through language, to facilitate the transmission of emotions (Li Yan Tsai, 2004; Vesterinen, 2001; Hosts Red, 2007).
Picard (2000) mentioned on the Emotional Intelligence and noted that affective computing can be divided into four levels, they are: (1) Identification of emotions (2) The expression of emotions (3) With emotion (4) Emotional Intelligence.

1.3 Android

Android is created by Google, many technology and mobile phone companies .They gathered a team called "Open Handset Alliance", and it's totally free and open source, this reduces the costs of research a new mobile device. Android mobile device is designed on the basis of Java programming language, and use Linux Kernel as core; It provide a lot of convenient API and works on Dalvik (the machine use to test Android system). In this framework, developers can minimize the coupling degree between programs and hardware that they can concentrate on developing Android program .

2. Research Methods

This research used affective computing algorithm, PHP, MySQL, Android mobile device and Flash AS3 , to build a platform that can recognize emotion with user's text or vocal level. We built a platform by Flash AS3,turning it into an Android App to catch information from user's inputs. After our database get user's information, it'll return the recognize results for users. The database used Facebook API to communicate with Facebook.
Word recognition, using the method as follows: (1) Ontology and natural language processing technology base on the Symbolic AI mode.(2) Computational Intelligence model which is Combined with SVM, KNN and other classifiers, emotional dictionary, language structure. Vocal level recognition part are: (1) Using sensors to capture emotional speech signal, then use the endpoint detection method to cut out the useful passages to exclude unnecessary data.(2) Calculating sound pitch and energy from the data to define different emotional features. Finally, to determine the emotion state with hybrid model of decision-making through voting algorithm to send the recognition results.

2.1 Emotion recognition database

User's Android phone or Facebook will be linked to the emotional identification database to define. The function of this emotion recognition database are as follows:

(1) Connecting and setting with user's Android phone.
(2) Capturing user's text from the platform and use text to do emotional recognition.
(3) Capturing user's voice then transmitted from Android phone to the database and doing voice emotion recognition
(4) The emotion recognition results will automatically publish on user's graffiti wall.

2.2 Facebook API

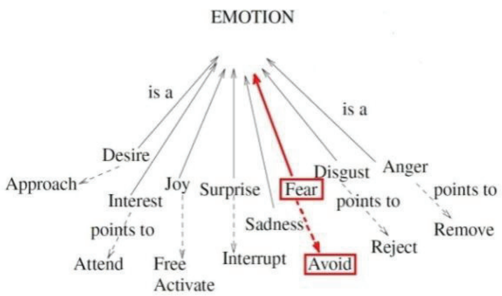
Facebook provide some API and related development kit for developers ;That can be used in Facebook's website, mobile application and so on. In this research we used Graph API and PHP for development, JSON for Graph API to pass user's data, PHP SDK will assist in communication between PHP and Graph API (such as login, pass the user ID, etc).
The main functions of this API are as follows:

(1) To obtain the permission to post the recognition on user's graffiti wall.
(2) Automatically obtain the user's information from Facebook.
(3) Automatically post user's results on the graffiti wall.

2.3 Symbolic AI mode: Ontology and natural language processing technology as the foundation

In the relationship between the intensity of the two concept ;If one concept is set to emotions of joy, anger, sorrow, hate, surprise or other emotions, then it can get a concept node relative to the distance between different emotions, then it can be regarded as a concept for associated intensity with different emotion. Therefore, we can define every keyword (concept) by the emotional intensity.

If we only discuss the keywords of a sentence, make inferences, then calculate, it can be regarded as the emotional content of this sentence.



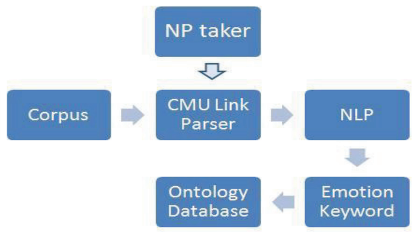


Figure I: Ontology-based & NLP system architecture Figure II: Emotion Ontology

2.4 KNN

KNN (K-th Nearest Neighbor) is based on Statistical Learning Theory. It developed a kind of unsupervised machine learning system. After analyzing text ,the information with those characteristic values will help KNN training and improving recognition accuracy.

2.5 Hybrid voting algorithm for decision-making model

We use Nguyen's study to decide the emotion, it contains three types (Nguyen, 2005): (1) Minimum Misclassification Method (2) Maximum Accuracy Method (3) Dominant Class Method.

2.6 System usability scale(SUS)

SUS was created by Digital Equipments Co Ltd. in 1986; It's purpose is to help companies to know their product's usability and it's easy to get the information which you need. We used SUS to figure out how people think about our platform. We analyzed the question and solve the problem which base on these questionnaire.

Table 1 shows our SUS questionnaire. In this research, we got 59 subjects .

Table1 SUS questionnaire

	Very disagree	Disagree	Non	Agree	Very agree
I think it's really easy to use this					

prototype of the Simulation tests ,and I love to use this way to share my emotion					
I think this prototype of the Simulation tests is too difficult, there are some Redundant design.					
I think this prototype of the Simulation tests is easy to use					
I think I might need a guide to tell me how use this prototype of the Simulation tests					
I think this prototype of the Simulation tests have a good design of interface, it can help me to share emotion easily.					
I think this prototype of the Simulation tests have so many confused place.					
I think most of the people can easily learn how to use this prototype of the Simulation tests					
I think it's hard to use the prototype of the Simulation tests					
About this prototype of the Simulation tests ,I have confidence to use the correct way to share my emotion.					
I think I should use more time to figure out how to use the prototype of the Simulation tests					

Table2 is the calculation base on Table 1.The average is 62.14;Minimum is 45, maximum is 87.5, and mean is 60.

Table 2 The result of SUS

Average	Median	Minimum	Maximum	Standard deviation
62.14	60	45	87.5	10.15

The initial simulation questionnaire's scores are not look pretty well. So we redesign the system and platform. At next round, we picked 30 people to do the questionnaire again. And we got Table 3.

We find that the score has raise. It means most of the subjects think our system is worth to develop and they would like to use our platform.

Table 3 (For 30 surveys)

Average	Median	Minimum	Maximum	Standard deviation

69	65	60	87.5	8.77

Why are these surveys have different score?

(1) Most of the subjects are students; They don't have much experience on using smart phone whether Android or iPhone, so they answered the question as "non". After using our system they find that it's not difficult to use smart phone and it's pretty easy to use our platform on it.

(2) At the first time we have this questionnaire is only on paper, so some of the subjects maybe can not fully understand what we are doing and accept our system. After we turn it into video and put it on Youtube ,we put our questionnaire on the internet and we got positive affirmation more than we expected.

3. Experimental Results

Users can use our platform on Facebook or their Android phone. When users is using their Facebook on the PC, they can use microphone to input the vocal level, then upload to emotional recognize database or type text with their keyboard; Or, using Android smart phone to give the information which our system need to our database. After system recognized, the database will transfer user's emotional state to their platform and the platform will automatically upload the result to Facebook's graffiti wall.

4. Conclusion and Future Works

In this research, we met a numerous problem ;Some user don't have a smart phone and it's not easy for everyone to accept what affective computing is (Some of the subjects said that it's dangerous to give emotion to computer). This research did a great job to help people understand what is the new trend of 22 century technology, Smart phone ,Android, and affecting computing. We proof that computer have emotion it's really humanity and it's only dangerous in movies.

There are more and more people start using smart phone. Android, Apple and windows, they are getting better and cheaper. This is a chance to have a revolution on technology, letting everybody have a smart phone it's not just a dream; It have happened , and it's still happening.People will get closer due to our platform. It's really easy to share your feeling, after recognized you can upload your emotion to the Facebook. It is so easy to let people know each others.

We hope to add facial detection in our platform. Besides, we want to put our platform not just on Facebook or Android but even iPhone or Windows phone. This might help our system to get more recognition and more accuracy. Hoping user who use our platform will:(1)Getting more and more people to use Facebook, and let the social network getting better and better.(2) Let user know what is their feeling and help them to recovery or share with user's happiness (3) Let people know each other not just what they looked outside but their heart inside.

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A Designing of a Storage Sharing System for LMS using Cloud Storage:

A Case Study of eDLTV

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Abstract: The use of e-learning has always been encouraged in Thailand; however, in medium and small schools, the effort has not yet been achieved due to the inability to produce quality content, which resulted in a knowledge gap between larger schools and the medium and small sized schools. This paper proposed the design of an e-learning system that can easily be distributed to schools throughout the country. The system is a combination of an existing LMS system called eDLTV and a cloud storage technology; thus creating an e-learning system that is available to all instructors and students through the use of the Internet, with the flexibility to choose whether to use an existing learning material or to create their own custom content.

Keywords: Learning Management System, LMS, Cloud Storage, Content Sharing, Distributed Data storage, Gluster File System

Introduction

The effort to encourage the use of e-learning in Thai educational system is increasing over the years, especially in secondary schools. Many of these schools accompany regular teaching with an e-learning system to improve the student performance. The teachers are trained to be able to manage a simple e-learning system, as well as to create the content. From this perspective, the growth of e-learning in Thailand is to be expected; however, the result is not so. Two major problems faced by most schools are in the creation of digital content and the readiness of the infrastructure. These problems are even more severe in rural schools because of the limited number of teachers and other financial resource; to have an e-learning system of their own is almost impossible to accomplished. With this in mind, we proposed a new model of an e-learning system so that schools will not have to create the content or own their own server. The content is created by experts in each subject and stored on cloud storage, ready for school access. The servers will be supported by organizations with available infrastructure such as government agencies or universities. In this paper, the design of digital content sharing based on cloud storage technology for eDLTV, a further development of LearnSquare e-learning system, is presented.

1. Background

The proposed system consists of two components: eDLTV system and Cloud Storage technology.

1.1 eDLTV: an e-learning system based on LearnSquare - an open source e-learning system developed by NECTEC, Thailand [1]. The eDLTV was established under the collaboration of Her Royal Highness Princess Maha Chakri Sirindhorn: Royal IT project and the Distance Learning Foundation for the celebrations on the auspicious occasion of his majesty the King's 80th birthday anniversary [2]. Initially, in May 2007, the project provided only the content of the secondary school; now the eDLTV has expanded its operations through a network of 35 Rajabhat universities, with more than 30,000 instruction content including videos, slides, sheets and tests [3].

1.2 Cloud Storage technology: an efficient way for data sharing over the Internet. People are able to access the storage anytime and anywhere [4]. Many large companies have begun to deploy their own cloud computing platform, such as IBM, YAHOO, Amazon, Google and Facebook [5]. Two popular methods used to create Cloud Storage are Hadoop Distributed File System and Gluster File System.

1.2.1 Hadoop Distributed File System (HDFS) is a distributed file system, which is one of the two component of Apache Hadoop [6]. The HDFS is composed of two modules called Namenode and Datanode [7]. The Namenode stores three major types of metadata of the entire file system, i.e. file and block namespaces, the mapping of files and blocks, and the locations of each block's replicas, whereas the Datanode stores the actual data [5].

1.2.2 Gluster File System (GlusterFS) is a network-attached storage file system developed by Gluster. The idea is to aggregate various storage servers over the Internet and interconnect them into one large parallel network file system [8]. Two component of GlusterFs are GlusterFS client and GlusterFS server. The GlusterFS servers are typically deployed as storage bricks, with each server running a glusterfsd daemon to export a local file system as a volume; the GlusterFS client composes these composite virtual storage volumes from multiple remote servers [9].

The paper will focus on GlusterFS because it is easier to be implemented with the eDLTV, since it doesn't affect the original data [9].

2. System Process

In this section, the overall structure and the fuctionality of the eDLTV Cloud Storage System is explained.

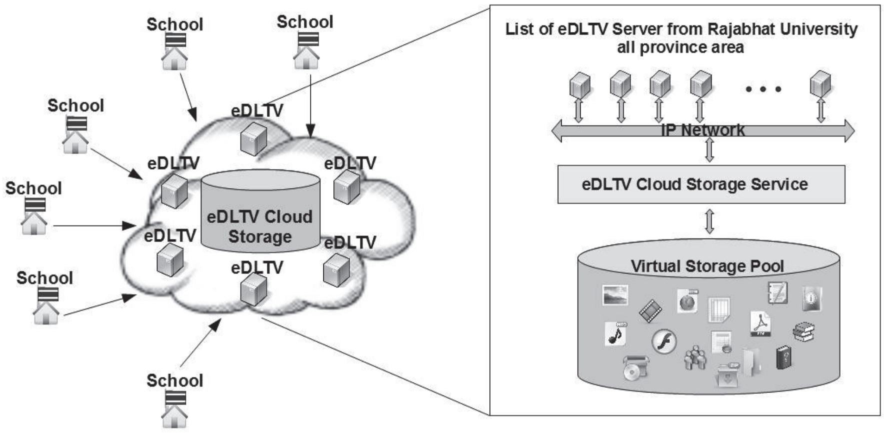

Figure 1. eDLTV Cloud Storage System Overview

2.1 eDLTV Cloud Storage System Overview

In Fig. 1, the eDLTV Cloud Storage System is the central storage for the eDLTV System. All eDLTV servers are connected to the eDLTV Cloud Storage Service which is then connected to the central Virtual Storage Pool that is responsible for storing data such as courses, texts, quizzes, SCORM, log files and so on. Every school has the same access to the same resource on the eDLTV server through the same URL, and will be able to use authoring tools, e-learning software and utilities from the eDLTV Cloud Storage Service without having to install them on their machines.

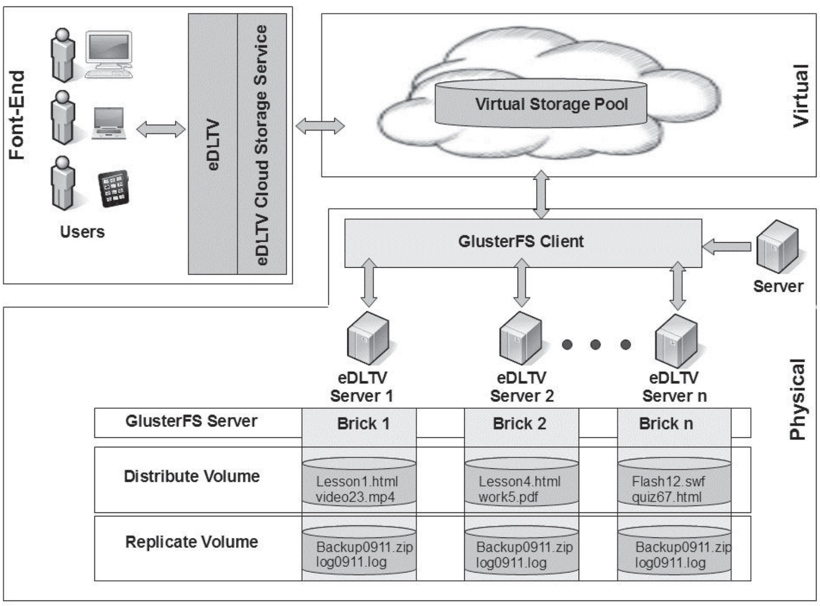

Figure 2. eDLTV Cloud Storage System Structure

2.2 eDLTV Cloud Storage System Structure

Fig. 2 is the process flow of the eDLTV Cloud Storage System: the flow starts when a user connects to the eDLTV server through various clients, such as computers or mobile devices as shown in the Front-End block. Each eDLTV server then tries to retrieve the requested content via eDLTV Cloud Storage Service, which is connected the Virtual Storage Pool. Virtual block represents Virtual Storage Pool on the Internet. Virtual Storage Pool is created by GlusterFS which includes GlusterFS client and GlusterFS server.

In Physical block, the server that installs GlusterFS Client is responsible for managing GlusterFS Server from network, connect Brick from GlusterFS Server and defining data cluster type in Brick to create a virtual storage pool. Section of eDLTV server which installed GlusterFS Server will create Brick from free space in eDLTV server. Format of data cluster type of eDLTV cloud storage system includes two volume: Distribute and Replicate. Distribute Volume is distribute data storage of data cluster type which distribute files such as html, pdf, video, sound and flash store at each Brick. Example: Courses includes lesson1.html is stored in Brick 1, work5.pdf is stored in Brick 2 and flash12.swf is stored in Brick n. Replicate Volume is repicate data storage of data cluster type which repicated same files in all Brick. It backups file about content and log file.

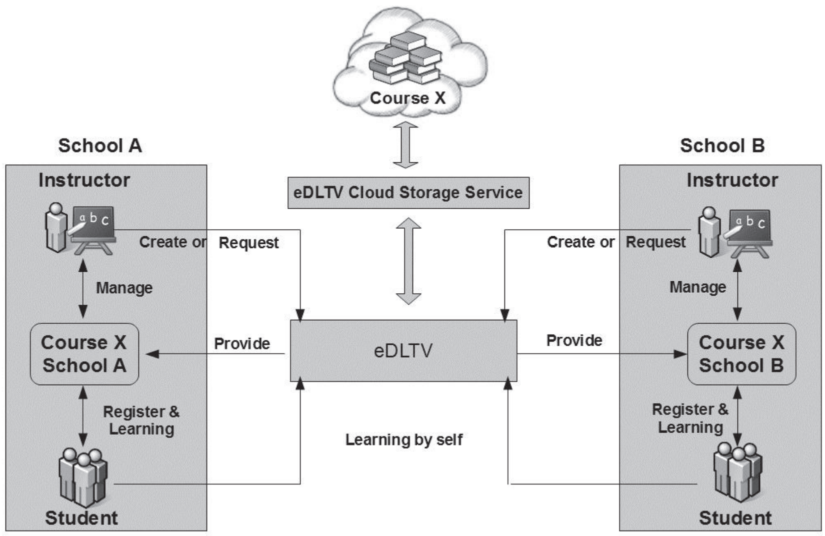

Figure 3. LMS via eDLTV Cloud Storage System process

2.3 LMS via eDLTV Cloud Storage System Process

Fig. 4 illustrates the work process flow of the LMS in eDLTV cloud storage system. As you can see, School A is connected to eDLTV servers. If the students want an access to Course X, they can do so using the eDLTV server through the Internet. The eDLTV server fulfills the request by connecting to the eDLTV cloud storage system, retrieving the Course X, and passing it to the students. The same process also applies if the instructors want to create their own course; they can upload their courses to the eDLTV cloud storage system using the eDLTV Cloud Storage Service as well. School B also has the same access to the eDLTV system; however, the instructor and the student of School B will not have the access to the custom course created by School A.

3. Conclusion and Future work

The purpose of this work is to solve two major problems in implementing e-learning in schools in Thailand, which are the creation of digital content and the readiness of the infrastructure. We proposed a model of an e-learning system that can be used in schools without the requirement to have their own server or to create the content themselves. By using cloud storage technology, we expect that the digital content will be thoroughly distributed to schools in every part of the country, the issues concerning human and financial resource will be reduced, and the quality of the education system will improve.

In the future, we plan to connect the eDLTV to the Repository system to provide a larger knowledge base.

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An Article/Presentation Revising Support System for Transferring Laboratory Knowledge

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Abstract: The main topic addressed in this paper is to develop an article/presentation revising support system for transferring experiential knowledge to be shared by a research laboratory in university. Graduate and undergraduate students in the laboratory usually deal with not only formal information such as research articles and presentation documents but also informal information which represents a process of research activities. However, it is difficult for them, especially new students belonging to the laboratory, to acquire such informal information from researchers and other students in the laboratory. In order to resolve this issue, we focus on the concept of laboratory knowledge. The laboratory knowledge is information such as research know-how, which facilitates the research activities for the laboratory members. We then demonstrate the article/presentation revising support system called CommentManager using the Office Open XML format. The system extracts the laboratory knowledge from the informal information accumulated from the laboratory members using.

Keywords: Article/Presentation Revising, Laboratory Knowledge, Informal Information Research Activity, Office Open XML

Introduction

In our daily research life, researchers and students, who belong to a research laboratory in university, have to handle various research activities with a lot of information. They usually deal with not only formal information such as research articles and presentation documents but also informal information which represents a distinctive process of the activities in a laboratory manner. On the other hand, such laboratory periodically experiences a students' turn-over by their admission and graduation. Although management policy of the laboratory often remains the same for long period of time, it causes a decrease in number of students who have good experiments for performing the distinctive research activities. Therefore, it is difficult for the students, especially new students belonging to the laboratory, to acquire useful informal information accumulated from the laboratory members.

In order to resolve this issue, we adopt the concept of laboratory knowledge [1]. The laboratory knowledge is useful information such as research know-how for revising the articles or presentation and for making research schedule, which facilitates the research activities for the laboratories. For instance, actual process of trial and error for making a presentation document is one of the informal information. On the other hand, how to make a presentation in the laboratory manner is one of the laboratory knowledge extracted from the informal information or past experiences. Of course, it is important for the students to accumulate the informal information and to refine the laboratory knowledge so that they can improve productivity of the research activities. However, informal information has the problem of disappearing with the time passage. It is also important for the laboratory members to transfer such knowledge to the novice students of the laboratory.

We have consequently developed an article/presentation revising support system called CommentManager that can extract the laboratory knowledge from the informal information accumulated in the process of revising the research articles by the laboratory members. One of the features of CommentManager manages all the comments distributed by several versions of the research article or presentation based on the Office Open XML[2]. This makes it easier for the students not only to comprehend the comments for their own articles or presentations but also to find high-frequent or useful comments by the other members.

In this paper, we first describe a model of the article/presentation revising and demonstrate the functions of CommentManager. We then report preliminary case studies by using CommentManager with the comment data described by the researcher in the articles that our laboratory students had written as master theses. The results of the case studies showed a potentiality for extracting the laboratory knowledge and some future tasks to improve CommentManager.

1. Article/Presentation Revising Model

1.1 Process of Article/Presentation Writing

In this paper, the target of the research activity is "article/presentation writing" that is frequently performed by the graduate or undergraduate students in their student life. Such activity enables them to promote understanding of not only specific research findings but also widespread reasoning skill [3]. The process of the article/presentation writing usually involves a series of revising documents with comments and corrections by the researcher. From this way of communication, they may be able to learn how to write the article/presentation practically. However, it is not so easy for them to accomplish the article/presentation according to the laboratory writing style. One of the reasons why they do not learn sufficient writing skill is that the researcher does not always take a systematic approach for training of the article/presentation writing skill. Of course, the students often read some articles or see some presentations related to their research. But, it is difficult to learn the writing skill since the ways of writing are different in the ones written by the laboratory. They also learn how to write the research article/presentation by taking the courses or reading the books. But, these courses and books do not necessarily cover the specific writing style in their research field. For these reasons, the students do not have enough chance to learn the writing skill apart from corrections of the articles/presentations by the researcher. Therefore, the article/presentation revising is one of the important roles from laboratory education point of view.

1.2 Model of Article/Presentation Revising

Figure 1 shows a model of the typical failure process of the article/presentation writing. The student first writes a draft version of the article or presentation. The researcher then makes comments for the draft version. The student next seeks to correct the article/presentation, but he/she gets stuck on such revising. Some of the reasons why the student has troubles in the article/presentation revising are as follows.

(a) The student, especially novice student in the laboratory, cannot reflect the provided comment to the new version of the article/presentation because it is difficult to understand the researcher's intentions of the comments.
(b) The student is often interrupted by revising not contents but style of the article/presentation because he/she is not always aware of what he/she should consider in the article/presentation writing.
(c) Most of the student cannot estimate the time to revise the article/presentation in advance because he/she does not have enough experience for the article/presentation writing.

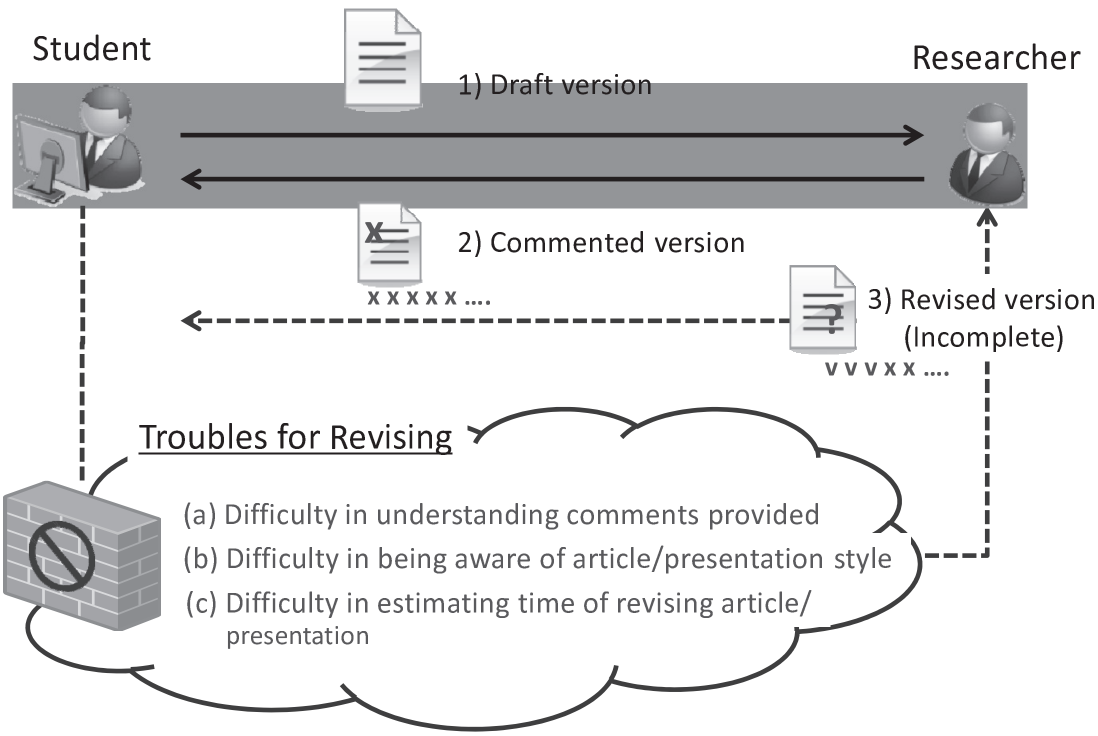

Figure 1. Model of Article/Presentation Revising

1.3 Approach

In the process of the revising, the researcher and the student exchange informal information. Such information has a central function for the article/presentation revising in a quick and efficient manner. From laboratory management point of view, it also makes the laboratory members communicate with each other effectively. However, it is difficult to figure out actual informal communication because it is implicit and disappears rapidly.

In order to resolve this issue, we need to provide the laboratory members with the laboratory knowledge for the article/presentation revising. Our approach is to extract the laboratory knowledge by gathering informal information existing in the process of the article/presentation revising from the laboratory members. In this research, the informal information means a set of researcher's comments and corresponding process for the article/presentation revising by the student. For this reason, such information often exists in more than one version of the article/presentation as the history of the corrections of the comment as shown in Figure 2. Therefore, we first design a comment management system which stores the researcher's comment to be revised and the student's answer. This system would facilitate the revising process by means of a comment list function which manages status of the comments. At the same instant, the system gathers the comments and the answer as the informal information and extracts reference comments as the laboratory knowledge. The reference comments are frequent comments from the researcher or complex comments for the student. This makes the laboratory members trace other's corrections of the comment and the answer, if he/she had a trouble in the revising process.

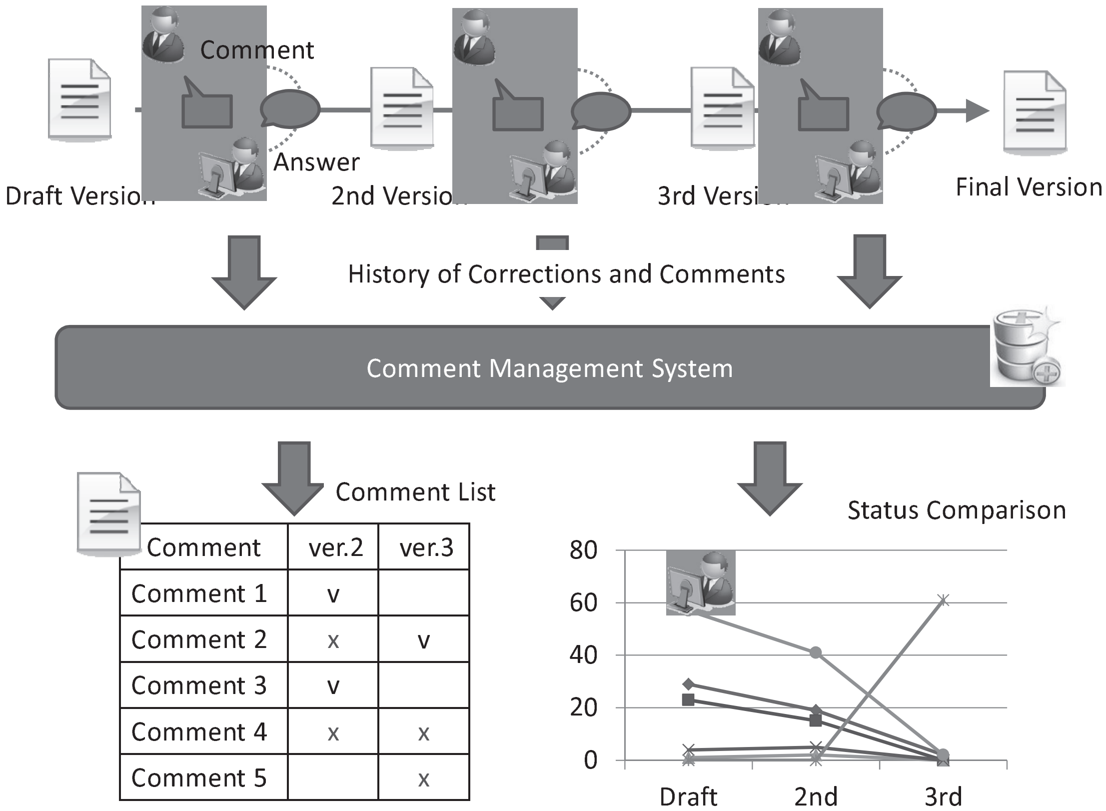

Figure 2. Concept of Comment Management System

2. CommentManager

We have developed an article/presentation revising support Web service called CommentManager. In the article/presentation revising process, many comments are exchanged between the researcher and the student. However, these comments are usually distributed by several versions of the article/presentation so far. CommentManager manages such comments as the informal information through the revising process. In addition, CommentManager provides the students with a knowledge transferring function which navigates related comments and high-frequent comments as the laboratory knowledge.

2.1 Extended Comment

CommentManager has a version control function for not only the articles/presentations but also the comments as extended comments. The extended comment means a set of comment, original and revised sentence, and the answer with the serial number among versions of the article/presentation as shown in Figure 3. This makes the researcher and the student share the informal intention for the revising. When the student uploads a Microsoft Word document (.docx) or a Microsost PowerPoint file (.pptx), CommentManager makes a comment list from the comment metadata by using the Office Open XML automatically. After that, all communication for the comments and the answers takes place in CommentManager. In addition, the researcher and the student are able to set a status flag such as “try again” and “close it” to the extended comments.

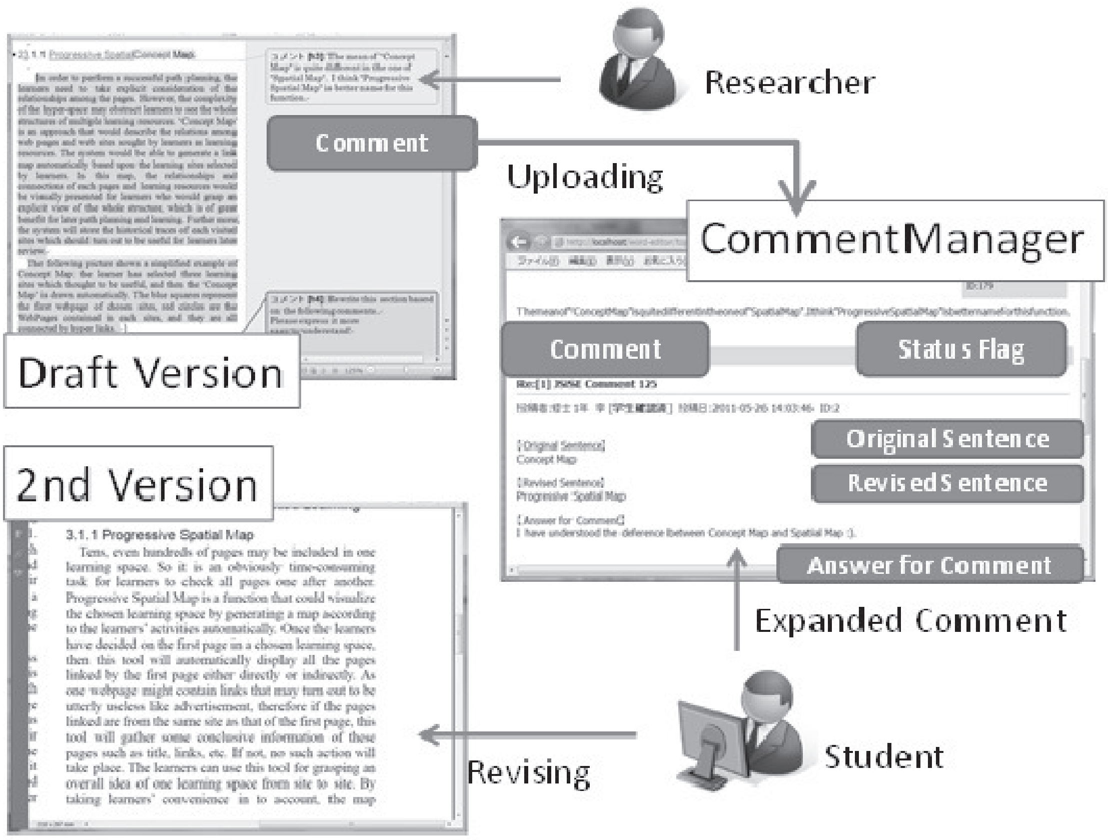

Figure 3. Sample of Extended Comment

2.2 *Extracting Laboratory Knowledge*

The extended comment implies a process of trial and error for the revising. CommentManager extracts the laboratory knowledge by gathering such comments from the laboratory members. CommentManager first lists the comments that the researcher made frequently or typically as a check list. This would make the student notice important points for the researcher’s check in advance. CommentManager also extracts the reference comments that the student could not correct suitably by a single revising. Such process would be available for learning how to revise in the laboratory manner.

We have divided 200 over comments that the researcher of our laboratory makes in the article revising process of the laboratory old boys and girls into five categories as shown in Table 1. Weight in Table 1 means average time taken to respond to the comment in the category. These values were decided by actual time of the revising process. Therefore, Commentmanager calculates the estimate time needed to submit next version of the article/presentation if the student selects the category of the comments. It also compares writing schedule of the old boys and girls. These functions make the student plan the writing schedule of the article.

Table 1. Categories of Comment

Category	Weight	Description
Comment for Section	60 min.	Revising a section including course of story.
Comment for Sentence	20 min.	Revising a sentence including word definition.
Comment for Format	1 min.	Revising a format error.
Comment for Figure	30 min.	Revising a figure and associated sentence.
Direct Correction	1 min.	Revised by the researcher.

2.3 Flow of Revising by CommentManager

Figure 4 shows a basic flow of revising by CommentManager. It has been implemented with PHP based on OpenTask [4] which is an open source bug tracking system. First, the student writes the draft version of the article using the check list so that he/she avoids basic indications. And then the researcher makes comments for the draft version. Next, the student looks up the expanded comment, especially the ones revised more than once as the reference comment, if he/she faces the comments that he/she is unsure how to deal with. The students write down his/her expanded comment such as original/revised sentence or slide and the answer for the comment to CommentManager. If needed, he/she is able to link the expanded comment to other comment that he/she use as a cue. Finally, the researcher checks the status of each expanded comment and changes the flag of the comment. If the flag is "try again", the researcher adds advice so that the student can revise it effectively.

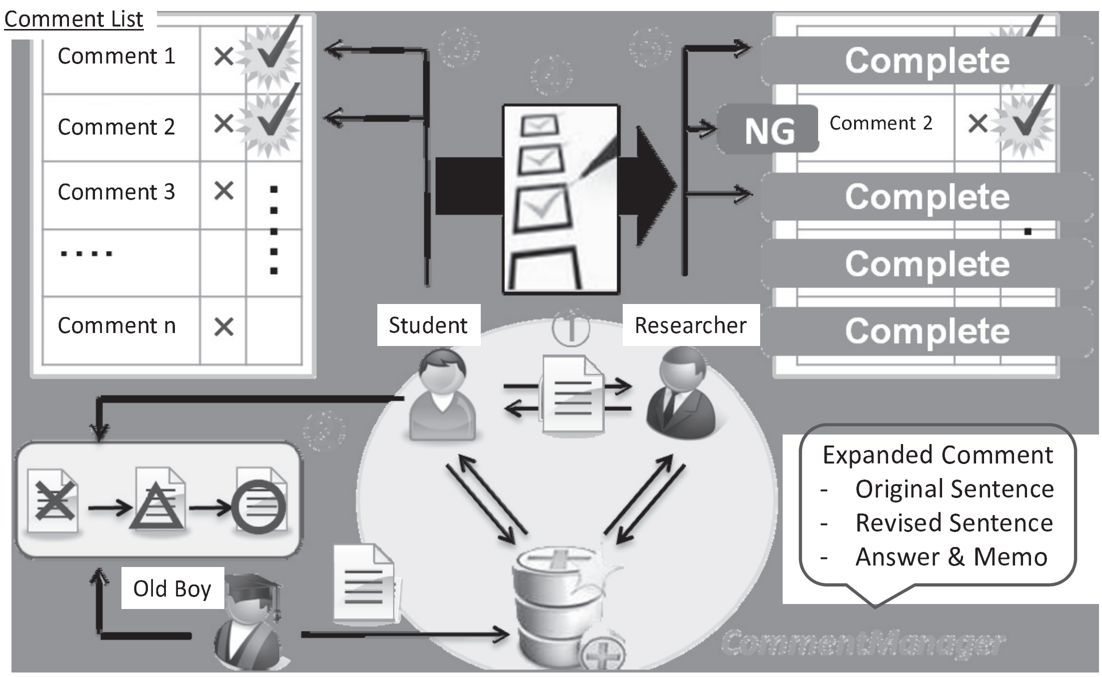

Figure 4. Basic Flow of Revising by CommentManager.

3. Preliminary Case Studies

3.1 Observation of Comments

In order to analyses tendency of the comments, we observed logs for a student who used CommentManager in the process of writing his master thesis. Figure 5 shows a number of the comments classified by the categories in each version of the article. From the results, the comments for Comment for Sentence and Comment for Figure tended to be closed in the early versions. On the other hand, the comments for Direct Correction were received in the last half version. Such tendency would depend on the strategy of the article revising of the researcher. The reason why the comments were increasing from draft version to 2nd version because draft version was just 7 pages abstract and 2nd version was over 60 pages detail version. Compared with Microsoft Word, CommentManagere gave the researcher the student's intention to the comment that he could not revise adequately. However, the student had a load for managing a lot of unimportant comments.

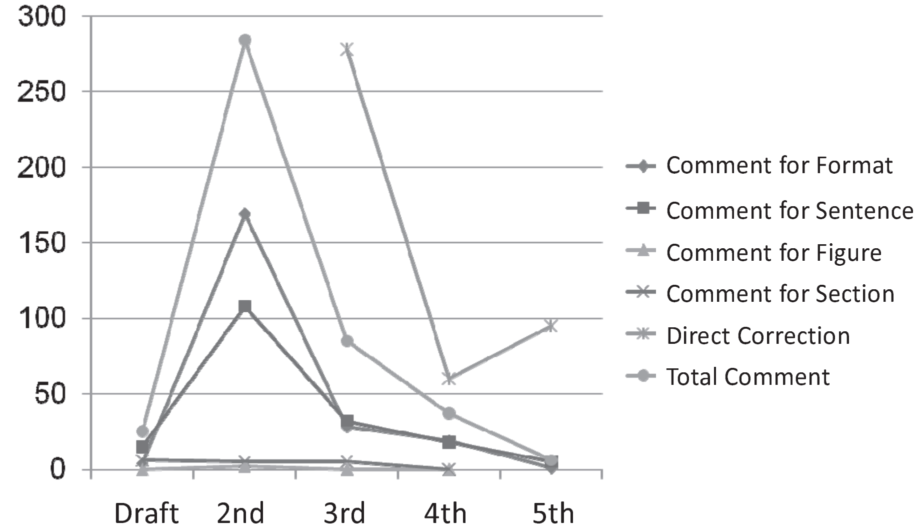

Figure 5. Variation with Number of Comment by Categories in Each Version

3.2 Observation of Laboratory Knowledge

In order to decide criteria for extracting the laboratory knowledge, we manually listed the comments made to 2 out of 3 students who wrote master thesis at January 2011 in our laboratory. Table 2 shows the candidates of the check list items. More than half of the candidates were matched with what the researcher usually coached. Therefore, we need to extract such candidates automatically.

We then compared subjective reference comments judged by the laboratory members to estimated reference comments determined by whether the one was revised by a single revising. From 284 comments, the number of the subject reference comments was 18 and the number of the estimated reference comments was 17. 11 comments were contained within both of them (precision ratio = 61.1%, recall ratio = 64.7%). The result indicated CommentManager extracted a certain number of the reference comments as the laboratory knowledge by managing the comment over the version of the article. We would like to improve the accuracy by implementing an evaluation function by each student.

4. Conclusion

This paper has described the article/presentation revising support system called CommentManager. The fundamental functions of the system are to manage the expanded comments over the versions of the article and to provide the students with the laboratory knowledge by the form of the check list and the reference comments. These functions would enable the laboratory members to transfer the laboratory knowledge to be shared such as research know-how, which would facilitate learning research skill.

In addition, this paper has discussed the preliminary case studies for confirming effectiveness of CommentManager by using the comment data described in the articles that our laboratory members had written. We first inputted the informal information such as "memo of the trial and error" by using CommentManager, and then analyzed what the laboratory knowledge was extracted from the system. The results of the case study showed potentiality for extracting the laboratory knowledge, which would support the article revising process of the new students.

In the near future, it will be necessary to improve the extraction accuracy and to facilitate skill development for writing the research article. Finally, we need to evaluate effectiveness of the functions by new students belonging to our laboratory in a more detail.

Table 2. Candidates of Check List

Candidates by Multiple Comments	Number of Commented Students	Evaluation by Researcher
Specify the definition of new technical term.	3	Important
Standardize technical term in the article.	3	Important
Describe why the support needs.	3	Important
Use concrete examples.	3	Important
Match figure and sentences.	3	Normal
Rewrite complex sentence to short sentence.	3	Important
Study and list reference work.	3	Important
Correct typographical and grammatical errors.	3	Normal
Divide paragraph adequately.	2	Normal
Check font style and size.	2	Normal
Avoid being redundant in sentences	2	Normal

Acknowledgements

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Applying an Extensible Learning Support System to Collaborative Learning Environments

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Abstract: This paper describes an investigation of the application of an extensible learner-adaptive system, Extensible Learning Environment with Courseware Object Architecture (ELECOA), to a collaborative learning environment. The design goal of ELECOA is to provide a flexible learning environment that ensures both function extensibility and content reusability. The concept of a "courseware object," which is a program module that is used to incrementally implement various educational functionalities, has been introduced to achieve this goal. Based on this concept, a self-learning environment has been implemented that is fully compliant with the SCORM 2004 specification. This report provides the investigation results of implementation on a collaborative learning environment based on the Learning Design specification within the ELECOA framework.

Keywords: Learner Adaptation, Courseware Object, Learning Design, Extensible Learning Support System

Introduction

In order to provide high-quality e-learning services that offer rich educational experiences, the interoperability and reusability of learning content is vital. There have been various efforts made to develop and disseminate e-learning content specifications [4]. Many learner-adaptive systems, capable of presenting learning content and resources that match the learner's comprehension level, have also been considered as an effective means to provide an improved learning experience [2, 7, 9]. However, there has been little consideration of the interoperability and reusability of content in the field of learner-adaptive systems. Generally speaking, learner-adaptive systems have been designed on the basis of a certain single learner-adaptive strategy without any extensibility to support multiple learner-adaptive strategies or even to modify a single implemented strategy. Due to this lack of flexibility, it is difficult and sometimes impossible to add new functions that could improve the effectiveness of learning because the newly added functions may interfere with the current content, thus impairing its reliable behavior.

In response to this problem, we developed a learning-system architecture called Extensible Learning Environment with Courseware Object Architecture (ELECOA) that can both extend learner-adaptive functions and make the learning content interoperable [10]. This architecture was designed around the concept of a "courseware object," which is a program module that implements various educational functionalities and is usually embedded as an inseparable fragment of program code in the learning platform. It is possible to incrementally extend functions by adding new courseware objects. We have previously shown that several learner-adaptive functionalities for self-learning, including the SCORM 2004 standard specification [1] and its extensions, can be successfully implemented on ELECOA [10].

Educational Modeling Language (EML) has attracted the attention of developers of learning environments. EML was designed to formally describe formations and sequences of various types of educational activities, including not only self-learning materials but also lectures and collaborations in which groups of learners and instructors are involved. The intent was to share and reuse pedagogical strategies to achieve effective learning. In particular, the IMS Learning Design (LD) specification [6, 9], which was derived from EML and developed by the Open University in the Netherlands, has been widely used in several research projects. These projects include the development of LD authoring tools, LD execution systems [3, 8], and a system to generate pedagogy described in LD from higher level design requirements that take into account instructional design theories [5].

In this paper, we discuss our investigation of how to implement an LD execution system based on ELECOA, which has primarily been used only in the self-learning environment. The results of our investigation indicate that ELECOA is capable of seamlessly integrating self-learning learner-adaptive environments (such as that of SCORM 2004) with an LD-based collaborative learning environment. We also found a few issues related to this implementation that will need to be addressed.

1. Extensible Learner-Adaptive System Architecture

1.1 Issues with Conventional Learner-Adaptive Systems

Conventional learner-adaptive systems typically have the system architecture shown in Fig. 1, in which the content is separated from the platform [10]. In this type of architecture, the content consists of learning materials specific to a particular learning subject, and the platform devises common learner-adaptive functionalities independent of the specific learning subject. By separating the content from the platform, this configuration makes it possible to design learner-adaptive content with less effort because the designer can concentrate on creating content to fulfill the specific learning goals and not worry about the specifics of implementing learner-adaptive functionalities.

The drawback to this architecture is its lack of function extensibility. After implementation, extending the platform to add new functionalities is difficult because it is not possible to ensure that the existing learning content designed for the original platform will work correctly on the extended platform. A representative standard with learner-adaptive capabilities, SCORM 2004, uses the same configuration, resulting in the same lack of function extensibility.

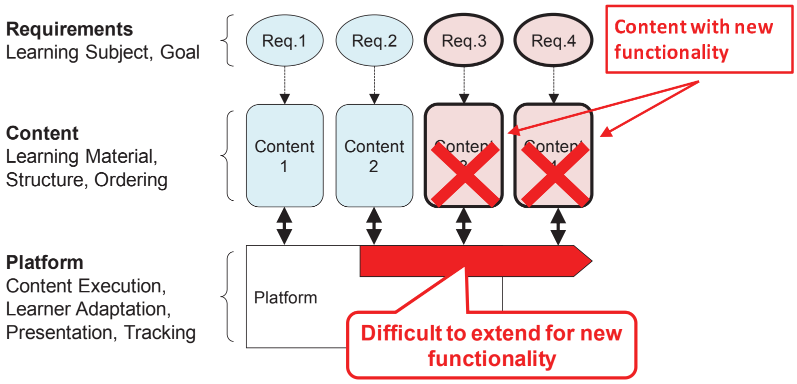

Fig. 1. Architecture of conventional learner-adaptive systems.

1.2 Approach of Proposed Learner-adaptive Architecture

To overcome the drawbacks of conventional learner-adaptive systems, we recently proposed a learner-adaptive system architecture called ELECOA with the aim of achieving both function extensibility and system interoperability [10]. Our key to accomplishing this goal is the concept of a "courseware object" to modularize the learner-adaptive system architecture. The courseware object is a program module that implements various educational functionalities that are embedded in the platform of the conventional architecture. The courseware objects implement functions, including learner adaptation, to select the most suitable learning material for the learner, material presentation to tailor the way the learning material is presented, and learner tracking to record the status of the learner's progress. For example, there might be multiple courseware objects, each of which implements simple linear, conditional branching, complicated remedial, or much more sophisticated strategies such as scenario-based sequencing using a state-transition machine.

Fig. 2 shows the proposed ELECOA architecture in which the courseware object is clearly separated from the platform. With this configuration, incremental extension of functions is possible by adding new courseware objects. Since this extension does not affect the previously implemented functions, the existing content will continue to work correctly. In addition, courseware objects can be distributed along with content, thus enabling existing platforms to be immediately updated for newly developed functionalities.

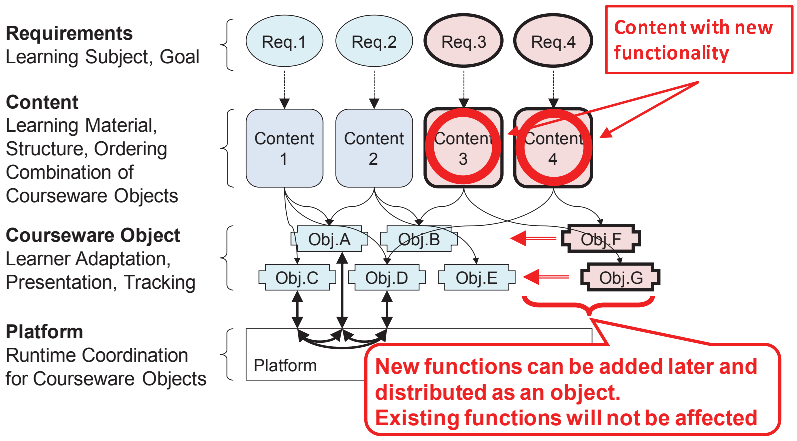

Fig. 2. Proposed ELECOA architecture.

1.3 Application of ELECOA to Self-learning Environment

For the ELECOA architecture to be of any value, it must be possible to assemble any courseware objects developed by various designers at various times and have them work together. To make this feasible, it is necessary to design some criteria or standards to which every courseware object designer must conform. These criteria may include the communication scheme between courseware objects, the information maintained by courseware objects, and the responsibility of courseware objects.

To investigate these issues, the system was designed in accordance with the following principles and assumptions. First, it was assumed that the content is structured hierarchically, or like a tree. This is because content with a hierarchical structure is widely adopted in learning materials by various standards, including AICC CMI, ADL SCORM, and IMS CC [4], as well as various proprietary LMSs. Second, it was assumed that the courseware objects are assigned for each hierarchical node of content, as outlined in Fig. 3.

It is the responsibility of the courseware object assigned to a content node to manage the learner-adaptation behavior of the sub-tree under its node. The courseware object sequences its child nodes by taking into account their learner progress information according to the pedagogical strategy implemented in it. This makes it possible to implement different pedagogical strategies in different sub-trees. It is also assumed that the communication between courseware objects is only limited between parents and children. On the basis of this assumption, definitions are designed for the required communication patterns between courseware objects and the interface that courseware objects should provide for other courseware objects.

The SCORM 2004 specification, which is a standard for learner-adaptive content, has been implemented based on these principles and assumptions [10]. The implementation was demonstrated to be conformant to SCORM 2004 3rd edition by checking against the test suite of the specification consisting of 100 test cases.

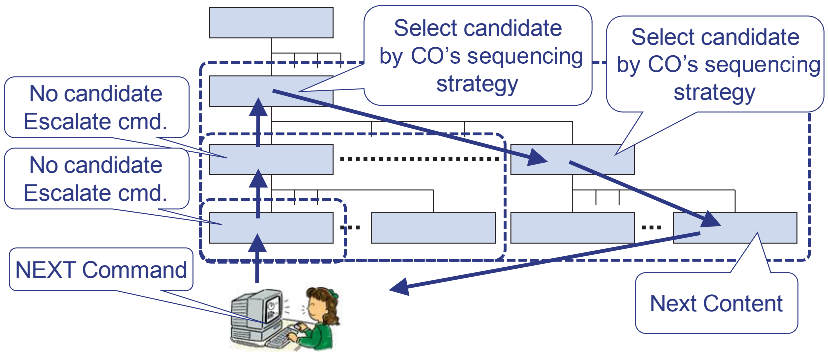

Fig. 3. Communication between courseware objects in hierarchical configuration.

2. Application of ELECOA to Learning Design Specification

2.1 Learning Design Specification

The LD specification is designed to promote the sharing and reuse of pedagogical strategy to achieve effective learning results by formally describing formations and sequences of educational activities. It is a pedagogy-neutral technical specification capable of describing various types of educational activities, including self-learning materials, lectures, and group learning. However, the LD specification's most notable feature is its capability to describe collaborative learning activities, which follows the recent trend of e-learning toward a learner-centered approach.

The LD specification defines a data model to describe learning activities. In the LD specification, the primary elements to describe learning activities are "activity," "role," and "environments." An activity uses several environments, including "learning objects" and "services." It also involves people with several roles, such as "learner" or "staff." The activity has an "activity structure," which is a hierarchical one so that the aggregation of activities becomes an upper-level activity. The above-mentioned description of learning activity can be represented using level A of the LD specification. With level B, the properties of a person or group and conditions for the sequence of activities can be described to control the learning sequence. In addition, events resulting from certain activities, such as the notification of a question from a learner, can be described with level C.

LAMS [3], which is the most commonly disseminated open source learning tool compliant to the LD specification, has two types of communities: one for a system developer to update the system itself and the other for instructional designers to share and reuse descriptions of designed educational activities. LAMS deals with sequences of learning activities, e.g., each learning activity can be assigned to one of a variety of environments, such as document, survey, chat, or forum. It can also deal with a hierarchical activity that has an internal structure with conditional branches. Synchronization of multiple learners can be implemented by a waiting point where all the learners have to stop until every other learner finishes the previous activities. For example, before entering a synchronous forum, all the participants must finish a pre-assigned series of activities.

2.2 Basic Framework to Implement LD Specification with ELECOA

The basic implementation framework of the LD specification using ELECOA has previously been investigated [11]. ELECOA was originally designed for self-learning; it was not intended to support group learners. However, both ELECOA and the LD specification deal with hierarchical structures. In addition, ELECOA has the capability to control learning activity sequences by means of courseware objects.

The investigation took into account these characteristics. With the LD specification, learners follow a predefined learning path in which they communicate with other learners and instructors using communication tools such as chat or forum. The learning path varies according to the learner's own learning status as well as those of other learners. Thus, the following issues should be considered for implementing the LD specification using ELECOA:

(1) implementation of a learning path for each individual learner,
(2) integration with communication tools, and
(3) control of the learning path based on the status of multiple learners.

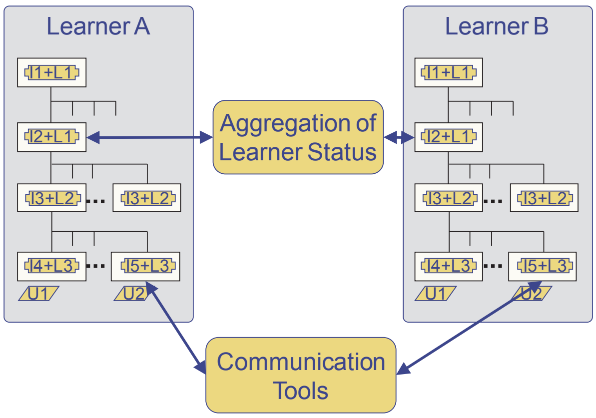

Fig. 4. Implementation of LD specification with ELECOA.

The implementation is outlined in Fig. 4. First, the learning path of each learner is controlled by the courseware objects in a similar manner to the original ELECOA behavior for self-learning in a hierarchical structure. The courseware object selects the next node to be presented to the learner according to the learner's status. This makes it possible to implement learning path control that takes into account each individual's status. Second, communication tools are integrated as learning resources to be associated with the leaf node of the hierarchical content. In the LD specification, communication tools and learning services are environments that also include learning resources such as static HTML documents or quizzes associated with the leaf node of hierarchical learning activity. Thus, in the ELECOA-based implementation, they are associated with the leaf nodes in the same way that the original ELECOA has learning resources assigned to leaf nodes. Finally, to reflect multiple learners' statuses in each individual learning path, a courseware object is equipped with the capability to exchange information with other courseware objects controlling the learning path of other learners. In this way, the courseware object can determine the learning resources to be presented by taking account of multiple learners' statuses. This means that each learner's learning sequences can be controlled on the basis of their own learning status as well as those of other learners.

It is important to note that the basic framework of ELECOA is not modified to implement the LD specification. The framework defines the process of information exchange between courseware objects assigned to a hierarchical structure to determine the next learning resources presented to the learner. Since this framework is independent of the learning resources to be presented, it does not need to be modified if communication tools or learning services are assigned as learning resources. In addition, this framework simply defines the communication schema between courseware objects in the hierarchical structure, which is independent of the internal behavior of each courseware object, to control the learning path. Thus, the framework does not need to be modified if the courseware object, as its "internal behavior," exchanges information with other learners' courseware objects to control the learning path. It is therefore possible to implement the LD specification using ELECOA without modifying its basic framework by simply adding learning resources and courseware objects for collaborative learning.

2.3 Issues to be Considered regarding Implementation of LD Specification with ELECOA

The following issues should be considered with regard to the implementation of a group learning environment defined by the LD specification within the ELECOA framework:

(1) assignment of activities and environments according to roles,
(2) dynamic generation and assignment of activities and environments, and
(3) function to aggregate and control this information.

These issues are discussed in the following sections.

2.3.1 Assignment of Activities and Environments according to Roles

The biggest difference between a collaborative learning environment and a self-learning environment is the necessity of multiple-user control in the former environment. In the collaborative learning environment, every user can be a learner, or some users can be another role type such as an instructor. The LD specification defines learner and staff as two major roles. Designers can also define new roles that are derived from the major roles. Roles can be defined in a hierarchical manner, and this functionality makes it possible to assign users to hierarchically divided groups. The designer may assign activities and environments to roles. It is thus possible to create assignments in which each learner group uses different discussion rooms and instructors can join any discussion in any room. From the system implementation point of view, these assignments can be created either before runtime, when the activity structure is generated, or during runtime, while the learning sequence is executed.

2.3.2 Dynamic Generation and Assignment of Activities and Environments

Flexible formation of learner groups is necessary in any collaborative learning activity. For example, the jigsaw method requires separate groups to learn certain topics and then give presentations on these topics, as shown in Fig 5. In this method, first, different learning topics related to one learning subject are assigned to each group. These groups discuss the assigned topic, and then groups are formed for presentations in such a way that each group gives a presentation to learners from different groups on their particular learning topic. In this way, learners with knowledge about different topics collaborate in their respective groups to discuss their topic and prepare their presentation. There is the option of assigning learners to multiple groups during collaborative learning activities, and there are also various options about the number of groups and the criteria for assigning individuals to groups (such as fixed, random, learners' preference, learners' performance, etc.). These assignments are made either statically in advance or dynamically during the learning activity itself.

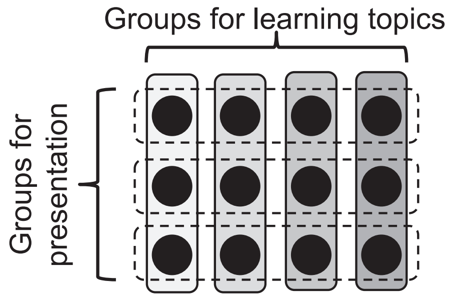

Fig. 5. Group Formation for Jigsaw Method.

Another example is the Versailles role play, shown as an use case in the Learning Design specification [6]. In this case, *n* groups of learners corresponding to *n* countries perform bilateral negotiation. All combinations of countries require C(n, 2) negotiation meetings. For example, as n is set to 6 in this use case, it is required to prepare C(n, 2) = 15 online meeting rooms statically defined in the LD manifest file.

As seen in this example, the original LD specification requires environments to be statically defined before execution, which can possibly lead to a lack of flexibility and extensibility. LAMS, on the other hand, provides a group assignment strategy based on the number of groups and the number of learners per group. To carry out this assignment strategy, it is necessary to implement a function to dynamically generate the proper number of groups with required environments according to the number of learners and to assign learners to these groups.

2.3.3 Function to Aggregate and Control Information for Collaborative Learning

In order to deal with the issues discussed in the previous two sections, it is necessary to implement functionality for learner status aggregation and learning sequence management (as shown in Fig. 4). Various physical implementation schemata for this functionality can be considered, including a schema with a central server aggregating all information, a schema with functions and information completely distributed to the courseware objects of each learner, and an intermediate schema in which both a central server and courseware objects are responsible for managing learner status and learning sequence. In fact, the original LD specification has been implemented in several ways, including on a single state transition machine that takes care of the management of all learners and on a P2P network in which the distributed engine assigned to each learner exchanges information for the learning sequence [8].

Because of these differences, if used, the implementation schemata would impact the scalability of the system and the effectiveness of implementing management functionality. In addition, since the implementation schemata would affect the extensibility and reusability of courseware objects for collaborative learning in ELECOA, careful consideration is required as to the responsibility and interface between individual learners' modules and common modules taking care of learner status and learning sequence management.

3. Conclusion

In this paper, we discussed our investigation of the implementation of the LD specification using ELECOA, an extensible learner-adaptive environment enabling both functional extensibility and content interoperability. Although the original intention of ELECOA was to support self-learning, its extensibility may make it possible to implement the LD specification to include group learning. With this capability to implement self-learning and group learning in the same framework, it would be possible to provide an integrated learning environment in which materials and learner history could be seamlessly exchanged between self-learning and group learning. Further study is needed to clarify a few issues that remain in applying ELECOA to the implementation of collaborative learning environments that include the LD specification.

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Expanding the Scope of Metadata and the Issue of Quality

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Abstract:
This paper summarises the current context of metadata standards development relevant to Information Technology for Learning, Education, and Training (ITLET). A number of issues are identified that need further discussion in order to harness the potential of ICT in LET. In particular, issues related to assessing quality of standards; how to scope ITLET standards; and how to specify metadata for explanatory content are highlighted.

Keywords: metadata, ICT standards, IEEE LOM, ISO MLR, learning resource description, learning technologies, ITLET

1. Introduction

Metadata is a term that can convey diverse meanings, probably because the root ‘meta’ has rich semantics and can mean: ‘beyond’, or ‘above’ as in metaphysics or metacognition; ‘behind’ or ‘after’ as in metaphase; ‘change’ as in metamorphosis; and, ‘together with’ as in metabolism. It is a term that has been adopted in recent decades by standards development organizations such as the Institute of Electronics and Electrical Engineers (IEEE) and the International Organization for Standardization (ISO). It also describes the core focus of the Dublin Core Metadata Initiative (DCMI) and is basic to the specifications developed by the IMS Global Learning Consortium (IMS GLC).

While both the IEEE and ISO choose not to define it within their standards that are used by IMS GLC and many other stakeholders worldwide [1, 2], the DCMI uses a very short and commonly accepted definition of metadata as “data about data”. The US-based National Information Standards Organization (NISO) provides a longer version as: “structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource” [3]. While it is also noteworthy that Wikipedia declares it to be “an ambiguous term” [4], evidence suggests a common and evolving understanding of this term within the standards development community is that metadata is data that not only describes or identifies other data, but also information resources (digital and non-digital), events, people, and services [5, 6]. Following on from this the discourse on metadata standards for learning is far from over and indications are that the scope of what metadata does within ICT infrastructure is expanding.

It is commonly stated, however, that “the nice thing about standards is that there are so many of them to choose from.” This quote, attributed to Andrew Tanenbaum [7] highlights the dilemma of many implementers of metadata standards. Due diligence, particularly in the ISO context, requires that any new standardization project must identify and situate its scope of work in the context of having navigated a complicated standards landscape of the past, relevant current initiatives. For implementers, the challenge is discerning those standards that are best fit for purpose.

IEEE LOM was the first e-learning metadata standard, published in 2002 [1]. Other *de facto* standards at the time, such as the Dublin Core (DC) Metadata Element Set [8], also provided a means of describing learning resources, although without the same degree of specificity. However, this situation unfortunately led to significant confusion by stakeholders in the education community. While both these standards had similarities they were not interoperable, and implementers of systems were left to solve the interoperability issues with workarounds. It was in this context, following the formation within ISO/IEC of SC36 (subcommittee 36, IT for Learning, Education and Training – ITLET), that a project on Metadata for Learning Resources (MLR) was initiated. While there were perceived deficiencies with IEEE LOM, however, national bodies participating in SC36 wanted to produce “a harmonized standard” with LOM and DC. Also, because of industry adoption of LOM as a result of the market success of SCORM [9] they also wanted to “maintain compatibility with the implementation of IEEE 1484.12.1:2002 where practicable”. Apart from these initial requirements the consensus about direction of development was not clear and the early years of drafting a framework for specification went through much iteration. This was further complicated as a consequence of significant and evolving work taking place within the Dublin Core Metadata Initiative (DCMI) [8]. As a consequence, SC36 used the rest of the decennium before finalizing their first MLR standard, the framework part, published in 2011 [2].

It might be easy to criticize SC36 on the time span involved in delivering MLR to the ITLET community without understanding the full context – a context which is characterized by unprecedented innovation in information and communications technology (ICT) development and strained relations between a number of the specifications and standardization bodies. Standards development does not happen in isolation, however, and ensuring optimum process and quality outcomes is dependent upon a number of factors. Probably of most importance for the next steps in metadata standards is consideration of the broader context of ICT innovation on the Web and the consequences this has for the specification and use of metadata.

1.1. The Evolving Web

From the very beginnings of the Web metadata has played a key role shaping its ongoing architecture. Whether in the form of HTML META tags (to assist search engines of the time), as hypertext enabling the foundational utility of the Web, or as indexes produced by the sophisticated algorithms developed by Google, metadata has existed in various forms. Hypertext itself represents a powerful instance of executable metadata; Extensible Markup Language (XML) is a key technology that facilitates the interoperability of structured content and provides capacity for very rich encoding of metadata; Web 2.0 tags used in social software applications (such as del.icio.us, Twitter, and Flickr) provide a collective, informal means of classifying and sharing resources [10]; and metadata standards such as the IEEE LOM [1] and the Dublin Core Metadata Element Set [12] have provided standard mechanisms for the description of resources on the Web for many years [5,6]. The recent publication of the ISO standard, *Metadata for Learning Resources – Part 1: Framework*, builds on both these standards and provides an extensible and modular framework for specifying new metadata data elements [2].

While much of the development of e-learning standards started after it became clear that the web would have a huge impact on learning technologies the relational database paradigm continued to influence metadata development. The IMS Content Package specification [13] was developed in tandem with the IEEE LOM and has played a dominant role in moving resources between applications, despite this specification having been modeled on the pre-web CD-ROM media. This legacy contributed to controversy in the development of ISO MLR with regards to "web enabling" the standard, leaving the database area to embrace the web architecture view on metadata.

An environmental scan of related metadata innovations reveals a number of other uses of metadata, particularly in relation to e-learning. For example, the European standards committee CEN has recently standardized Metadata for Learning Opportunities [14], based on the Dublin Core Abstract Model (RDF). This is the first in a series of smaller standards that address "European learner mobility". We also see that syndication technologies such as RSS and ATOM, which play an important role in Web 2.0 technologies, are commonly used in educational settings and are dependent upon metadata (RDF or XML) to function. For the ITLET standards community, however, it is essential to adopt or adapt the work of other communities, e.g., the digital library community. This is because the scope of ITLET embraces *both* standards that need to be specifically developed for ITLET purposes (such as e-learning) as well standards that are useful for it (such as digital library protocols like METS) and promote interoperability with an ever expanding domain of Web technologies [15]. This breadth of scope, however, has also brought alternative specifications and development philosophies to the standardization committee tables. This has often created tensions regarding due process and often politicized or tribalised the consensus-building process required. So, the questions arise: *where to go from here with the application of metadata to ITLET systems and services and how might issues of quality be addressed within the broadening scope of development?*

2. Implementation and the issue of Quality – the top-down perspective

In addressing the quality of a metadata standard a number of guidelines and frameworks aim to improve both the product quality (i.e. the quality of the information models, profiles, bindings etc.), and the process quality (i.e. the modeling technique) [16].

A metadata standard is typically developed once conceptual modeling of a particular domain, e.g., the field of educational technology, is clearly established. Some commentators claim that all metadata schemas have an inherent model, whether this has been made explicit or not [17]. Such a model is also known as an "abstract model", as it describes the abstract overarching information structure the standard relies on for implementation, e.g., the information model or a binding [17]. In the case of DC metadata [8] an abstract model was produced many years after the element set was standardized. The fact that over time it became perceived as necessary to specify is significant, and vindicates the view that was already inherent. Interestingly, the history of the DCMI can be seen as a bottom-up development that responded quickly to the immediate needs of the rapidly evolving Web.

The product quality raises issues of how well the developed models are fit for purpose or give a good description of the domain. This discourse on quality is often based on top-down frameworks [18] which define quality dimensions inspired by e.g. accounting principles, as the Guidelines of Modeling of Schuette and Rotthowe [19]. The guidelines include six principles to improve quality of information models: correctness, clarity, relevance, comparability, economic efficiency, and systematic design – the first three being a more necessary precondition for quality than the other dimensions [16]. Correctness and relevance are principles also found in the semiotic framework (SEQUEL) developed by Lindland *et al.* in 1994 [20], in which the Perceived Semantic Quality dimension is measured by indicators of correctness, relevance, completeness and authenticity. Quality goals of completeness (expressiveness) and validity are not easy to validate empirically. Krogstie *et al.* [21] have revised their SEQUEL framework, taking into consideration the problems participants had making reliable evaluations by means of it. They also supported the criticism of the first version SEQUEL taking a too static view of the domain, leaning towards the "knowledge-as-object" view talking about the model as "externalized knowledge" [21]. Krogstie *et al.* has come up with a concept of "active models" [21], leaving behind the descriptive conceptual modeling ('as-is' modeling) in favour of more prescriptive process models. "The notion of quality for a model is extended by looking at its ability to facilitate learning and action, more then just being a representation of the domain" [21]. This extended quality notion establishes also a new context for assessing metadata standards. The following short case study illustrates why this is much needed.

2.1 Measuring quality by counting elements in different metadata standards

In the July 2011 issue of IEEE Learning Technology newsletter Pons *et al.* give an update on "e-learning metadata standards" and a comparison between "the most commonly used standard for learning object metadata" IEEE LOM and the new ISO/IEC MLR [22]. They note that the new standard is "based on two basic principles", modularity (since it is a multipart standard) and compatibility (since it "opts for compatibility with LOM and Dublin Core"). Pons *et al.* state that the "usefulness of an educational resource metadata corresponds to data stored about pedagogical features of the educational resource". This leads to a quantitative assessment of which of the two standards that have the highest number of data elements covering the different dimensions of the standard. Pons *et al.* find that MLR "overall incorporates 45% more" of educational information, and "offers much more capacity to include information about intellectual property" (finding 25 such elements in MLR and only 3 in LOM) [22].

This is not the place to discuss what the authors of this IEEE LT newsletter story might have misunderstood about ISO MLR, considering that the parts on educational elements and IPR elements are not yet published. They are not alone in assessing quality of standards in this way. When a European best practice project recently reported on strengths and weaknesses of current specifications and standards it concluded: "ICOPER chose to use LOM instead of DC-Ed as the base standard for Teaching Method/Unit of Learning application profiles because fewer description fields could be mapped to DC-Ed." [23]

The authors of this paper observe that it is a widespread approach to appraise the quality of metadata standards by putting a quantitative metric on expressiveness, assessed by the number of data elements defined in the standard. Our claim is that this implies a static and ontological idealistic view on knowledge, which does not align with an active concept of knowledge and Learning, Education and Training needed in the 21st Century.

3. Quality of standards – the bottom-up perspective

Mendling *et al.* [18] reports on several works on bottom-up metrics related to quality aspects of process models. In summary, this research concluded that "larger models tend to be negatively connected with quality" [18]. Model size is important for understandability of the model. Therefore, a large number of metadata elements will at some level inhibit the quality of a standard, at least when it comes to implementation by diverse communities of stakeholders.

However, expressiveness is not necessarily linked to size of a model, measured by number of data elements. When the CEN WS-LT discussed design principles of the CEN MLO standard the group came up with a declaration stating

"Harmonization efforts should focus on small, simple models based upon existing commonalities that can be expanded upon at national or regional level, rather than all-inclusive monolithic standards." [24]

The key phrase here is "expanded upon". Building on the Dublin Core Abstract Model principles the European experts agreed that *extensibility* was a more important quality criterion than *completeness* (i.e., that the standard covered all aspects of the domain). This lifted the quality discussion to a meta level, from the coverage of the metadata model to the ability of the model language to cope with future need for constructs.

4. Emerging requirements

4.1 Due Process towards a good Product

The LET domain is described as complicated, complex, emergent and adaptive [25, 26] and this highly dynamic context is putting great strain on both the process of standardization and the resulting products. The legitimacy of the activity is under threat [27], and therefore, it is an urgent need to deliver on promises. However, it is impossible to change the process without changing the outcomes. A more agile design process will give a different kind of standards. At the moment, the authors do not observe a strong debate on design principles for ITLET standards. Without an informed discussion on both process and product the tensions in the LET standards community will be disguised as a conflict between organizations and strong personalities rather than between different design approaches.

4.2 Expanding the scope of metadata

No e-learning standard is "pedagogically neutral", as the US Department of Defense (ADL) put it when they first published SCORM [9]. Underlying every standard is an idea of rewarded activity taking part in learning, education or training. Delivery of content has been a primary concern till now. The ubiquitousness of means of *communication* with the evolving web opens up new possibilities for a wider range of pedagogical ideas to be supported by technology. Exchanging units of meaning rather than units of content expands the scope of metadata. We therefore see that recent terminology like "learner-ownable information", "competencies", "learning opportunities", etc. enter the scope statements of ITLET standards. This development has just begun and calls for leadership.

4.3. Beyond Metadata about Learning Content

Conceptions of "learning content" and "learning resources" are in most practical cases semantically equivalent. However, the short history (15-18 years) of metadata standards development relevant to ITLET demonstrates a bias toward "object oriented" conceptions of content. IEEE LOM has been the most successful metadata standard to date that has been specifically developed to support e-learning. Its name gives clear emphasis to the notion of a "learning object". Likewise, in the ISO context, the publication of MLR builds on this approach, although it also implicitly embraces the entity-relationship model of the Semantic Web and the Dublin Core Abstract Model. But in neither of these cases is there any (current) specific support for the discovery of content that is specifically explanatory in nature. Both schemas ultimately privilege content or learning resources that can be described or referenced by factual *information* (derived from the primitives: *who*, *what*, *where*, and *when*). However, *explanation* is more than information; it is often a key to comprehension, understanding, and learning. Clearly, if a metadata specification (such as MLR) purports to support learning in any holistic sense then a means for specifying the varieties of explanatory content and the metadata elements required to do so represents work that could be undertaken.

Mason [28, 29] presents a sense-making model that indicates potential new scope for the application of DC-based metadata in relation to accommodating *explanative* metadata – that is, metadata that can effectively reference *explanatory* as opposed to just *descriptive* content. Mason argues that among the many questions a learner might ask while learning or discovering content *why*-questioning is important as it is closely linked to reasoning and critical thinking. Despite advances in natural language search engines, such as TrueKnowledge [30] and DeepQA [31] there is still a lack of Web-based tools that can support learners asking *why*-questions. This is partly due to the fact that *why*-questioning is often heavily dependent upon context and the variety of *why*-questions possible spans causal, motivational, conditional, and teleological dimensions [32]. Thus, this adds complexity to any information that needs to be rendered into suitable metadata elements.

5. Issues

The following represents a preliminary list of issues that relate to metadata specification and implementation in the field of ITLET. They are listed as a means of stimulating discussion in the context of a workshop:

Issue #1 Quality assessment of specification and standards – are the principles articulated by Schuette and Rotthowe (correctness, clarity, relevance, comparability, economic efficiency, and systematic design) adequate?

Issue #2 Standards development and the tension between innovation and standardization – choosing a good process for a good product and the demands for agility

Issue #3 The expanding scope of opportunities for learning with ICT requires a broadening understanding of stakeholder requirements with regards to standards

Issue #4 How to specify metadata for *explanatory* content, and how to develop an information model of explanatory content?

6. Conclusions

It is not clear if a little more than two decades of development history of ITLET standards should be characterized as a success or a failure. A great number of standards are published, many of those metadata standards. The evolving Web and pedagogical, economical, demographical and other challenges have changed the context for ITLET standards development expecting the standards community to engage in a discourse covering both the quality and design principles of the current work, and the scoping of new and innovative metadata schemes.

This paper has argued that issues of quality, both of process and product, should be addressed. Furthermore, there is scope for an expanded view on metadata in

ITLETmoving beyond content objects into the domain of learning opportunities and competencies. It would appear to be timely for the standards community to address metadata for explanatory content in order to assist in stimulating ICT support for the sense-making activities so important for learning. The paper is a contribution to a workshop on Strategic Approaches for e-Learning Standards and as such more concerned to find a strategic entry point to the discussion. However, this aim has limited the authors' possibilities to discuss in depth where to go with metadata development.

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The Effect of Ontological Modeling of Lesson Design: A Case Study in a Community of Teachers

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Abstract: This paper discusses computer support for sharing empirical instructional design knowledge among active teachers in schools. The authors have developed an ontology called OMNIBUS and a theory-aware authoring system called SMARTIES. This study prompts their adoption by a community of social studies schoolteachers in Tokyo. This paper presents the advantages of OMNIBUS and SMARTIES and considers problems faced in widening their adoption in schools.

Keywords: ontological engineering, authoring system, lesson plan

Introduction

In the field of education, people have accumulated knowledge theoretically as well as practically. A representative theoretical approach is to build theories of learning or instructional. A typical practical approach involves a "lesson study" [5], in which schoolteachers observe and review each other. This interactive approach does not always work as well as in other areas. Schoolteachers tend to educate students using their own experiences [7].

A big goal of this study is to build an information system that support both for putting theoretical knowledge to practical use and for sharing the empirical knowledge of schoolteachers. In other words, this study aims at promoting exchanges of knowledge between researchers and schoolteachers. Hayashi et al. propose an ontology and an authoring system for utilizing theoretical knowledge of teaching; OMNIBUS ontology is a basis for organizing learning and instructional theories and SMARTEIS is a theory-aware and standards-compliant authoring system [1]. As the first step to achieve the latter goal, support for sharing the empirical knowledge of schoolteachers, this paper reports attempts to deploy them in practice with a lesson study group of teachers.

Deploying them in practice requires analyzing the needs of actual schoolteachers and developing support functions to meet these needs. The authors conducted a needs analysis with a lesson study group of teachers in Tokyo. This group is consisted of active teachers and former teachers. The active teachers are highly interested in lesson study and have experience of it. The former teachers are working in school committees to coach active teachers. In this study, we examined the practical aspects of OMNIBUS and SMARTIES with this group and considered improvements that can be made to the technology based on insights gained in its practical use.

	Items to be learned	Point of instruction	Evaluation (■), Methods (○)
Introduction$_{(a)}$	“ Check the location of Fuchu City in the Kanto region ”$_{(b)}$ • Students look$_{(b')}$ for Fuchu city in the Kanto region and express$_{(c)}$ it in their exercise books.	• The teacher calls students attention to the positional relation of Fuchu City in Kanto region with comparative expression.	■ Students can look for Fuchu city in Kanto region with atlas ○ statements, exercise book

Fig. 1Part of a lesson plan modeled in this study.

This paper discusses the effect of modeling of design of lessons based on OMNIBUS. Schoolteachers describe a design of lesson in a document called lesson plan. The authors were given lesson plans that the group had prepared for their lesson study and modeled them based on OMNIBUS. The authors discussed the models with the active teachers in the group. What is discussed are the analysis results, proposals for alternative instructional strategies, and the usefulness of OMNIBUS and SMARTIES. The authors received six lesson plans from the group and modeled four of them. This paper reports the findings of the practical efforts in using the models.

The rest of this paper is structured as follows. The next section explains a proposed modeling framework and how a lesson plan is described in the framework. Section 3 reports the results of the practical efforts and considers the effectiveness of the framework, based on comments received from active teachers. Finally, the last section concludes this paper and presents some future plans for this study.

1. Modeling Lesson Design based on OMNIBUS

1.1 Learning and Instructional Scenario Model

OMNIBUS proposes a framework for modeling the learning and instructional process, called the *learning and instructional scenario model (I_L scenario model)*. This will not be taken up in detail here. This section concentrate on the basic features of it. Further details are given in [1].

The I_L scenario model is composed of the concepts *I_L event* and *WAY* that are defined in OMNIBUS. The definitions of them are explained later with examples. The basic features in the definition of the I_L scenario model are the following [6]:

- learning is modeled as a state change of a learner[1];
- learning and instructional process are organized separately as “what to achieve” and “how to achieve”; and
- the principles of learning and instruction are organized in relation to “how to achieve” as the design rationale.

Based on these features, OMNIBUS allows us to describe the design rationale of the learning and instructional process as a hierarchical part–whole structure of learning goals. Although OMNIBUS is firstly proposed as a basis for organizing theoretical knowledge in a cross-paradigm manner [1], this paper discusses another use of it. It is to extract and organize empirical knowledge from the practical efforts of active teachers.

[1] This includes change of cognitive, physical and affective state.

1.2 Modeling Lesson Designs as I_L scenario models

The aim of this study was to allow us to make computer-understandable *lesson design*. By lesson design, we mean a plan of a lesson in a teacher's mind. This study proposes describing lesson design as an I_L scenario model.

As mentioned above, a lesson design is often described in a document called a lesson plan. A lesson plan is composed of a plan of lessons for a course unit. A teacher describes the overall plan of the lessons and the detailed plan of one of them with learning goals, points of instruction and so on. Figure 1 shows an example of part of a detailed plan. The average length of a lesson plan is four A4 pages. Broadly speaking, half of them are for the overall plan, and the others are for the detailed one. This document functions as a medium for sharing lesson design among teachers. However, it is difficult for teachers to represent lesson design in a document of lesson plan because of the length limitation mentioned above and the difficulty in externalization of thoughts in one's mind. The I_L scenario model is expected to work as a means for bridging the gap between a lesson design and a lesson plan.

Figure 2 shows an example of an I_L scenario model made from the lesson plan shown in Fig. 1. This tree structure represents not the *is-a* structure of I_L event but the *part-whole* structure of it. Each node represents I_L event. This is composed of instructional action, learning action and state change of learner. The state change is the core of the I_L event as mentioned above. Each line linking nodes above and below it represents WAY. It means that the upper I_L event can be decomposed into the lower ones. On the contrary, this also means that the lower I_L events can achieve the upper one.

This model represents the design rationale behind the lesson plan. The part of the lesson plan shown in Fig. 1 describes the introduction part of the lesson. This description is shown as the nodes surrounded by a dotted line in Fig. 2. The authors inferred the rest from the description in the lesson plan and observations made in a lesson given by the teacher who created the lesson plan. In the lesson plan, the teacher asks students a question (Fig. 1(b, b')) and then lets them write down the answer (Fig. 1(c)) in the introduction part (Fig. 1(a)). Two nodes surrounded by a dotted line (Fig. 2(b) and (c)) represent the intention of these concrete actions. These nodes are I_L events representing that students recognize a topic (Fig. 2(b)) and externalize the cognition (Fig. 2(c)). The links between these events and the event representing the whole of the introduction part (Fig. 2(a)) composes the design rationale of this lesson plan.

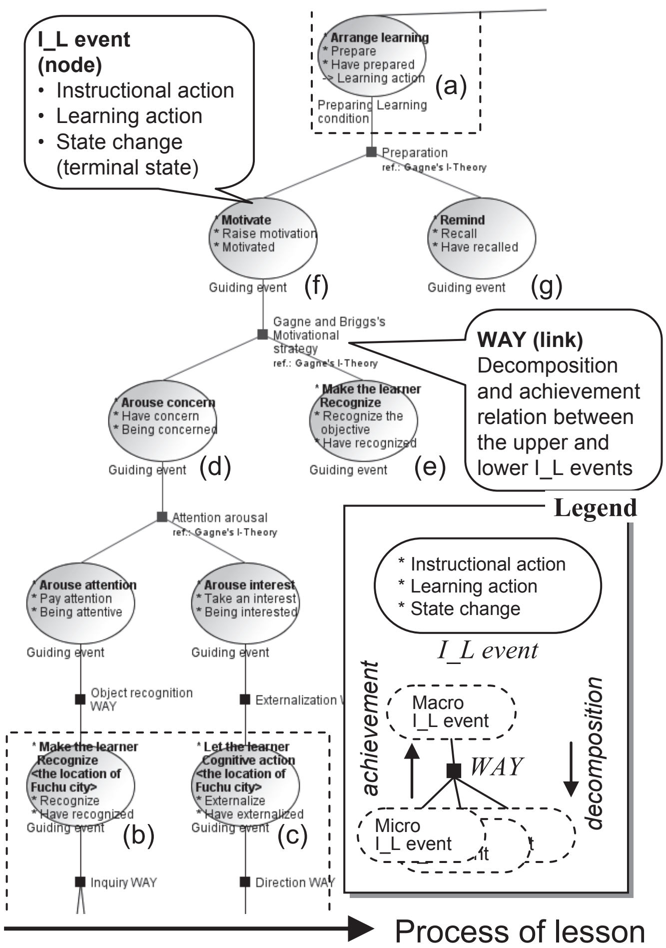

Fig. 2 Part of an I_L scenario model.

The events in Fig. 2(b) and (c) are for achieving the goal to get motivated to learn, which is represented in the event shown in Fig. 2(d). The event is paired with the event shown in Fig. 2(e) for making the learner recognize the goal of learning. This pair of events is for motivating the learner (Fig. 2(f)). Finally, this event for motivation is paired with the event for recalling prior learning (Fig. 2(g)), together composing the introduction of this lesson (Fig. 2(a)). Like this, an I_L scenario model allows us to describe the design rationale included the lesson design as a hierarchical structure of I_L events.

The lesson plans the authors examined are simple, like the one shown in Fig. 1, and do not have a detailed description of the design rationale. Of course, due to the length limitation, it is difficult for schoolteachers to write a lesson design in detail. However, reflection of the lesson design by the creator and sharing of it with others requires such an implicit design rationale included the lesson design. This study positions making I_L scenario model based on OMNIBUS as a tool to extract an implicit design rationale from a lesson design.

Note that the authors do not insist that the I_L scenario model should replace a lesson plan. The I_L scenario model complements a lesson plan, making the relation between the lesson design in the teachers mind and lesson plan as the resulting document clear by externalization of the implicit design rationale that is not described in the lesson plan clearly. Furthermore, making lesson design computer-understandable, the authors also aim to facilitate sharing of lesson designs and empirical knowledge among teachers. One of the causes of difficulty in sharing lesson designs is the differences in backgrounds among teachers or communities of teachers. OMNIBUS and the I_L scenario model help to expose such diverse backgrounds, allowing us to describe the lesson design behind the lesson plan. They also enable us to analyze lesson design, such as the characteristics of each lesson design, comparisons between them, and the tendencies of teachers and teacher communities.

2. An Analysis of Lesson Design with I_L Scenario Models

In this section, we discuss analysis of lesson design with an I_L scenario model and teachers' responses to it. The origins of the models illustrated in this section are lesson plans made by the group of teachers cooperating with the authors. The authors modeled the lesson plans with a presumption of the design rationale and then analyzed them and alternatives to some part of the design. We showed the teachers the models, analysis results, and alternatives in order to discuss their validity and the usefulness of the I_L scenario model for them. The authors made only four models and this section discusses the extraction and management of empirical knowledge of active teachers via these models.

In the practical efforts, the authors made the I_L scenario models on SMARTIES and the teachers did not operate it. This is because the purpose of this work was to assess not the utility of SMARTIES as an authoring tool but the usefulness of making I_L scenario models based on OMNIBUS. Although the preliminary study [3] suggests the usefulness of OMNIBUS, it also suggests some difficulty in the use of SMARTIES by active teachers. Therefore, in order to focus on assessing the usefulness of the model, active teachers were not assigned the task of making the I_L scenario models on SMARTIES in the current study.

2.1 A Structural Analysis of Lesson Design

An advantage of making an I_L scenario model is that we can compare lesson designs on a common foundation. OMNIBUS works as the common foundation that converges varying terms and represents the design rationales behind lesson plans.

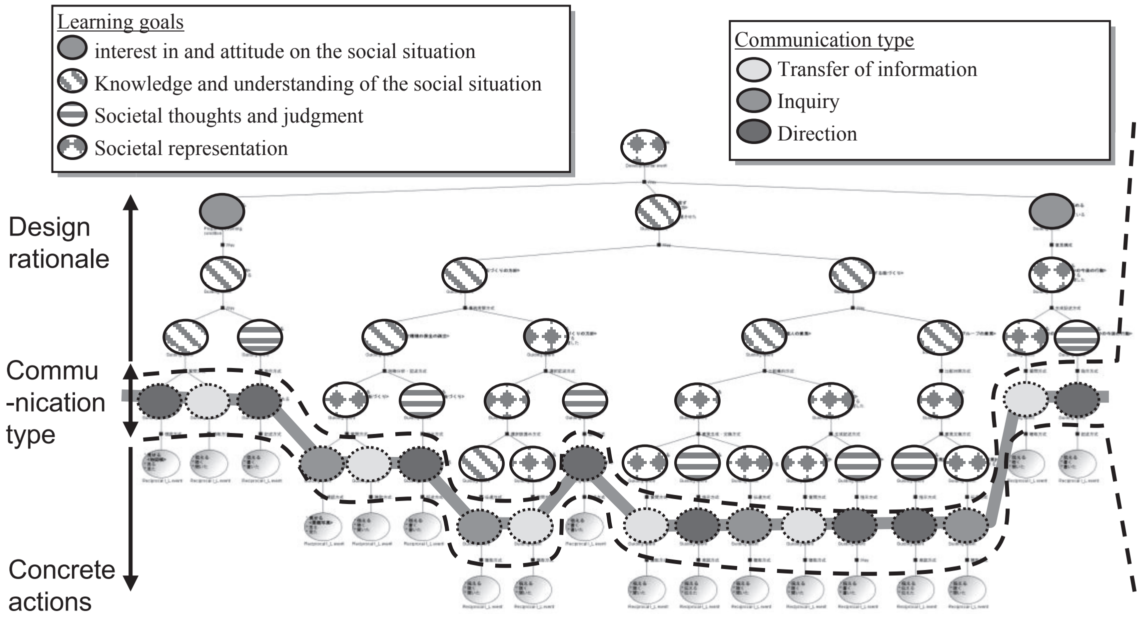

Fig. 3 An overview of an I_L scenario model.

Figure 3 illustrates an overview of the I_L scenario model made from a lesson plan provided by an active teacher and the structural analysis result obtained from it. This figure represents the model of the whole of a lesson. The nodes and links in the figure represent I_L events and WAYs, respectively. The flow of the lesson is represented from left to right in the figure. The bottom nodes represent the time-line of concrete actions to be performed teachers and students from left to right. For example, concrete actions include teachers talking or showing materials to students, and students verbalizing their opinions, so on. The hierarchical structure represents the design rationale behind the process of such concrete actions at multiple levels. For example, the second level from the root coarsely represents the lesson process, composed of “introduction”, “development” and “summary”.

Analysis shown here can be carried out from two standpoints according to the types of layers of the I_L scenario model [2]. One is the standpoint of interaction between teachers and learners, and the other is the standpoint of learners’ internal states that express learning goals. In particular, in the latter, the states defined by OMNIBUS are related to the goals defined in the curriculum guidelines set by the Ministry of Education in Japan, which are familiar to active teachers.

Fig. 3 also shows the I_L scenario model with state types. Nodes are overlaid with patterns correspond to types of learning goals and communication. This distribution of types represents tendency of this lesson. Fig. 4 shows quantitative analysis that is the proportion of types of communication between teachers and students in the model. These results tell that us this scenario is well-balanced in terms of both learning goals and communication styles with students because the types of them are not weighted in a type.

The teachers gave positive comments in the practical analysis of lesson design with OMNIBUS. Their comments showed that this analysis is useful to bring to light the problems involved in lesson design, such as inconsistency in lesson design and the gap between lesson design and the lesson plan.

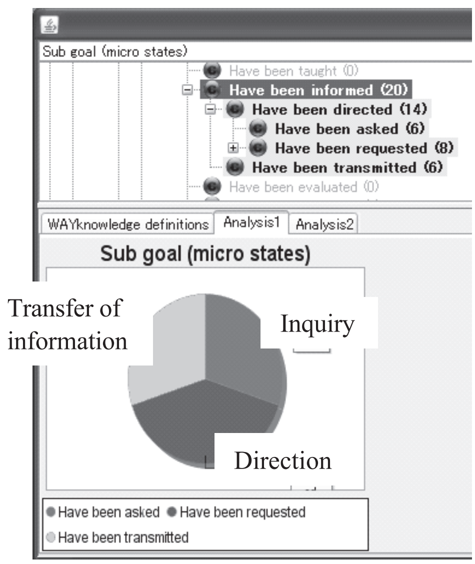

Fig. 4 Lesson design analysis result.

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This will allow them to get an overview of a lesson design and then to refine it.

2.2 A Comparative Analysis of Instructional Strategies in Lesson Design

Another advantage of making an I_L scenario model is to record the design rationale included a lesson design. As stated above, an I_L scenario model can separately deal with a learning goal and ways to achieve it because of the separation of the concepts of I_L event and WAY. For example, in order to make a learner recognize his/her error, a teacher can directly inform him/her or can make him/her aware of it indirectly. The former is a kind of cognitivist way to achieve the goal. The latter is a kind of constructivist way. There are pros and cons to both: whereas the former is effective in achieving the goal itself, the latter is effective in generating self-reflection. In this manner, there are alternative ways to achieve a learning goal, depending on the educational policy. Organizing learning goals and ways to achieve them separately and combining them for a lesson allows us to record not only the final decision but also alternatives. This helps to clarify the reason for the decision making.

Figure 5 shows an example of such a record that includes a teacher's final decision and the alternatives. The combination of WAYs (a) and (b) is the final decision described in the source lesson plan. WAYs (a') and (b') are alternatives to (a) and (b), respectively. The final decision, the combination of WAYs (a) and (b), means that a teacher presents multiple choices of typical thoughts on the topic in order to help learners make their own thoughts and then let the learners choose one as their own thought. Modeling the process as multistage decomposition by WAYs (a) and (b) is helpful in considering alternatives. In this case, the main focus of decomposition is multiple choices to be presented to students. The difference between WAYs (a) and (a') is whether or not a teacher lets the students consider multiple choices. The difference between WAYs (b) and (b') is whether or not the teacher gives choices to the students when the teacher lets the students consider multiple choices.

It is noteworthy that, in this study, the WAY describes these differences in the abstraction level. Making each instructional or learning strategy reusable in the other lesson designs requires abstraction and modularization of the strategy instead of embedding it in a lesson design. Furthermore, its background is valuable information for principled reuse of strategies. For example, WAY (b') is closer to a constructivist approach than WAY (b) is and requires a heavy cognitive load of learners. Therefore, we could consider that WAY (b) is suitable for the primary stage of learning and WAY (b') is suitable for the advanced stage.

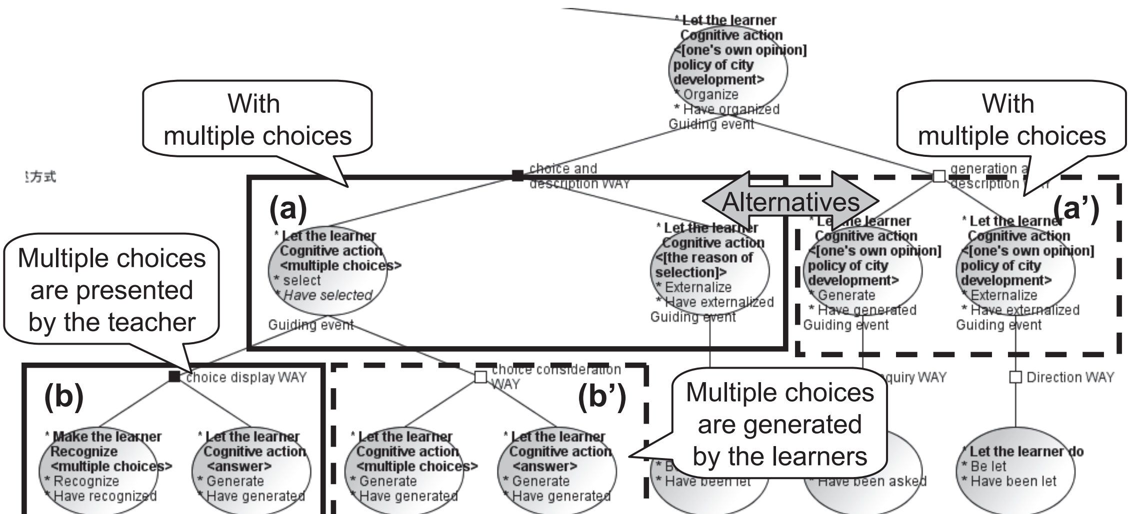

Fig. 5 Alternatives in an I_L scenario model.

Abstraction of strategies and information about them will allow us to reuse lesson designs and strategies included in them effectively.

In fact, when the authors showed an I_L scenario model with alternative strategies to an active teacher, he explained the difference between his own educational policy and that of the teacher who made the source lesson plan. He noted that the teacher who made the lesson plan often used the strategies of WAYs (a) and (b), whereas he often used the strategies of WAYs (a) and (b') not like this lesson design. He also said that, although he had been aware of the difference between him and other teacher, he had never fully verbalized the difference. Based on these impressions, he commented that describing a lesson design as an I_L scenario model helps to understand the difference between not only lessons but also teaching styles. He also suggested that this method may be helpful for disseminating instructional strategies in a community of teachers. He expected that such dissemination facilitates awareness of the differences between teachers' own strategies and those of others.

3. Conclusion

This paper reports the findings of practical efforts for the development of a technology for extracting and organizing empirical knowledge of active teachers. Although we do not insist on the generality of the results because of the paucity of available data, the teachers who joined in the practical efforts gave positive comments on the effectiveness of OMNIBUS in describing lesson design. Their comments suggested that modeling strategies in a lesson design as WAYs allows us to organize empirical knowledge in a reusable manner.

Our practical efforts revealed that what active teachers require is a system for organizing the instructional strategies of excellent teachers or strategies that have been refined in a community, rather than mere theoretical knowledge that the authors have accumulated so far by themselves. In response to these findings, we also aim to make OMNIBUS a common foundation for sharing the empirical knowledge that active teachers have accumulated. This foundation may be a circular system of theory and practice in which we can put theories into practice effectively and build theories from findings gained in practice.

Of course, it is difficult for active teachers to describe lesson design and extract empirical knowledge to be shared in a community of teachers with their current forms of OMNIBUS and SMARTIES. In the earlier preliminary study and the practical efforts reported in this paper, it took time for teachers to understand OMNIBUS and SMARTIES. It is difficult for them to describe the lesson designs behind lesson plans because they tend to make lesson designs with habitual ways of thinking. They are usually not aware of the design rationale. Therefore, the authors are planning to improve OMNIBUS and SMARTIES in terms of usability. This includes not only refining the user interface of SMARTIES but also developing a way of managing OMNIBUS and SMARTIES in a community of teachers. In addition to that, the authors also planning to add functions for reducing the cognitive load on teachers in terms of meta-cognition [4]. It is necessary to consider support functions for helping externalization and self-reflection of the lesson designs in their mind.

An even broader goal of this study is to strengthen the solidarity of communities of teachers in terms of knowledge sharing. Currently communities of teachers are mainly organized by subject. For example, the community that we have collaborated with is social studies. In social studies, there are the three areas of civics, geography, and history, and each area tends to develop its own instructional methods. Of course, each area needs its own methods that depend on the subject. However, through our practical efforts, we consider that there are two types of instructional method that can be shared beyond subject boundaries. We are planning to conduct a survey of pilot schools with regard to such cross-subject instructional methods. In pilot schools, teachers conduct cross-curricular discussions with each other, and this appears to be a suitable scenario for considering the generality of instructional methods.

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Chapter 6

Technology-Transformed Learning: Going Beyond the One-to-One Model?

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Preface

The advancement of personal computing devices, from personal computers to mobile devices, has been gradually changing the landscape of the technology-transformed learning. This facilitates the incorporation of one-to-one computing into education and opens up endless possibilities of the design and enactment of innovative teaching and learning models (or the enhancement of pre-existing models), such as perpetual and ubiquitous learning, personalized learning, authentic and contextualized learning, seamless learning, digital classroom, rapid knowledge co-construction, among others. This leads to the further empowerment of the learners in deciding what, where, when, and how they would learn, and whom they would learn with/from. After the initial hype, however, there have been voices within the researcher community to reassess the notion of one-to-one computing in classroom and informal learning, such as whether and how one-to-one settings may impact peer collaboration and teachers' roles, the issues of student, teacher, school and social readiness, as well as the explorations of alternative or hybrid settings of many-to-one, one-to-many, many-to-many, and one-to-one configurations.

This workshop deals with the fundamental concerns and challenges in adopting one-to-one computing in either or both classroom and informal learning settings. The collection of paper will serve as an international forum for researchers and practitioners to exchange their thoughts and contributions and set future directions in one-to-one technology-transformed learning.

Organizers
Lung-Hsiang Wong, *National Institute of Education, Singapore*
Hiroaki Ogata, *University of Tokushima, Japan*

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Effects of Video Caption Modes on English Listening Comprehension and Vocabulary Acquisitions Using Handheld Devices

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Abstract: This study used different display modes of video captions in mobile devices, including non-caption, full-caption, and target-words, for English comprehension and vocabulary acquisition of fifth graders. During the one-month experiment, the students' English listening comprehension and vocabulary acquisition status was evaluated per week. From the experimental results, it was found that the English target-word group had as satisfactory learning achievement as the full-caption group in terms of vocabulary acquisition, and both groups outperformed the non-caption group. Moreover, the visual style students in the English target-word group and full-caption group had better learning effectiveness in terms of vocabulary acquisition than those in the non-caption group. Furthermore, in terms of listening comprehension, the students in the three groups all made remarkable progress without significant difference.

Keywords: listening comprehension, vocabulary acquisition, captions, learning styles

1. Background and Objectives

English has been recognized as being an important international language for decades. Many non-native English countries have developed and utilized various computer systems to support those English as Foreign Language (EFL) learners. Most non-native English countries intend to have their people learn English as early as possible; therefore, the Ministry of Education in Taiwan extended regular English instruction down to the third grader in the elementary school. In the next decade, regular English instruction is considered to be extended down to the first grader in the elementary school. The policies of government in the nations whose mother tongue is not English, such as Taiwan and Korea show the importance of English instruction. Foreign language learning is often categorized into four parts which are listening, speaking, reading, and writing. Listening is an initial important aspect in social interaction to receive message or information from outside. Accordingly, Ministry of Education in Taiwan indicated that elementary schools should put emphasis on English listening first, and then reading or writing. Moreover, most of the English certifications today includes the listening proficiency examine. Due to these requirements and reasons, this study applied mobile and multimedia technologies to the learning activities of English listening for elementary school students. It is expected that such an approach can enrich the daily life input stimulus of listening opportunities in the non-English countries and environment as Taiwan.

With the advance of mobile technologies and multimedia, the instructional materials which can be used for English listening training are not restricted in school and presented in diverse forms. For example, many people have the habit of bringing an MP3 player so that they can learn via listening at anywhere. As for seeing videos, they can both have visual and aural input, such as YouTube videos and TED talks. Owing to the popular of mobile devices and the wireless network such as Wi-Fi and Wi-Max, it is convenient for most of students to do individual and independent learning by means of mobility aids. Therefore, it can be foreseen that students will eventually be equipped with a mobile device installed with proper leaning tools, systems, or materials so that they can have their own learning progress, and may set the difficulty degree of their learning content to meet their proficiency. Previous studies have shown that videos embedded with captions are helpful for students to learning second language reading [2] and listening [6]. Hsu and Chang (2010) have further reported that hiding part of the easier foreign vocabularies and showing only the more difficult words in the captions can contribute to undergraduates' listening comprehension [14]. Those selected vocabularies are presented when the students press the "pause" button of the video player during the process of listening to the foreign language courses; on the other hand, full captions are provided when the videos are played.

Accordingly, this study tries to provide different display modes of captions in the mobile devices for students to learn English via listening. A video without any caption of English and Chinese subtitle is used for the students in the control group one because previous studies indicated that no caption or subtitle help student get adaptive to various pronunciation appearances, such as reduced forms, assimilation, elision, and resyllabification [26]. On the other hand, a video with full English captions and Chinese subtitles of target vocabulary is used for the students in the control group two because a previous study showed such setting is helpful to training listening proficiency and comprehension, and confirmed that full Chinese subtitle is not needed [14]. Another video with both English caption of target vocabulary and Chinese subtitle of target vocabulary is used for the students in the experimental group.

The study aims at exploring whether different display modes of caption and subtitle result in different effectiveness on listening comprehension and vocabulary acquisition of elementary school students. Moreover, this study also investigates the learning performance of different learning style students in learning with different caption modes. The learning performance will be assessed by a test including listening comprehension and vocabulary acquisition examination in each week.

2. Related Literature

Subtitles are the on-screen text in the students' native language combined with a second language soundtrack in the video. *Captions* are the on-screen text in a given language combined with a soundtrack in the same language [21]. In this study, subtitles refer to the on-screen Chinese text combined with an English soundtrack, and captions refer to the on-screen English text combined with an English soundtrack. In addition, *bilingual subtitling* refers to the on-screen texts in both students' native and target languages combined with the target language soundtrack [15]. For example, in this study, *bilingual subtitling* refers to the English audio with simultaneous appearance of English and Chinese texts on the screen. These clear definitions of terms are helpful in the following description of the study instrument. The definition of *target-word* in the study refers to the new or key vocabulary which the learners need to know well in the new lesson or unit of the listening instructional material or video.

2.1 Caption and English Listening Comprehension

Krashen (1985) indicated that students need to receive a great quantity of comprehensible input so as to achieve the objective of language learning when they learn foreign or second language [19][20]. When students watch videos with foreign language, the contribution of comprehending and connecting foreign learning and its meaning is limited while students cannot understand what they heard at all. Therefore, using caption and subtitle to assist listening comprehension is helpful for learners to reserve more effectiveness after learning. Scholars confirmed that combining captions with audio-visual materials is an effective instructional method to enhance listening and reading comprehension of second language [1][6]. Captions visualize the information of foreign language which learners heard in the video [6]. Videos with captions facilitate listening comprehension [5][21]. On the contrary, another scholar stated that providing native subtitle for learners will obstruct their listening familiarity of pronunciations [26]. Therefore, the study designed control group one as a both non-caption and non-subtitle group, and control group two as the full caption and target-word subtitle group while the study design the experimental group as the target-word caption and target-word subtitle group. The study observed the effects of different display modes of caption and subtitle on listening comprehension and vocabulary acquisition of elementary school students.

2.2 Learning style

Learning style refers to individual preference way of learning, which affects how individuals accept stimulus, memories, thinking, and problem-solving. There are many different scholars proposing diverse categories of learning styles [7][9][10][11][13][16][17][18][22][24][25]. If teachers realize the difference of learning styles among learners and design appropriate instructional methods or media, learners will possibly be benefited.

This study utilized the scales of learning style proposed by Felder and Soloman (1991) who developed the Index of Learning Style (i.e., ILS) based on Felder and Silverman (1988) [7][8]. The ILS consists of 4 dimensions (i.e., active/reflective, sensing/intuitive, visual/verbal and sequential/global), each of which has 11 items. This study employed the visual/verbal dimension to evaluate the learning styles of the participants since this dimension is highly relevant to the use of videos in training the listening competence or vocabulary acquisition of foreign language.

3. Method

3.1.Participants

The experiments were conducted in an elementary school in an Asia country. The people there learn English as foreign language. There were nine classes of fifth graders in the elementary school. The fifth graders consisting of 11-year old students on average in the school were divided into three levels, A, B, and C, based on their English proficiency in the school. There were three classes in each level. The study selected the three classes which were the same level and are all the lowest level C among the nine classes. Therefore, totally eighty-one low-achievement fifth graders in English participated in the learning activity. The number of the students in the three classes was 26, 27, and 28 respectively. The study did not adjust the original number of students in each class. One class in which there are 27 students, including 16 males and 11 females, is called the control group one, one class in which there are 28 students, including 12 males and 16 females, is named the experimental group one, and the last one class in which there are 26 students, including 15 males and 11 females, is called the experimental group two. Each group had different treatments which will be explained in the following section.

3.2. Research design

The participants used PDA to play the instructional video related to the lesson they study each week. Each student was equipped with one PDA. After watching the video, the students immediately took a test for evaluating their listening comprehension proficiency and vocabulary acquisition. The experiment was conducted for a month as shown in Figure 1.

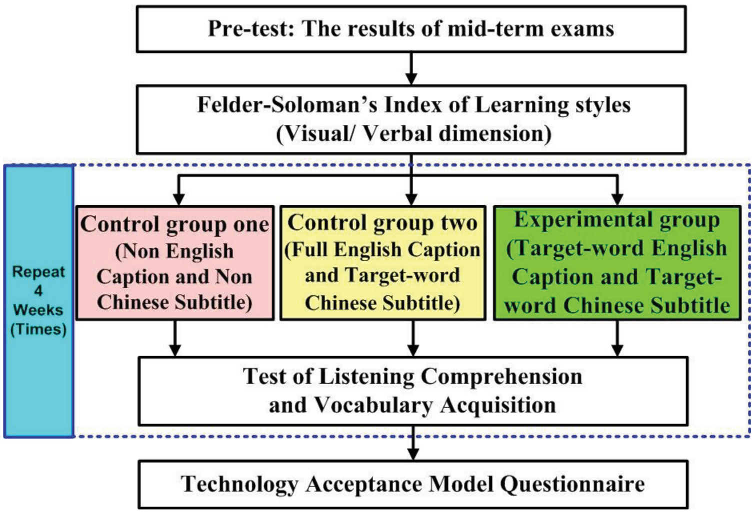

Figure 1. Experimental procedure

The videos for the three groups had the same content with different caption modes. No caption was provided for control group one, while full English caption and Chinese target words were provided to control group two, and English and Chinese target words were provided to the experimental group. Figure 2 shows an example of the caption modes for control group two (left) and the experimental group (right).

Figure 2. The playing interfaces of control group two (left) and the experimental group (right)

Researchers have indicated that, for the students to get used to the tempo of usual conversation, there is no need to provide the fast forward or slow play function; instead, the function of play, pause, and replay is necessary for listening training [12]. In order to meet the practice of mobile assisted listening training, students in each group can use a stylus to operate the function of play, pause, and replay to listen in the limited time.

3.3. Research tool

The measuring tool of learning styles used in this study is the visual/verbal dimension of Felder-Soloman's Index of Learning styles [8].The visual/verbal dimension contains 11 items to evaluate the learning styles of the students. Its Cronbach's alpha value is 0.76.

As for the test items in each week, all the questions and items are verified by two English teachers so as to have similar difficulty degree. Each test of listening comprehension has five multiple-choice questions broadcasted from audio. The students are asked to listen to the questions and fill out the answers in the answer sheet. In addition, there are five multiple-chose questions for testing their vocabularies learned in the lesson. Both the perfect scores of the listening comprehension test and the vocabulary test are 100.

4. Results and Discussions

4.1. Analysis of pre-test and post-test

The study used the mid-term test conducted one week before the experiment as the pre-test, which was used to evaluate the students' listening comprehension and vocabulary proficiency. The ANOVA analysis results of the pre-test among the three groups are not significant difference (p=0.94 >.05); that is, the three groups of the students had equivalent prior knowledge before the learning activity.

After using mobile devices with the three different caption modes to learn, the students in the three groups all made remarkable progress in comparison with their pre-test results during one month. Figure 3 shows the students' progress in listening comprehension and vocabulary acquisition. It was found that both experimental group and control group two had significantly better learning effectiveness than control group one, especially after the third week; moreover, experimental group had similar learning effectiveness in comparison with control group two.

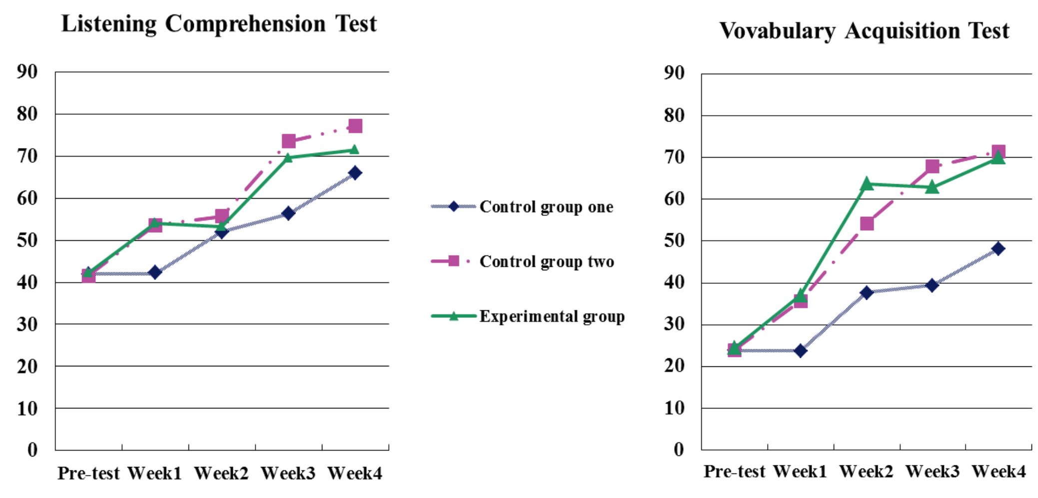

Figure 3. The improvement progress of listening comprehension (left) and vocabulary acquisition (right)

By employing ANCOVA on the post-test scores of the three groups no significant difference was found between the listening comprehension scores of the three groups. On the other hand, the ANCOVA analysis on vocabulary acquisition showed significant differences between the experimental group and the control group one as well as the two control groups, as shown in Table 1. That is, the students who watched to the videos with captions (no matter Full English caption or only English target words with Chinese target words) revealed significantly better learning achievements in English vocabularies than those who learned without captions.

Table 1. ANCOVA analysis results of vocabulary acquisition tests

Group	N	Mean	SD	Adjusted Mean	F	Pairwise comparisons
Control group one (a)	27	48.15	24.34	51.10	3.71*	(b)> (a)* (c)> (a)*
Control group two (b)	28	71.43	26.35	68.81		
Experimental group (c)	26	70.00	33.11	67.17		

**p*<.05

4.2. Analysis of learning style

This study further compared the learning achievement of the verbal style and visual style students in the three groups. In terms of listening comprehension, no significant difference was found. Therefore, the listening comprehension of the students in the target-word group had similar performance with the listening comprehension of the students in the full-caption group. As a result, it is no need to provide full-caption for the purpose of training students to have more opportunities of practicing various pronunciation appearances, such as reduced forms, assimilation, elision, and resyllabification. Because the listening materials of the elementary school students is relatively easier, such pronunciation attributes were rare happened in the video used in the study, resulting unremarkable difference influence between the full-caption group and the target-word group on the effectiveness .

As for vocabulary acquisition for visual style students, a significant difference was found between the experimental group and control group one, and between the control group two and control group one, as shown in Table 2. On the other hand, no significant difference was found between the three groups of verbal style students. Therefore, the students with visual learning style in the target-word group performed as good as the students with visual learning style in full-caption group in the vocabulary acquisition, and both the target-word group and full-caption group outperform the non-caption group. As a result, for visual style students, it is suggested to provide both English and Chinese target words to them; in particular, for those low-achievement students.

Table 2. ANCOVA analysis of vocabulary acquisition of different learning style students

Learning style	Group	N	Mean	SD	Adjusted Mean	F	Pairwise comparisons
Verbal (L)	Control group one(L1)	8	50.00	26.19	50.17	0.89	
	Control group two(L2)	9	73.33	33.17	68.64		
	Experimental group(L3)	9	62.22	38.01	66.39		
Visual (V)	Control group one(V1)	19	47.37	24.23	51.55	3.23*	(V1)<(V3)* (V1)<(V2)*
	Control group two(V2)	19	70.53	23.45	68.71		
	Experimental group(V3)	17	74.12	30.63	70.30		

**p*<.05

5. Discussions and Conclusions

This study found that the target-word strategies have better effects on vocabulary acquisition rather than on listening comprehension for low-achievement elementary school students. As those low-achievement elementary school students in non-English speaking countries do not know enough English words, they especially need the assistance of the target words when watching the videos for vocabulary acquisition. On the other hand, the results concerning listening comprehension are different from those of previous study carried out in the universities since undergraduates have learned the frequently-used 2200 English vocabularies while elementary school students have only learned few of the words; therefore, the undergraduates benefited (Hsu, & Chang, 2010). Therefore, this study suggests that the partial hidden mechanisms of captions can be used in an adaptive way that presents the selected vocabularies with different difficulty degrees based on the learning level of the students.

Furthermore, in terms of English vocabulary acquisition for visual style students, it was found that the students in the full caption and the target-word groups had significantly better learning achievement than those in the non-caption group one, while no significant difference was found between the three groups of verbal style students. Therefore, it is suggested that, for visual style students with low learning achievement, the provision of both English and Chinese target words are needed.

From the interview results, we have several interesting findings. For example, the students in the control group two (the full English caption group) indicated that it was not necessary to provide full English captions to them; moreover, they stated that showing full captions interfere with their listening to the learning materials. They believed that providing only target words were sufficient to assist them in improving listening comprehension, which conforms to the results of the perception investigation toward using the system in learning English listening. In addition, some students said that they would like to learn from watching videos and playing computer games related to the topics of their textbooks.

In the future, we plan to conduct more experiments from three perspectives. The first is the longer broadcasting time of videos and not limited to use in the classroom. The present study only applied short-term videos in an elementary school. It is suitable to elementary school students with low learning achievement, but may not be appropriate to advanced learners. Therefore, secondly, the study suggests future researchers can set and show the target words and hide the other words in the caption of different video length for the learners in different ages. Thirdly, English listening proficiency needs learners to spend more time on exercising and training so as to make remarkable progress easier. Therefore, in the future, we plan to extend the experiment in a seamless learning environment to accelerate the listening proficiency of learners. It is inferred that the extended time of self-learning may have contributions to listening proficiency.

Acknowledgement

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Teacher Attitude and Preparation for Technology Innovation: A Case Study of 1:1 Laptop Initiative

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Abstract: The success of one-to-one laptop learning initiative in a school largely depends on support and acceptance by teachers. Teacher's technological skills also play an important role in the implementation of one-to-one laptop learning initiative. This research, conducted in a middle school located in Beijing, China, investigated teacher attitude and technology preparation for the upcoming one-to-one laptop learning initiative. Research data were collected by interviews and surveys during the training before the commencement of the initiative. According to the data, most teachers acknowledged the effectiveness of laptop to teaching and learning, and showed great enthusiasm toward the technology innovation. Meanwhile, some doubts were expressed toward new pedagogy and class management strategies. And there existed attitude difference between different subject teachers. Based on the surveys, most teachers were familiar with only one specific operating system and can use PC proficiently. The findings of this research provide valuable planning framework and suggestions for the schools and educators that want to launch one-to-one laptop learning initiative.
Keywords: Teacher Attitude, Technology Innovation, One-to-one Laptop Initiatives, Classroom teaching

1. Introduction

Due to the development and diffusion of information and communication technologies, we have witnessed the greatest change in the domain of education. Ubiquitous computing and mobile technology make it possible that every student can have one laptop for his/her own use with 24-7 internet access. Not surprisingly, over the last ten years the emergence of one-to-one programs has grown increasingly in popularity. More and more schools around the worlds are implementing one-to-one programs as a means for increasing student achievement and performance. There is no doubt that one-to-one laptop initiatives have the potential to significantly impact education, especially classroom instruction. More importantly, we have to confront another question: are teachers prepared for the upcoming changes and able to handle all the technological challenges. From traditional teacher-lecturing-and-student-listening classroom to laptop and Internet supported learning environment, teaching styles are changing. Concerns of change by a teacher will definitely influence the integrating use of technology into the classroom.

2. Factors influencing 1:1 laptop learning initiative

Based on Ely's research on technology integration and a review of existing literature, he proposed eight conditions that facilitate the implementation of educational technology innovations: dissatisfaction with the status quo, knowledge and skills, adequate resources, time, rewards or incentives, participation, commitment, and leadership (Ely, 1990, 1999). These conditions can greatly influence the effect of technology innovation and even decide whether the innovation is likely to succeed or not based on the number of conditions present. We know from prior research on innovation adoption that successful implementation is deeply rooted in an understanding of the concerns of the individuals delivering the innovation (Hall&Hord, 2001). Obstacles to change such as inadequate educational resources, not enough training time, and lack of leadership support have been excuses for not implementing new technology in schools.

When it comes to 1:1 laptop initiatives, many researches showed wide range of factors that can affect the success of this type of technology innovation. Those factors include both school- and teacher level ones, such as professional development, availability of resources and technical support, teacher readiness to integrate technology, and teacher beliefs and attitudes (Inan, Lowther, 2010).

3. Conceptual framework

All teachers cannot be expected to be excited about laptop initiatives. Although some teachers might be enthusiastic about the creative use of laptop in teaching, others might be reluctant because they might not have the confidence in using the laptop in classroom teaching. The Technological Pedagogical Content Knowledge approach proposed by Misha and Koehler (2003a, 2003b) showed that teachers connect technology with content and knowledge. The Figure 1 demonstrates the complex knowledge system that teachers have to possess for the successful technology integration.

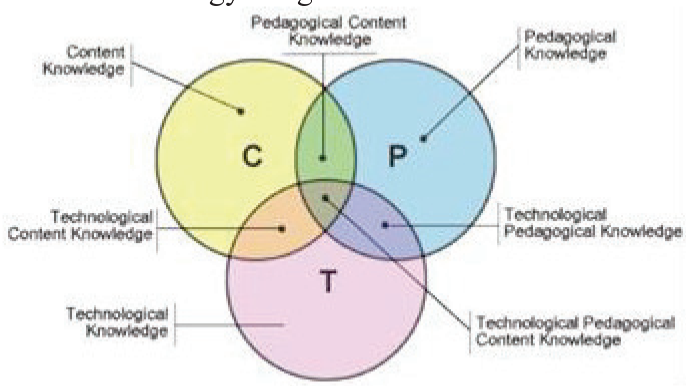

Figure 1. TPCK (Mishra & Koehler, 2003a, 2003b).

According to TPCK, it is very important to provide teachers who will participate in the technology innovation programs with exposure to educational technology professional development and require them to attend sessions. Sufficient pre-program preparations for teachers' confidence and self-efficacy with technology can greatly affect the result of technology programs in school. Getting teachers started in their use of technology and establishing an expectation of applying integration strategies may be all that most teachers need (Yost, 2007). However, teacher competency in using specific hardware and software used to be the focus of former educational technology professional development. More and more researches supported the professional models that can expand teachers' knowledge, skill and confidence in integrating use of technology in their classroom teaching activities (Borthwick & Pierson, 2008).

Hence, we think effective training and appropriate professional development are the important factors to promote teachers' attitude and preparation, which meanwhile can be the crucial factor to the success of technology innovation in schools. The following research will carry on under that conceptual framework (shown in figure 2).

Figure 2. The research conceptual framework

4. Method

4.1 Participants

The participants are 18 teachers from The High School Affiliated to Renmin University of China (abbreviated to RDFZ) Xishan School in Beijing, China. RDFZ Xishan School is a public middle school with many educational reform thoughts. The one-to-one laptop initiative was enthusiastically propelled by the school leaders. The initial implementation planned to begin at September, 2010 including 70 students at the 7th grade and 18 teachers of several subjects, such as Chinese language, mathematics, English, history, biology, art, geography, psychology. A two-day training was carried out by the researchers in the school with specifically designed courses. All the program teachers participated in the training in August, 2010. All the teachers can PC for daily work, but none of them had experience of teaching in 1:1 laptop classroom. The laptop for the program is Apple MacBook, which was completely unfamiliar to all the teachers. 2 of the teachers had taken a laptop computer skill training from the technology company 4 months before the pre-program training.

4.2 Data collection

A mixed method was applied to collect teachers' attitude and concerns of 1:1 laptop initiatives. The researcher interviewed 5 teachers during the break time of the training, including one teacher who had taken new laptop technology training before. A questionnaire was designed based on the result of teacher interviews. Five teachers took the interview during the training while the survey was conducted at the end of the training for all the program teachers.
The interview outline was composed of following questions:

- How do you think about the technology innovation in the school?
- How would you expect the integrating use of laptop will influence your pedagogy?
- Do you have any ideas of how to implement laptop integrating use in classroom?
- What is your biggest concern of the 1:1 laptop initiative in the school?
- How do you think of your laptop computer skills? Can you use laptop expertly?
- Are you familiar with the new type of laptop and new software?
- Are you comfort with the scenarios of one student with one laptop?
- Do you think you are technically ready for the 1:1 laptop initiative?

During the interview session, teachers responded to these open-ended questions. Teachers' responses were written down by the researchers.The questionnaire includes 16 items about teachers' attitude toward the effect of laptop using in the classroom teaching.

5. Results

After reading and analyzing interview transcriptions, data analyses resulted in the following themes: great enthusiasm of the forthcoming program, excitement of the new pedagogy, concern about the classroom management, anxiety of different laptop computer.

The interview was conducted after the first day training lectures. The training lectures were about digital instructional design and new teaching models for 1:1 laptop class. Teachers were very excited about the new program. Some of the teachers described the laptop use could become an opportunity for fulfilling their 21st century education ideal. Some teachers talked about using laptop to foster students' 21st century skills, showing great active, embracing attitude about technology innovation. Several teachers however were more conservative about the laptop use in classroom. These teachers would like to stick to their conventional teaching method. They admitted the advantages of laptop for students, but they were very uncertain about the new pedagogy for 1:1 laptop classroom. Almost 5 teachers, including the one had learned how to use Apple MacBook laptop said they were very unfamiliar with the new laptop. One teacher even insisted that school should use PC instead of Mac. All the interviewed teachers said they would feel very confident about their computer skills if the program laptop were PC.

14 items of the questionnaire use 4-range answers to show teachers' attitude of laptop use in class. The results are shown in table 1. According to the results, all the 18 teachers confirmed the positive influence of laptop use on 5 items, which are: effect of teaching and learning, teaching efficiency, students' learning motivation, involvement in learning, and knowledge extent. This result showed all program teachers' great optimism and confidence of the laptop initiative.

The other positive influence teachers would like see are test scores, communications between students and teachers in classroom, understand of learning content. The percentage of teachers to support these influence is 92.8%. And 71.4% teachers thought positively about the knowledge sustain by laptop use in class.

Among the negative influences, the most concerned issue is teachers' workload. 64.3% teachers thought laptop will increase their workload. Teachers said that they would spend more time on instructional design, preparing the learning resources. But there are still 21.4% of teachers thought laptop can make their teaching much easier because of the teaching assisted software. We can see that technology competence is the factor that effect teachers' attitude.

Another issue teachers are worried about is students' attention. 14.3% teachers thought laptop would become a distraction in class. But 85.7% teachers thought they can use more interesting learning tasks and classroom management strategies to "draw back" students from non-learning related activities.

Items	Increase	Decrease	No Influence	Uncertain
*Effect of classroom teaching & learning	100%	0	0	0

Students' standardized test score	92.8%	7.2%	0	0
Teachers workload	64.3%	21.4%	7.1%	7.1%
*Teaching efficiency	100%	0	0	0
Teaching pace	64.3%	0	28.6%	7.1%
Communication between teacher &students	92.8%	7.2%	0	0
*Students' learning motivation	100%	0	0	0
Students' attention	85.7%	14.3%	0	0
Students' understanding of the learning content	92.8%	0	7.2%	0
Students' knowledge sustain	71.4%	0	28.6%	0
*Students' involvement in learning	100%	0	0	0
*Broadening knowledge extent	100%	0	0	0
Students' enrollment rate to high school	71.5%	7.2%	7.2%	14.1%

Table 1. teachers' attitude of laptop use in class

Generally speaking, program teachers from RDFZ, Xishan School hold a very positive attitude toward the up-coming 1:1 laptop initiative. Besides of support of school leaders, the pre-program training would be thought as another essential reason. After the interview, the researchers adjusted the form of training. Simulating-classroom teaching workshop took place the original lectures. Teachers were asked to practice what they have learned in the previous lectures. Digital instructional design and new teaching models were the focus of all program teachers. They implemented the new design methods and teaching models during the workshop session, and discussed the effectiveness of the instructional design and teaching models. The adjustment of the training course was friendly accepted and thought highly helpful by all the program teachers.

Chart 1 shows that teachers of different subjects use laptop in their teaching with different frequencies. Only 28.6% teachers thought laptop use is very frequent for the subjects they teach. While there are still 28.5% teachers who thought other teachers of the subject rarely use laptop in class. 35.7% teachers think laptop use is an occasional activity for their subject teaching. The explanation for this result could be the features of different subjects will be taken into great consideration when it comes to laptop use in class.

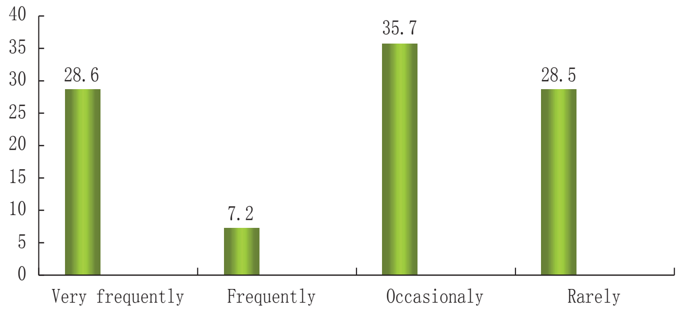

Chart 1. Teacher perception of the laptop integrating use in the subject teaching

According to the survey result (shown in chart 2), teachers planned to use laptop in their classroom for different amount of time. Only 7.2% teachers would like let students use laptop for a whole class. Over 70% of the program teachers would not use laptop more than half of class time. The result brings a very key question: will it be necessary for students to use laptop for the whole class? Another question worthy of further discussion is: what kind of teaching and learning activities we employ in the laptop classroom.

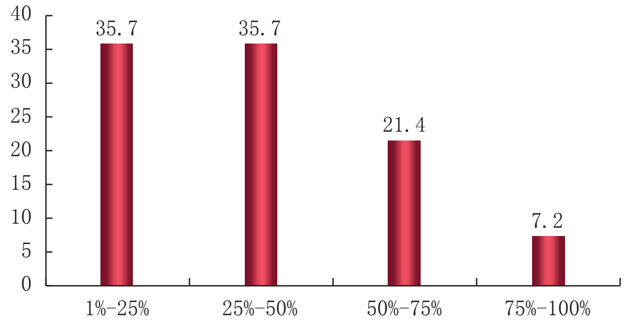

Chart 2. The amount of time that teachers plan to carry out laptop learning in class

6. Discussion

Implementing 1:1 laptop initiatives in schools is a huge step in bridging the digital gap. The excitement of this kind of technology innovation needs to be appreciated by all the teachers because they are not only the crucial factor of successful implementation, but also an important part of the technology innovation in education. As long as teachers feel they are embraced by the innovation programs, they can completely engage in their everyday teaching with technology. The first stage of programs should improve teacher attitude and gain their support. Teachers not only need technology skills, but also should attain advice and help about the pedagogy and beliefs toward technology innovation. Before the commencement of 1:1 laptop initiatives, teacher training must be carefully planned and conducted. The content of the training should be designed specifically, including all the technology skills based on teachers' need and the professional development plans. Teachers will feel confident about teaching in a 1:1 laptop classroom with tacit

In this study, the researchers proposed an experiential training framework for the pre-program teachers, showed in Figure 3. The training takes on the form of a three-step-circle workshop. First step is watching. Teachers will be organized to watch and discuss some successful laptop teaching class videos. Secondly, after taking training course of technology and pedagogy, teachers will try to practice the teaching strategies and experiences they learned in their own class. Thirdly, teachers will write reflection of their teaching practice in the workshop and obtain advice and help from experts and program researchers.

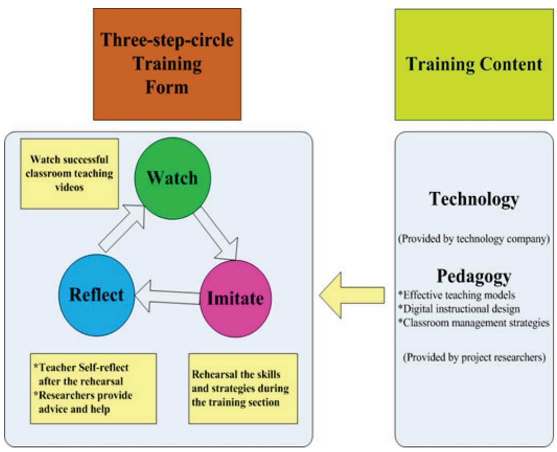

Figure 3. pre-program teacher training framework

Educational technology professional development also plays an important role in the implementation of technology innovation. Only pre-program training is far from enough to motivate teachers' support and passion toward technology innovation. High-quality professional development, no matter small or large, may have different goals, but all should be planned to convince teachers to involve, learn, and then constantly use technology and instructional strategies in their daily work. Professional development also can be achieved in many different ways. Training (pedagogy and technology), workshop, school-based researches are some examples of commonly recognized professional development forms, and not all of them are equally suitable for every school. Therefore, schools that want to start 1:1 laptop initiatives must find the most appropriate professional development of their own.

According to the interview and survey results, we designed a systematic professional development 3-year-plan (shown in Table 2) for the program teachers of RDFZ Xishan School. The plan includes six sections with the different sub-goals for every section. The six sections have covered six aspects of teachers' concerns of the 1:1 laptop initiatives while the forms are flexible. The plan will be carried out through the whole process of the 1:1 laptop initiative, assuring teachers will reach out help and advice any time they need them.

Section	Content
Understanding the Program	● Plan Goal, Vision of the Program
Constructing Digital Learning Environment	● Laptop computer skills ● Teaching and Learning Software ● Web-based educational platform ● Multimedia information technology
Digital Pedagogy	● Instructional design for 1:1 laptop learning ● 5-step innovation teaching model for middle school ● Learning resources design ● Evaluation and reflection
Information Technology Integrating Use	● Theory of information technology integration ● Case study of classes with successful information technology integration ● Problem-based learning in 1:1 laptop scenario
Teaching and Learning In 1:1 Environment	● Classroom management strategies and cultures for 1:1 laptop learning ● Fostering students' 21st century literacy ● Nursing students' creative thinking skills ● Bridging the digital gap between students

Thinking and Working Like A Researcher	• 21^{st} century teacher professional development • Introduction of educational research • How to conduct research and write research papers

Table 2. Professional development plan

7. Conclusion

Successful implementation of one-to-one project is deeply rooted in an understanding of teachers. Obstacles such as inadequate technology skills, not enough training time, and lack of new pedagogical support have been causes for one-to-one project failures. Hence, the design and practice of professional development plan must maintain consistency with teachers' needs in a very specific school.

This research, conducted in a middle school located in Beijing, China, investigated teacher attitude and technology preparation for the upcoming one-to-one laptop learning initiative. Research data were collected by interviews and surveys during the training before the commencement of the initiative. According to the surveys and interviews, teachers of program school hold a very positive attitude toward the up-coming 1:1 laptop initiative. This result will become a positive factor for the implementation of the project. Otherwise, additional work should be carried out to promote teachers' attitude. Teacher training should be innovative, flexible and updated according to the teachers feedback of pre-program training. After analyzing the data, the researchers proposed an experiential training framework for teachers and a designed a systematic professional development 3-year-plan. This professional development should be altered to meet different schools concrete requirement.

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Using Shared Display Mind Tools for Facilitating One-to-one Collaborative Learning

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Abstract: Most collaborative mind tools are applied in asynchronous learning contexts. In other words, these tools can support students in joint construction of knowledge through the Internet. However, face-to-face collaborative learning may pose new challenges for the design of collaborative mind tools. For example, without a proper arrangement of learning devices, the control of a mind tool may be limited to a single member and this may reduce willingness on the part of other students to share their personal opinions and this may in turn impede the group learning process. This study has adopted a shared display mind tool combining shared display with a one-to-one learning environment to help students engage in collaborative mind activities. The participants were nine graduate students who enrolled in the course "Learning, Collaboration and Creativity" in a middle-sized university in Taiwan. By analyzing activity logs and video, it was found that the shared display mind tool could facilitate information exchange and sharing. This tool can also help students establish shared visual focus and attract the attention of group members. In addition, it elicits ideas from each individual and inspires new search directions, thus enhancing the elaboration of knowledge for new understanding.

Keywords: One-to-one collaborative learning, shared display, collaborative mind tool, peer interaction analysis

1. Introduction

Computer mind tools have been widely applied in supporting teaching and learning [6][8]. It has been shown that mind tools such as CmapTools [5] and Knowledge Forum [13] can help students to organize, judge and link information and knowledge and thus are helpful in improving high order abilities such as critical thinking and problem solving [16]. When such mind tools are applied in collaborative learning, they can promote the externalization of knowledge by facilitating students in judging, linking, and negotiating their own knowledge in a way which develops new understanding of knowledge.

Most collaborative mind tools are applied in asynchronous learning contexts. In other words, these tools can support students in jointly constructing knowledge in non-realtime through the Internet. For instance, Knowledge Forum [13] can facilitate students to exchange resources and ideas in support of collaborative knowledge construction. However, face-to-face collaborative learning may pose new challenges for the design of collaborative mind tools. For example, without the proper arrangement of learning devices, control of a mind tool may be limited to a single member and this may reduce willingness on the part of other students to share their personal opinions, which may in turn impede the group learning process [1]. Furthermore, collaborative learning involves both individual and group activities and would also include rapid transitions between the two activities [10]. For instance, students need to collect and organize information individually and then use the collected information in group discussion to advance their understanding. If the mind tool is used in a shared computer setting where all group members share only a single computer, individual students do not have the opportunity to conduct work independently and develop their own ideas. Therefore, in a face-to-face collaborative learning activity, individual workspaces are needed to support learning autonomy in order that students can generate their own ideas separately and then contribute those ideas in group activities [3].

One-to-one learning environments, which refer to the 1:1 ratio of computing devices and students in educational settings, can potentially address the above-mentioned issues. In such learning environments, each student can use the collaborative mind tool through his/her own computing device. For instance, Zurita & Nussbaum [17] and Manlove, Lazonder, & Jong [11] applied handheld devices in assisting students to perform collaborative learning activities. With the help of the personal computing devices, the group could be more productive due to better communication and interaction. However, individual work and group work taking place during collaboration often occur in parallel. This may impede collaborative learning due to a decrease in activity awareness [14]. More specifically, as each student works only with his/her personal computing device, some group members may not be aware of the learning activities of their partners because of the lack of a visual workspace in a collaborative activity [9].

Shared displays may be used to provide a shared visual workspace in the one-to-one learning environment. The groupware used with shared displays [4, 5] can facilitate collaboration by promoting shared understanding of the workspace and an increasing awareness of partner action, as participants can get close to one another's centre of visual focus with the shared display [14]. At the current development stage, shared displays are applied increasingly to support cooperative work. However, it is still not clear that how these collaborative mind tools, incorporating shared displays in a one-to-one learning environment, may influence collaborative activity.

In response, we conducted a study to investigate student interaction and discourse in the use of collaborative mind tools with the shared displays and personal handheld devices. In order to get a better understanding of student interaction, both verbal and non-verbal communications were analyzed. The former can reveal the detailed processes involved in shared cognition while the latter play an important role in face-to-face communication. For example, eye contact is commonly used as an expression of intention to transmit information to another person and hand-pointing behaviors indicate the direction of attention during human communication [7]. These non-verbal cues are important factors in understanding how students interact when exchanging knowledge [12]. Therefore, this study aims to explore the effect of shared displays and personal handheld devices on face-to-face collaborative learning by answering the research questions below:

1. How may the shared displays facilitate information sharing during collaborative learning in one-to-one learning environments?

2. What role do the shared displays play in non-verbal interaction among group members?

3. How do the shared displays affect verbal interaction among group members?

2. Method

2.1 Participants and the collaborative activity involved

The participants were nine graduate students enrolled in the course "Learning, Collaboration and Creativity" in a middle sized university in Taiwan. Because one of the major goals of the course was to develop collaborative skills in students, they were required to solve open-ended problems collaboratively. To achieve this goal, they were to search the Web and collaborate with each other in forming their individual perspectives of the problem in order to advance their understanding of the problems. During collaboration, students were required to explore all possible solutions to the assigned problems and then to discuss them with each other to achieve a shared understanding. Therefore, sharing information found on the Web and exchanging perspectives with peers were essential during their collaboration.

The nine students were divided into three groups of three, each of which had to generate a perspective on some open-ended problems. The three groups each took part in two collaborative activities. In one of these, the student group used a collaborative mind tool without shared displays (Non-SD) (described later) to explore an open-ended problem: "constructivist approach toward mathematics in Taiwan." In the other collaborative activity, the students utilized a shared display collaborative mind tool (SD) (described later) to investigate another open-ended problem: "low-price computers for education in emerging markets." The students were to explore possible issues and solutions by accessing resources on the Internet. Neither of the two problems has a well-known answer at present. Therefore, an analysis of student interactions during the two collaborative activities could help obtain a better understanding of the effect of the two collaborative mind tools.

Each collaborative activity took 3.5 hours including 0.5 hour for introducing the problem's background and the learning activities. During the collaborative activities, students used their own laptop computers to work on the problems, on which were installed the collaborative mind tools. For instance, group members used their laptop computers to search the Web for material related to the given problem. At the same time they could exchange and share search results with each other using the group mind tools. All collaborative activities and discussions were videotaped by three video cameras on the ceiling for subsequent analysis.

2.2 Collaborative mind tools

To achieve a better understanding of the roles played by the shared displays and handheld devices in collaborative mind tools, this study investigated student interaction assisted by two such tools: one designed based on the shared display (SD) and the other which did not provide a shared display (Non-SD). Both designs used handheld devices as an individual workspace to participate in the learning activity enabled by the collaborative mind tools.

In this study, the collaborative mind tools were used to support exploration activities on the Web. Therefore, they had to assist students in exchanging and sharing search results so that those students could join together to reflect upon the information they had found on the Web. To achieve this goal, this study developed two collaborative mind tools based on mind maps to facilitate such collaboration activities. The mind maps were applied because the use of knowledge maps can improve the quality of argumentation among participants in collaborative learning environments [15]. More specifically, the mind maps functioned as the main workspace in which all participants could amalgamate web search results to reflect upon their own understandings of the problems.

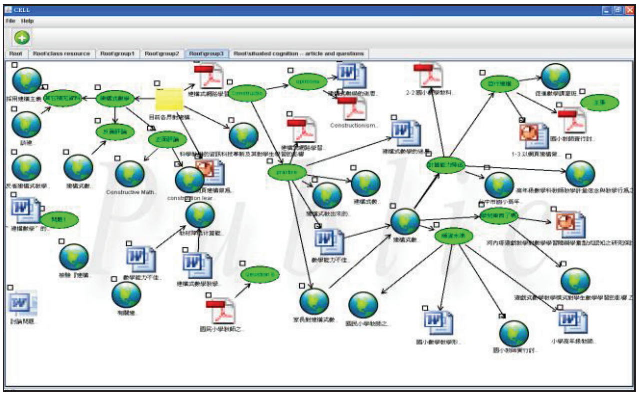

Figure 1. Diverse nodes on the group mind map

Both the Non-SD and SD collaborative mind tools were client/server groupware applications. Figure 1 displays the collaborative mind map constructed by a student group during the collaborative activity. The two mind tools enable students to work individually and collaboratively in the following ways:

- Individual search: Each student can search the Web freely using a personal laptop computer and can contribute any type of web search results as reference nodes to the collaborative mind map. The reference node may include web pages (shown as earth icons), and any type of document files (such as MS Word, MS PowerPoint, and PDF). Each student drags the web search result nodes from his/her laptop computer onto the group mind map.
- Exchange of web search results: Students can easily exchange and share web search results with their peers. They access the shared web search results through their personal mobile computers by double-clicking the web search result nodes on the group mind map.
- Integration and reflection: Students can organize and integrate information collaboratively by performing group mind mapping activities. When they read the web

search results, they can propose an issue, position or argument node (shown as an oval icon) on the group mind map to decompose the exploration topic. Students could also propose ideas on specific web search results by adding a comment node (shown as a square icon) on the collaborative mind map, or propose diverse ideas on a comment node added by others, which led them to further develop a shared understanding, refine a concept, or generate a new idea. In the meantime, students can clarify the relationship between these resources (i.e. web search results, concepts, and comments) on the group mind map by linking these resource nodes.

The Non-SD and SD collaborative mind tools have a different design in terms of the usage of the shared display. Therefore, a comparison of the interaction between students can be made to explore the influence of shared displays on collaborative learning. More specifically, the Non-SD collaborative mind tools allowed the students to perform mind mapping activities only on their own laptops. In contrast, the SD collaborative mind tool contained a shared display with which students could work together on their mind maps while also individually editing the mind map with their own laptop computers. Each group took part in the exploration activities with both the Non-SD and SD collaborative mind tools, therefore, a total of six collaborative mind maps were generated by the three groups. Their mind mapping behaviors with the collaborative mind tool were logged. The log files and the mind maps were analyzed to reveal the effect of shared displays on collaborative learning.

3. Results and discussion

3.1 The effect of students' visual focus

We were interested in how eye contact affected collaborative learning. This study analyzed video and activity logs generated during collaborative learning. It was found that group members discussed their teamwork in depth though the shared display. At the same time, group members modified the content of their proposed nodes and uploaded new search results on the shared display. For example, figure 2 shows that all group members looked at the shared display to discuss their group work. Such discussion demonstrated that they were elaborating their understanding of the problem. It also found that members B and C viewed position nodes 2 times and proposed 2 argument nodes which they then modified 4 times. The result reveals that shared visual focus in the discussion was helpful in eliciting the ideas of each individual.

[1] C: (gazing on the shared display) the difficulty/problem of teacher is that the quality of teaching skills which literally affected the learning effectiveness of students. Therefore, the competence of teachers should be raised up in order to promote 12-year compulsory education.
[2] A: (gazing on the shared display) I believe that the teaching skill is not only focus on their education level but should include the professional proficiency as well.
[3] B: (gazing on the shared display) the level of teaching skills.
[4] B: (gazing on the shared display)(hand pointing at the shared display) Yes, exactly, taking education background for instance, the qualification for being a teaching is just passing the examination to acquire the teaching certificate, thus, some of campuses have staff teaching subjects they are not qualified to teach. For example, Math was the subject most commonly taught by teachers not fully qualified in the area, followed by information technology, computer science, psychology and languages. That is because of a shortage of secondary teachers, schools often had little choice but to assign staff to teach areas they had not studied; therefore, I think, teachers should generally qualify for the role by having strong professional credentials and formal training rather than a teaching certificates.
[5] A: (gazing on the shared display) because one of important point is …..
[6] B: (gazing on the shared display) accordingly, teaching skill is the most imperative essence in the teaching education.
[7]A: (gazing on the shared display): the teaching skills are including professional proficiency as well as their education background.

Figure 2. The students' conversation is elaborative knowledge

To get better understanding of how Non-SD and the SD environments affected the eye contact of group members, this study analyzed the activity video and counted the number of eye contacts within a group. The result is shown in Figure 3. In Figure 3, each circle represents a group member and the number on the solid arrow represents eye contact frequency between one member and another. The number on the dotted arrow represents the frequency with which one member watched another member's laptop computer. For example, in Figure 3a, member A engaged in eye contact with member B 68 times and looked at member C's laptop computer 71 times.

It was found that the shared display promoted eye contact between group members. For instance, the total eye contact frequency count in the SD environment (500 times in Figure 2d and 663 times in Figure 3e) was significantly higher than that of the Non-SD environment (301 times in Figure 3a and 418 times in Figure 3b). Previous studies pointed out that an instance of eye contact is commonly used as an expression of intention (Gomez, 1996), especially when eye contact functions as an important confirmation cue in face-to-face collaborative learning. The result showed that the shared display increased the instance of confirmation in face-to-face learning. It was supposed that when group members discuss group work on the shared display, they often confirmed the intention of others through eye contact. It was also found that the shared display promoted exchange of information by enabling members to watch each other's computers. The number of instances of watching the computers of others and the shared display under the SD environment (318, 149 and 217 times, respectively) was higher than that of the Non-SD environment (290, 49 and 172 times, respectively). Notably, instead of watching computers of other members, the three groups watched the shared display more frequently (229, 88 and 208 times, respectively). The result shows that the shared display can help to establish shared visual focus and further promote confirmation between group members in achieving exchange of information. Such exchange of information can explain why shared visual focus could help to elicit ideas from each individual and inspire new search directions.

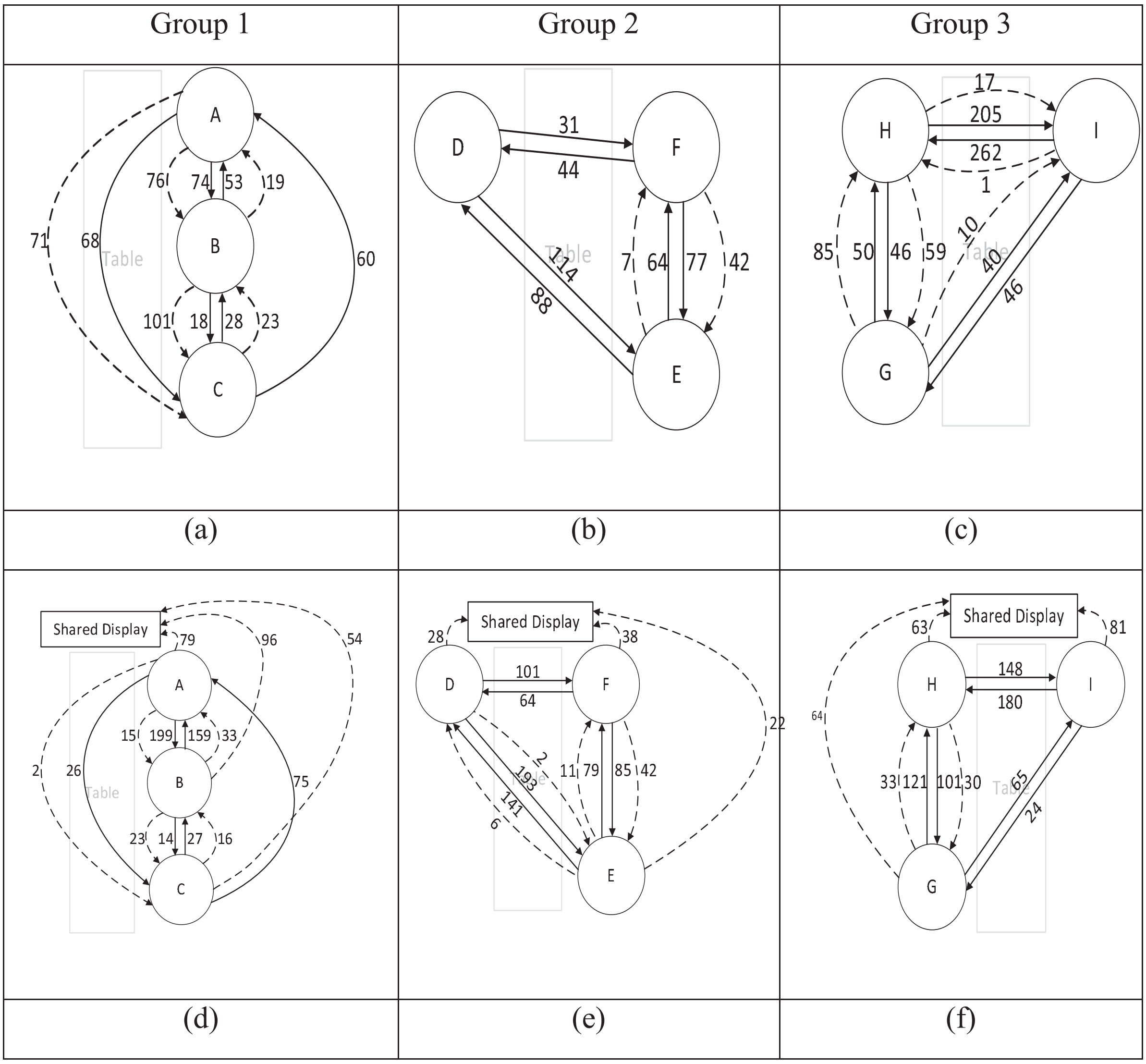

Figure 3. Students' eye contact in Non-SD (a-c) and SD (d-f) environments

Watch group member

Watch shared display or device

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This study also analyzed the activity video and counted the number of hand-pointing occurrences within each group in order to understand how the Non-SD and the SD environments affected hand-pointing behavior. The result is shown in Figure 4. The number on the solid arrow represents the frequency of hand-pointing between one member and another. The number on the dotted arrow represented the frequency with which one member pointed at another member's laptop computer. For example, in Figure 4a, member A pointed at member B 2 times and pointed at member C's laptop computer 5 times.

The hand-pointing frequency of individual devices under the Non-SD environment was 32, 0 and 70 respectively (Figure 4a-c) and that of the SD environment was 45, 15 and 48, respectively (Figure 4d-f). It did not show a significant difference between the two environments. Interestingly, it was found that the hand-pointing behavior shifted from pointing at one another or pointing at another's laptop computer to pointing at the shared display. The result showed that group members tended to use the shared display to discuss and organize group work instead of working on their personal devices. It also revealed a change of attention during collaborative activities. Hand-pointing represents the direction of attention during human communication [7]. Within the SD environment, students often focused on the shared display rather than interacting with each other via their personal devices. Our study showed that the SD environment can shift attention to group work, which is helpful in improving group performance.

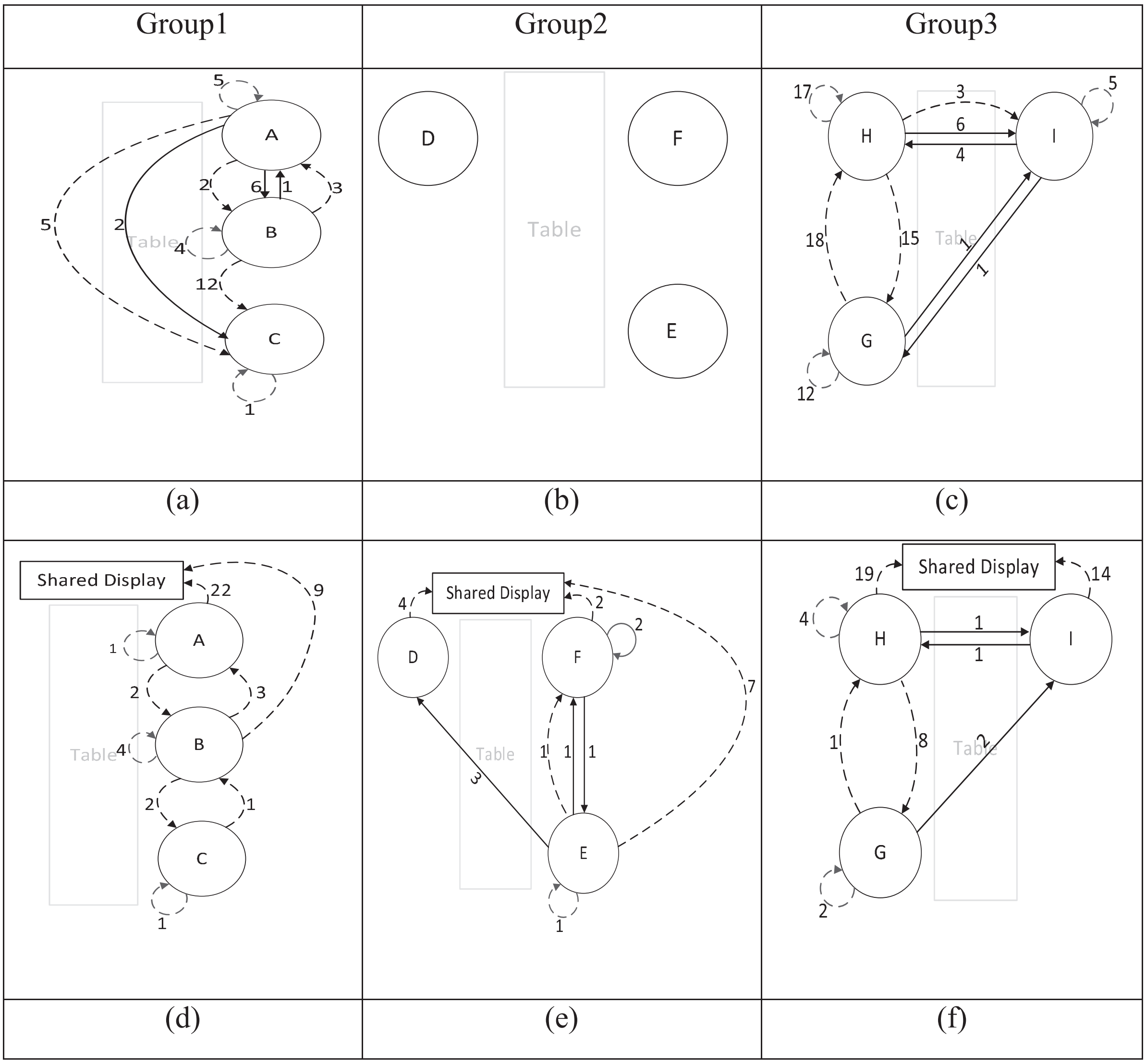

Figure 4. Students' hand-pointing behaviors in the Non-SD (a-c) and SD environments (d-f)

Point at group member

Point at screen

Table 1. The counts of students' conversation utterances under the Non-SD and SD environments

	Procedure discussion	Searching	Document explanation	Group argument	Group decision-making	Total
Non-SD	307(24%)	97(8%)	169(16%)	510(40%)	153(12%)	1236
SDG	159(12%)	28(2%)	158(12%)	803(59%)	210(15%)	1358

Besides investigating the effect of a shared display upon computer-mediated communication and non-verbal interactions, we also tried to analyze students' conversational utterances to reveal how group members developed collaborative strategies. In the activity video, we found five main types of conversational utterances during collaboration. Table 1 shows the counts these. There was no significant difference between totals of conversational utterances within the Non-SD and SD environments (1236 and 1358, respectively). However, there were clear differences in the character of conversational utterances between these two environments. Group members produced more instances of procedural discussion and searching within the Non-SD environment (307 and 97, respectively) than those in the SD environment (159 and 28, respectively). However, they produced fewer instances of group argument in the Non-SD environment (510) than in the SD environment (803). The result shows that group members often questioned procedure and search results during activities rather than focusing on group arguments within the Non-SD environment. This suggests that the shared display can enhance activity awareness and thus reduce the number of conversational utterances dealing with procedure discussion and searching. This finding is consistent with the eye contact and hand-pointing analysis. The shared display shifted more attention to group work during the discussion, so members spent less time describing their work status and search results and more pursuing group argument and elaborating knowledge interactively.

4. Conclusion and Implications

Many researchers contend that mind tools can improve high order thinking in students and improve the acquisition of new understanding of knowledge. Therefore, this study adopts the shared display mind tool, combining a shared display with a one-to-one learning environment to help students engage in collaborative mind activities. By analyzing the activity log and video, it was found that the shared display mind tool can facilitate information exchange and sharing. The shared display mind tool can also help students to establish shared visual focus and to attract the attention of group members. It further elicits ideas from each individual and draws out new search directions to enhance the elaboration of knowledge for new understanding.

The results of this study show that the shared display mind tool can help students conduct collaborative mind activities, but due to the limited number of available devices, only nine subjects were enrolled in the experiment. A future study will involve a large number of subjects to confirm the effect of shared display upon collaborative mind activities. The current subjects were graduate students. Future studies should use students with different knowledge levels to reveal how the shared display mind tool can provide assistance to a wider range of collaborative mind activities. In addition, the shared display may also be applied to other fields of knowledge. These new findings can also be provided to the designers of learning systems to aid them in improving their current design of collaborative mind tools and curriculum design in the classroom.

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Designing with mobile technologies for enacting the learning of geometry

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Abstract: Guided by the methodology of design research and the notion of seamless learning we develop a mobile learning activity for an outdoor context, where groups of 12 year old students are asked to coordinate themselves physically in terms of given distances with respect to both given and peer-defined points. Our learning activity consists of three connected tasks of successively increasing complexity, implemented at separate occasions over a period of 6 months. By participating in the activity, the students are offered opportunities to experience geometrical constructions in full-sized space. Specifically, they are stimulated to make use of their orientation ability, which differs cognitively from the visualization ability which is more commonly used to solve similar tasks in school. The outdoor explorations, the use of mobile technologies, and the distribution of the activity across time and locations, pose didactical as well as technological challenges which call for careful considerations regarding the design of the activity. In this paper, we account for the design process and its pedagogical grounding in ancient mathematics and modern psychology. Furthermore, we suggest to systematically combining the theory of instrumental genesis together with scenario-based design, within the methodological framework of design research, to guide the development of seamless mobile learning activities which provide a learning progression over time.

Keywords: Design research, geometry, instrumental genesis, seamless learning, scenario-based design, mobile technologies, technology-enhanced learning

1. Introduction

This paper reports on the design of a technology-enhanced learning (TEL) activity developed in collaboration between researchers in mathematics education and media technology. The activity emerged as an idea during a meeting where a selection of available mobile technologies and their didactical potential for the learning of mathematics were discussed. Several members of the current research team have previously collaborated in projects involving outdoor mathematics supported by mobile technologies and interactive visualization techniques [8,9,11]. These efforts have been inspired by Cobb, Confrey, diSessa, Lehrer, and Schauble [3], who formulate a mission for research in mathematics education as striving to develop, test and revise learning activities which are designed in order to support envisioned learning processes.

Research in mobile learning (m-learning) relates to a variety of subjects including school mathematics. An example of such an m-learning activity is MobileMath [13], designed as an outdoor activity for teams of students to compete against each other by constructing squares, rectangles, and parallelograms to cover as much area as possible while negotiating obstacles such as houses. The students define the vertices of the shapes by walking to chosen positions and clicking on a mobile device supporting GPS technology.

The device provides visual feedback to the students. As being a one-off activity, the game involves mathematics but it remains to exploit and research its potential for learning [13].

In this paper, we discuss the development and pedagogical grounding of a connected learning activity, whose three tasks have been initially tested with students. To achieve the specific learning objectives for the activity, we involve mobile technologies in an outdoor context. The development of learning activities for outdoor contexts is in itself a complex task, which becomes even more complex when attempting to support advanced mathematical learning objectives by making use of mobile technologies. In the next section, we account for the theoretical and methodological foundations that serve as a basis to support and guide our design efforts. In the last section, we suggest how to further strengthen the methodological approach in our future efforts. Moreover, the implemented tasks have to be negotiated with teachers and students. We address this latter issue of pragmatic roots in relation to dimensions of mobile-assisted seamless learning [14], and argue for using these dimensions as guiding principles for future work in educational design research.

2. Design research, scenario-based design, instrumental genesis, seamless learning

Two key aspects of design research are the central position of the design of learning activities and the cyclic character that allows their adjustment and improvement. One design cycle consists of three natural phases; the preliminary design phase, the teaching/learning experiment phase, and the phase of retrospective analysis [5]. The preliminary phase for design of a learning activity involves the negotiation between a) the design of a proposed activity, and b) a prospective analysis with focus on hypothetical learning trajectories [3], where the intended mathematical learning objectives guide the choice of trajectories. In our case, which concerns a learning activity with three connected tasks, the classical design cycle (Fig. 1, left pane) is naturally extended to involve three connected cycles (Fig. 1, right pane). This latter model involves transitions between designs (preparatory stage) as well as transitions between tasks (students in action).

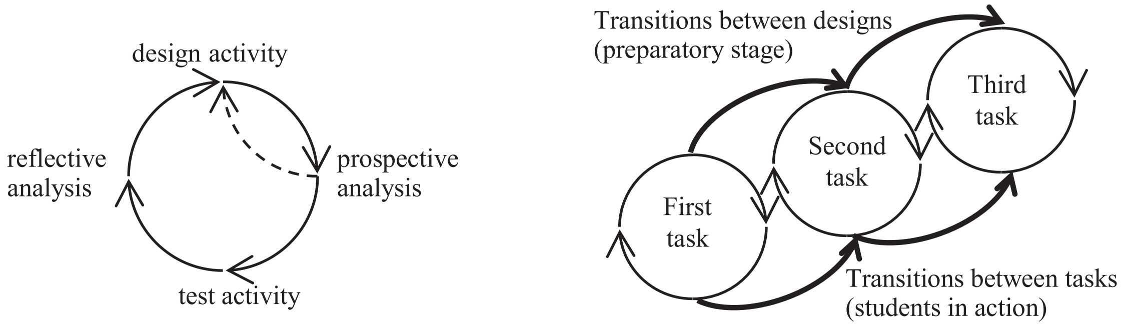


Figure 1: Design cycle (left pane) and connected design cycles (right pane)

In the current project, as well as in our previous efforts related to design research [8,9,11], the learning activities are highly self-regulated and stimulate collaboration in the sense that the students need to engage in a coordinated effort to solve tasks within the activity [4]. From a didactical point of view, we negotiate the design of a specific learning activity with prospective analysis in a local cycle and simultaneously negotiate technological requirements of the mobile applications with the technological domain experts. These discussions and negotiations are guided by scenario-based design (SBD) which enables "rapid communication about usage possibilities and concerns among many different stakeholders" [10] by providing narratives about the students' possible actions and interactions during a proposed learning activity. The scenarios make it possible to communicate about learning trajectories without having to engage deeply in specific subject matters.

The implementation of any learning activity, and particularly an activity that makes use of mobile technologies, has to include a phase where the students try out and learn to use the available tools. The process of turning a tool into an instrument (in our case, an instrument for learning) is summarized by the notion of instrumental genesis [12]. The theory of instrumental genesis makes a distinction between the tool as an object and the instrument, as a cognitive construct, emerging when the user interacts with the tool. A central feature within the current activity is a customized mobile application to be used in an outdoor context. The design considerations regarding the students' instrumental genesis could fortunately be limited to the first task, as the functionality of the application was changed just slightly from the first to the second and third tasks. As a consequence, the students' cognitive efforts during the latter tasks could be focused on the mathematical challenges.

Our three tasks being distributed across time and locations make them fulfill two of the ten dimensions (MSL3 and MSL4) characterizing mobile-assisted seamless learning (MSL), as recently suggested by [14]. The tasks were implemented at four different occasions beginning in December 2010 and ending in June 2011. Each task involved an indoor preparatory session combined with a self-directed group effort in an outdoor setting. We will discuss the dimensions of MSL in further detail in the last section.

Our general design approach can be characterized by the use of design research to develop learning activities which support specific learning trajectories. The prospective analysis is based on narratives, which account for the students' hypothetical action (and learning) trajectories. These narratives guide the pedagogical design as well as the technical implementations throughout our work. The reflective analysis in this contribution is limited to a concluding discussion in relation to the dimensions of MSL.

3. Grounding of the activity in ancient mathematics and modern psychology

Our activity offers the participating students enacted experiences of school geometry which are not commonly offered in school contexts. The activity, which will be described in the next section, was initiated during a team meeting where a selection of available mobile technologies and applications were introduced and implemented by researchers from media technology. The research team promptly agreed, influenced by the didactical opportunities offered by one of the mobile applications, to design an activity involving outdoor constructions of large-scale triangles. We now proceed to account for the theories and research findings which were identified and used to guide the design process in order to refine and support specific hypothetical learning trajectories within the activity.

From a mathematical perspective, the activity may be interpreted as the construction of a triangle with three given sides. A while after the task was proposed we felt confident that such a geometric construction must have been considered by Euclid (~300 BC). Indeed, we found such a proposition in Book 1 in Euclid's Elements [6]. The construction can be regarded as a traditional school task related to geometrical constructions, problem solving and visualization. Students may readily solve the task on a piece of paper by using a compass and a ruler. In that case, they make use of a spatial ability which is sometimes referred to as *object manipulation*. This ability includes abilities for spatial visualization and spatial relations and concerns manipulation of spatial forms from a fixed perspective, involving an object-to-object representational system [7]. Within the psychometric research tradition, spatial visualization and spatial relations are contrasted with a third spatial ability, namely spatial *orientation*, which involves "movement of the egocentric frame of reference" [7, p. 745] and a self-to-object representational system. The self-to-object system activates another part of the brain than does the object-to-object system [7], which implies that object manipulation and spatial orientation should be considered as separate spatial abilities.

Steering documents for compulsory school in Sweden have a one-sided focus on object manipulation and consider spatial orientation explicitly only in pre-school. This fact may be contrasted with the claim by Bishop [1, p. 260] that "insofar as we are concerned with spatial ideas in mathematics as opposed to just visual ideas, we must attend to large, full-sized space, as well as to space as it is represented in models, and in drawings on paper". Activities taking place in full-sized space may be related to Bruner's [2] enactive mode of action and corresponding mode of thinking, as one out of three modes – enactive, iconic, symbolic – characterizing an individual's interaction with the world. We find it reasonable to claim that these different modes, which Bruner considers as emphases (rather than stages) in a child's development [2, p. 28], may be fruitful to draw on during learning activities also for older children, especially with respect to learning subject matter of abstract nature, such as mathematics.

Our ambition has been to design a learning activity that stimulates students' enactive mode of action by putting special focus on spatial orientation while minimizing features related to spatial visualization. We argue that this singular activity may serve as a general frame of reference regarding students' future geometric constructions on paper, using compass and ruler, where the outdoor activity may provide a connection between iconic constructions on paper and constructions imagined to be enacted in an outdoor setting.

4. Design and implementation of our learning activity

The current learning activity draws on the use of GPS technology available in a mobile device. The research team has developed a mobile application, which allows a student to measure distances between her own device and mobile devices held by other students. Based on this feature, we have designed a learning activity providing opportunities for students to experience spatial self-orientation in full-sized space. The activity was tried out by twelve students in grade 6 (13-14 years old) at a school located in a rural area in southern Sweden. The students worked with three tasks within the activity during a number of sessions that took place during the period December 2010 - June 2011.

4.1. The first task of the learning activity

In the first task, implemented in December 2010 on a field covered in snow, the students worked in pairs. They were asked to use one mobile device to coordinate themselves with respect to two given distances measured against two fixed points, which were respectively marked on the field by a triangle and a square (Figures 2&4).

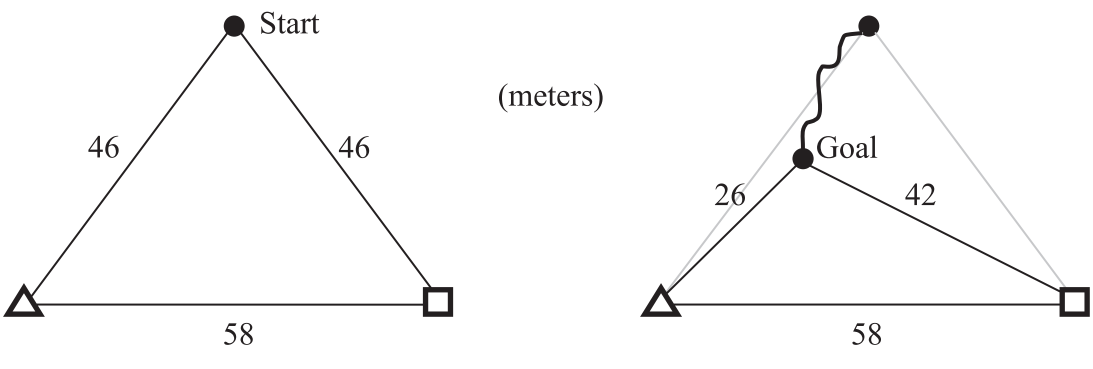
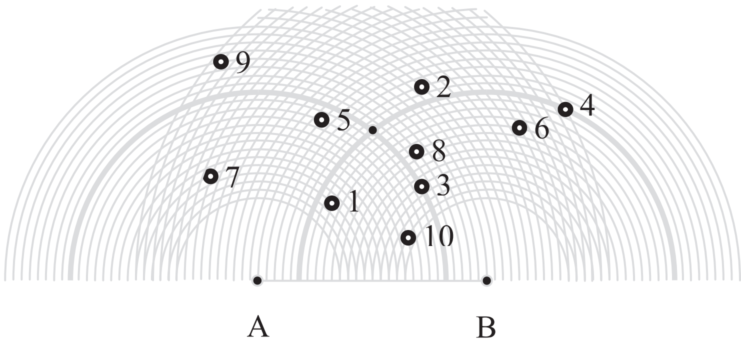


Figure 2: Visual representation of the first subtask.

The standing markers were placed 58 meters apart and could be readily identified from a large distance (Fig. 4). The starting point was marked with a pole and located 46 meters from each of the markers, as indicated in Fig. 2 (left pane). We chose to design ten subtasks, based on a diagram of level curves used to secure variation between longer and shorter distances (Fig. 4). The goal point for the first subtask, involving the students coordinating themselves with respect to the distances 26 m and 42 m, is indicated in Fig. 2 (right pane).



Point	A	B
1	26	42
2	62	50
3	46	28
4	86	46
5	42	56
6	74	38
7	28	72
8	50	36
9	54	84
10	38	22

Figure 3: Distribution of points for the tasks (unit: meter).

The rather large distances, 22-86 meters, were chosen for two reasons. Firstly, we wanted the students to move substantially (and reasonably far) within the chosen field. Secondly, inaccuracy of the GPS values resulted in an error for the computed distances. The research team tested both these aspects outdoors and found that a tolerance of two meters was enough to compensate for the inherent inaccuracies of the GPS technology. At the final stage of implementation (December 2010), the students were randomly organized into six groups. They worked simultaneously with the activity on the same field, which was covered with 20 cm snow. To avoid having the groups follow each other (in order to complete their ten tasks) six variations of the initial sequence of points were constructed based on symmetry (interchanging distances for A and B) and taking the ten points (Fig. 3) in different order (1-10, reverse order 10-1, and 3-10 followed by 1-2). A reference point was marked on the field with the two starting distances 46, 46 (meters). Between the points A and B, we provided distance markers for 5 and 10 meters which the students could use as references either before or during the activity. In order to put focus on the spatial orientation ability, we decided not to provide visual references on the mobile device although this was technically possible (such as maps with marked attempts). They were instructed in the classroom about the activity and the functionality of the mobile application. To promote students' reflections during the activity, their new distances were shown on the display of the mobile device only when so prompted by the students (Fig. 4, right pane).

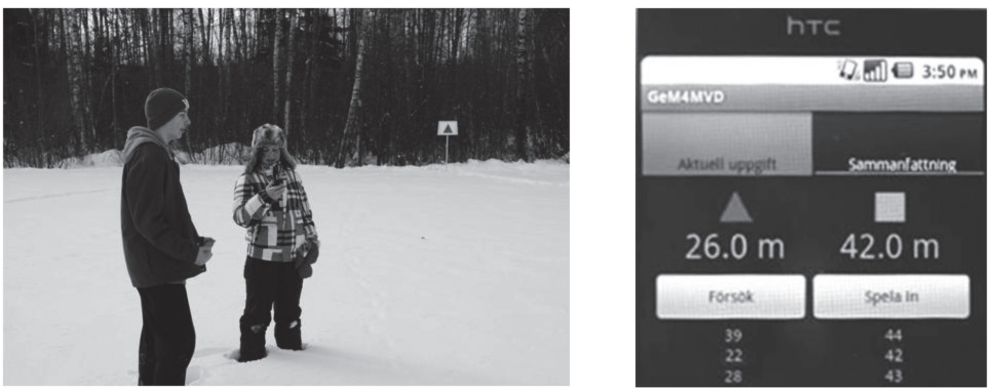


Figure 4: Picture from the outdoor activity. The display of the mobile device.

They were instructed to try to minimize the number of prompts/tries for each task and were also asked to record audio messages (on the same device) to be used for reflection in the classroom. The activity took less than one hour to complete by the six groups, despite the snow, cold weather, and humidity in the students' clothes.

4.2 The second task of the learning activity

The first part of the activity was followed by a more complex activity, implemented in early February 2011 involving a task where the students had to handle repeated coordination of distances. The new requirement for the mobile application was that distances had to be measured with respect to moving targets as the initial reference points A and B (triangle and square) had to be replaced by the other students as new reference points for the measuring of distances. Hence, each group needed three GPS enabled mobile phones which were running a customized application, so that relative distances between the students were measured. The activity was supposed to be tried out by three groups, one with four students and the two remaining groups with three students each (due to two students being absent on the day of the activity). The students who were chosen had all participated in the first part of the activity and were familiar with the functionality of the mobile application.

The groups prepared for the outdoor activity in the classroom. They were presented with maps (size A4) of a construction presented on a neutral white background and with marked distances on each edge (Fig. 5, left pane). They were asked to find the goal point, indicated with a circle in Fig. 5. Before attempting the constructions outdoors, they were asked to discuss possible strategies for approximately 15 minutes and to decide on a strategy for reaching the goal point before engaging in the outdoor activity.

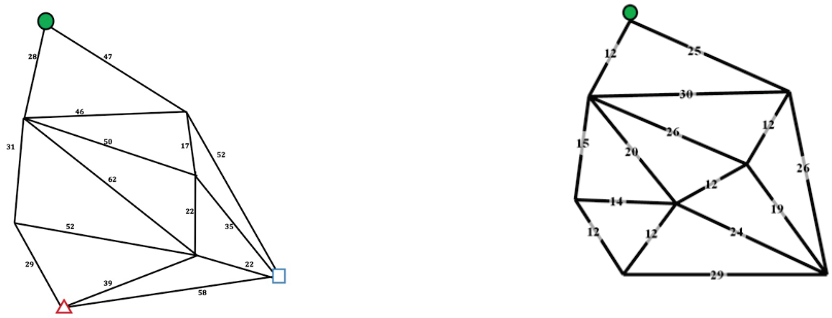


Figure 5: Maps used in February 2011 (left pane) and in April 2011 (right pane).

During the first implementation of the task, in February 2011, some incidents appeared that made us implement a re-designed version of this construction (Fig. 5, right pane) before the third and final task was implemented. These incidents concerned the students' preparation of strategies and the scaffolding of their outdoor communication. First, the students did not engage sufficiently in their indoor preparations of strategies for solving the task. Their insufficient strategies made them insecure and caused confusion when they tried to solve the task outdoors. Their confusion was amplified by communication problems due to the large distances in the construction and the strong winds on the day of implementation. For these reasons, the second task was redesigned with a technologically supported indoor session for preparing strategies. Furthermore, the distances in the construction were halved with the starting distance shortened from 58 m to 29 m in order to facilitate communication. This second iteration of the task worked out well when implemented in April 2011.

4.3 The third task of the learning activity

The last task of the activity, implemented in early June 2011, involved each of the three groups making a similar construction from different starting points (Fig. 6, left pane) by using the map above (Fig. 5, right pane). When all three groups had identified their different goal points (Fig. 6, left pane) they were instructed to collaborate in a jig-saw construction to construct the center of mass for the triangle (Fig. 6, right pane). The instructions did not mention "center of mass" which was an unknown and possibly distracting concept for the students. Instead, the goal points were named A, B, C, a form of notation they were already familiar with. The midpoints on the line segments AB, AC, BC were named D, E, F, respectively. The students were instructed to find the (final goal) point where the line segments AF, BE, CD intersect each other (Fig. 6, right pane).

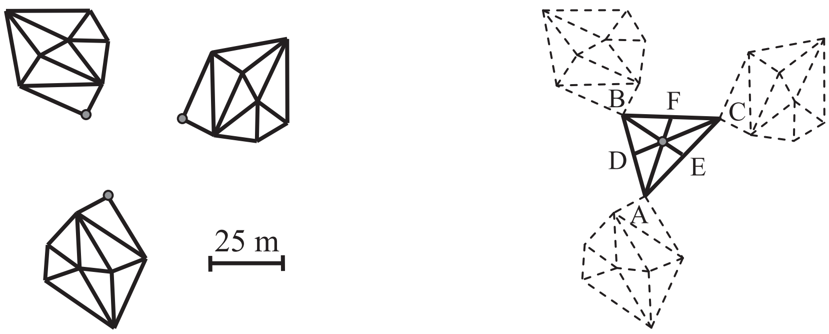


Figure 6: First phase (left pane) and the second phase (right pane) of the third task.

Our observations indicate that the students have been deeply engaged and motivated in solving the tasks, particularly when enacting the constructions in the outdoor contexts.

5. Lessons learned and future efforts

Based on the experiences from the first iteration, we plan to more systematically collect data during a second implementation of the activity with new groups of students. We plan to evaluate the outcomes based on a comparison of two groups of students, one which will do the tasks and one that will make similar constructions by solving standard tasks in textbooks. The students' ability to make geometrical constructions will be tested by letting them solve tasks with varying mathematical representations and modes of action.

As already mentioned, our activity obviously involves the two dimensions MSL3 and MSL4 (distribution across time and location) out of the ten dimensions for mobile-assisted seamless learning [14]. The tasks also encompass personalized and particularly social learning, (MSL2), they involve physical and digital worlds, (MSL6), and combined use of multiple device types – digital as well as traditional, (MSL7). Furthermore, the activity involves seamless switching between multiple learning tasks (MSL8) as individual students' roles in particularly the second and third tasks were changed frequently as they solved the tasks. Finally, managing the tasks in the connected activity requires a combination of prior and new knowledge (MSL9) as each new task builds on the previous tasks and each task involves both strategic planning and application of problem solving skills.

Although the participating researchers have been collaborating for several years in similar projects, there remains a need for a deeper understanding of both the didactical intentions of the activity and the functionality of the supporting technological applications in order to improve the design and realize the learning objectives for the students. In the current research effort, the ten-dimensional model for mobile-assisted seamless learning [14] has been used mainly for assessment purposes and has not been explicitly used in the design process, although some of the researchers are familiar with the model. Similarly, the methodology of scenario-based design has been used only implicitly. In our future efforts, we will attempt to make more systematic use of the dimensions of MSL as guiding design principles and apply the SBD methodology explicitly to further enhance the communication within the research team and to improve the quality of the design process.

Although our activity is designed for and implemented in a school context, we argue that it contains several features with strong impact for broadening students' learning experiences beyond both the activity itself and also beyond the formal school context. In a formal school context, the flow of learning is controlled and supported by the teacher, while the learner herself becomes primarily responsible for her learning in informal contexts. As noted by Wong and Looi [14], the "learners need to be engaged in an enculturation process to transform their existing epistemological beliefs, attitudes, and methods of learning". In our activity, we contribute to some extent to the learners' enculturation but even more to the enculturation of the teachers who are involved in the design process. By targeting teachers and transforming their attitudes and methods in the direction of seamless learning, we indirectly target their students and other teachers (and their students). The acceptance of our approach is underpinned by current steering documents for Swedish compulsory school, that highlight the development of general abilities (problem solving, communication, reasoning, representation, choosing and evaluating methods) which naturally encompass both formal and informal contexts, before specific content knowledge (arithmetic, algebra, functions, etc) which is more closely associated with the formal school context. By offering activities that are highly self-regulated and involve collaboration and communication with peers, we contribute to preparing the students for a future which requires them to take initiatives, be creative, take informed decisions, and puts high demand on their social skills.

A didactically relevant challenge for the future design improvements of our seamless learning activity would be to continue optimizing the hypothetical learning trajectories, aiming at specific mathematical learning objectives, while simultaneously attempting to incorporate additional dimensions of MSL in the activity.

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PACALL: Passive Capture for Ubiquitous Learning Log Using SenseCam

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Abstract: In our previous works, we developed a system named SCROLL in order to log, organize, recall and evaluate the learning log. However up to now, we just use an active mode to record logs. This means that a learner must take a capture of learned contents consciously and most of learning chances be lost unconsciously. In order to solve this problem, we started a project named PACALL (Passive Capture for Learning Log) in order to have a passive capture using SenseCam. With the help of SenseCam, learner's activity can be captured as a series of images. We also developed a system to help a learner find the important images by analyzing sensor data and images processing technology. Finally, the selected images will be uploaded to the current SCROLL system as ubiquitous learning logs. This research suggests that SenseCam can be used to do passive capture of learning experiences and workload of reflection can be reduced by analyzing sensor data of SenseCam.

Keywords: passive capture, learning log, life log, sensor data, SenseCam, ubiquitous learning

Introduction

Learning Log was originally designed for children as a personalized learning resource [6]. It was set by teachers to help their students record their thinking and learning. In this learning log, the logs were usually visually written notes of learning journals. We defined a ubiquitous learning log as a digital record of what a learner has learned in the daily life using ubiquitous technologies. We developed a system SCROLL (System for Capturing and Reminding Of Learning Log) [10] that helps learners collect their learning experiences as ubiquitous learning objects (ULLOs). Also, all of the collected ULLOs are organized, shared in this system, and the learning effect can be enhanced. The model of a learning process is shown in Figure 1 and we call it LORE [10].

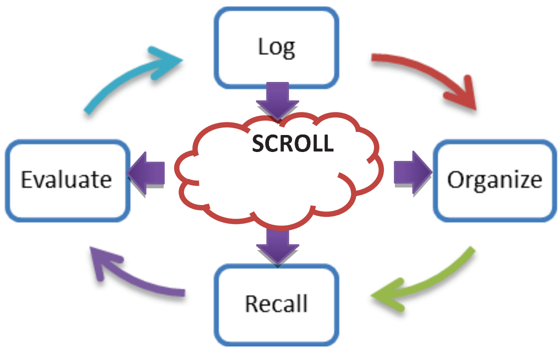

Figure 1. LORE Model in SCROLL

However, in the current SCROLL ULLOs are created by learners manually. It means that learners must record their learning experiences in the form of photo, video or other formats consciously. It is evident that learners cannot record all of the learning experiences in the system and most of them will be lost and forgotten.
In order to solve this problem, we attempt to introduce the concept of life log into this system. The notion of life log can be tracked back at least 60 years [1]. It means to capture a person's entire life or large portions of life. It usually uses digital devices to record life log such as wearable cameras or video recorders. For example, in the early 1980s Steve Mann captured his life using wearable computer and streaming video and even his everyday life 24 hours a day in order to see what he was looking at [7]. The life log brings us the data of whole life of not only learning but also other activities. However, if there is any way that we can extract the learning part from it, the learning log will be more significant and more sufficient. Besides, our system captures the learning log beyond their consciousness and learners' burden will also be reduced.
Microsoft's SenseCam [4] is an effective way to capture the life log. It is a wearable camera equipped with a number of sensors. The SenseCam is proposed to record a series of images and capturing a log of sensor data.
In this paper, we propose a system named PACALL (PAssive CApture for Learning Log) to capture the learning log passively using Microsoft's SenseCam. With the help of analyzing sensor data and image processing technology, it extracts the meaningful images for learning from life log and helps learners upload the learning content easily. In addition, we also conducted an initial experiment and analyzed the result.

1. Related Works

1.1 MyLifeBits

MyLifeBits [9] is a Microsoft's project. The aim of this project is to implement Bush's Memex model [1] that proposed to store everything that you saw and you heard.
MyLifeBits has a large amount of storage that can store email messages, web pages, books, photos, sounds, videos, etc. It also has a full-text search function to supply users with searching text, audio annotations and hyperlinks.
In addition, the MyLifeBits project team is also using SenseCam to have the passive capture of life log and upload the sensor information along with the photos to the MyLifeBits repository [3].
We have learned a lot from this system. In our previous works, we had made it possible to store the learned material such as photos, sounds, videos and pdf files into the system repository. Besides, we have also implemented recall functions that use quizzes and contextual information to help learners to remember what they have learned. However, all works that we have done are using active logging mode, not passive logging mode. It means that learners must record their learning experiences as learning material by themselves. Comparing to the passive mode, in the active mode we are more likely to lose learning experiences since we are not necessarily able to record what we have learned or sometimes we just forget to record it. Therefore, we planned to introduce passive capture in our project with SenseCam.

1.2 JAMIOLAS

JAMIOLAS [11] is Japanese mimicry and onomatopoeia learning assistant system. This system uses sensor to get the context information from real world such as temperature, light and sound level and use these data to support learning Japanese mimicry and onomatopoeia words. Because most of these words are just Japanese feelings, this system simulates the feeling of human beings with sensors, and generates proper word to help non-Japanese learners learning mimicry and onomatopoeia words. Each word has relationships with a number of sensors. Sensor data types are attributes of the word. For example, "hiyahiya" means cold in Japanese, so this word has a relationship with temperature sensor, and the temperature data is an attribute of "hiyahiya". The threshold is set by native Japanese speakers. In the second generation of JAMIOLAS [8], sensor network was introduced into this system, and in the third generation [5] this system also used online sensor data and supported learning mimicry and onomatopoeia with multimedia materials.
In the PACALL, we also use the sensor data to analyze the situation of an image file. When sensor data is collected by combined sensors, we need to analyze the sensor data, evaluate it as a situation and all the information will be added to each photo as properties.

1.3 Collaborative Reflection with SensorCam

Fleck and Fitzpatrick [2] used SensorCam to support collaborative reflection. In their research, the students were asked to wear SenseCam when they played arcade games. After that, they did a reflection on their learning experiences. They found that SenseCam images were not only used to support memory aids but also can be used as resources for supporting the collaborative reflective discussion. The research also suggests SenseCam has potential to support reflection and that it is more appropriate in learning situation than videos.

2. SenseCam

SenseCam is a prototype device under the development of Microsoft Research [4]. It is a small digital camera that is combined with a number of sensors to help to capture a series of images of the wearer's whole daily life at the proper time and it can be worn around the neck (Figure 2). Actually this device is designed for memory aid.

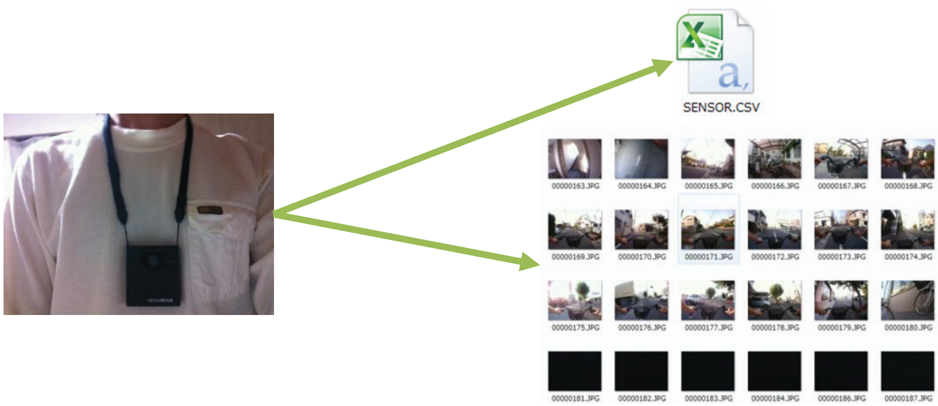

Figure 2. SenseCam and the record data

The SenseCam uses sensors as triggers to capture images along with a time trigger. As it is shown in Figure 2, when using the SenseCam all actions are saved into a single file named SENSOR.CSV including sensor data and the names of photos. Once the SenseCam is connected to computer, all the photos and the SENSOR.CSV file will be imported automatically.

```
CAM,2010/09/16 11:43:57,00000115.JPG,P
ACC,2010/09/16 11:44:20,00.037,00.940,-0.231
TMP,2010/09/16 11:44:20,0032.0
CLR,2010/09/16 11:44:20,00132
PIR,2010/09/16 11:44:20,1
BAT,2010/09/16 11:44:20,40992
MAG,2010/09/16 11:44:20,-374,892,-1924
```

Figure 3. Example of SENSOR.CSV

Figure 3 is an example of SENSOR.CSV. Each line starts with a flag (e.g. CAM, ACC) and a timestamp. Meanings of some flags that we are using in this research are shown in Table 1.

Table 1. Flags in SENSOR.CSV

Flag	Sensor/Meaning	Data Interpretation
CAM	Image capture	Image filename, capture reason (P: PIR, T: Timer, M: Manual, L: Light level change)
PIR	Passive infrared detector	1: the PIR is triggered, 0: not triggered
CLR	Color light sensor	Value for ‘white’ light
TMP	Temperature sensor	Temperature
ACC	Accelerometer	Acceleration values in x, y and z axis
MAG	Magnetic sensor	Magnetic values in x, y and z axis

The SenseCam itself has an algorithm for capturing images by a time trigger and other triggers that use sensor data. However, because SenseCam is designed for memory aid, it takes photos continuously even if it is dark or the situation is not been changed. The result is that there are so many photos that are duplicated or blurred or dark.
In this research, we focus on filtering the images with sensor data in order to help learners to select proper photos in a short time.

3. Research Design

3.1 Learning Process

This research is a sub-item of Ubiquitous Learning Log, and we named it as PACALL. It means a passive capture for learning log. The whole process of passive capture happens unconsciously. However it is no doubt that the simple photo capture is not the whole process of learning. It is necessary for learners to look through the captured photos and find the learning contents with the help of system. After entering the information of the image such as title and description, this learning content will be saved into SCROLL system as a ULLO. Of course, the saved ULLOs need to be recalled to help learners to remember, but this is the feature of SCROLL. That is to say, a process of passive capture includes capture, reflect and store. Such process is called a PACALL frame.

- Capture: Capture a series of photos for life log in daily life. This log is assumed that it includes all what learner has seen. Besides, massive redundant contents are also included in this log. We use SenseCam in the process of capture. SenseCam is already introduced in section 2.

- Reflect: After capturing life log, a learner needs to have a reflection of what he has learned. In this process, since there are so many photos, we provide a system to filter the redundant photos by analyzing sensor data or image processing technology. The analysis of sensor data is described in section 3.2.
- Store: When a learner finds an important learned content, the content must be stored into SCROLL. During this process, he also needs to enter the information of learned content such as title, description or tags.

3.2 Photo Classification and Sensor Data

In PACALL, we use SenseCam to have a passive capture of learner's daily life. However, since this device takes photos continuously, more than 200 photos will be taken in one hour, and more than 1500 photos in one day. Therefore, we propose a method to classify these photos by sensor data.
All photos are divided into 5 levels based on importance – manual, normal, duplicate, shake and dark.

- Manual: Manual means the photo is taken by pressing manual button consciously. When a learner takes a photo manually, it means that this photo must be important from his point of view. Manual photos are selected by the sensor data with flag CAM and the capture reason "M" (manual capture).
- Normal: Normal means the photo is clear and can be used as learning log object. After excluding the duplicates, shake and dark, left photos are judged as normal.
- Duplicate: Duplicate means the photos are duplicated. Duplicated photos usually have same conditions. We use CLR, TMP, ACC, MAG and timestamp of photo to detect photos that are taken under the same conditions and pick out them as duplicated photos.
- Shake: Shake means the photo is blurred. It usually happens when the light level is low and the camera shakes. The sensor data CLR help us detect light level and ACC help us detect camera shake.
- Dark: Dark means the photo is taken with insufficient light and the photo is dark. It can be detected by CLR data.

Figure 4 shows the process of photo classification.

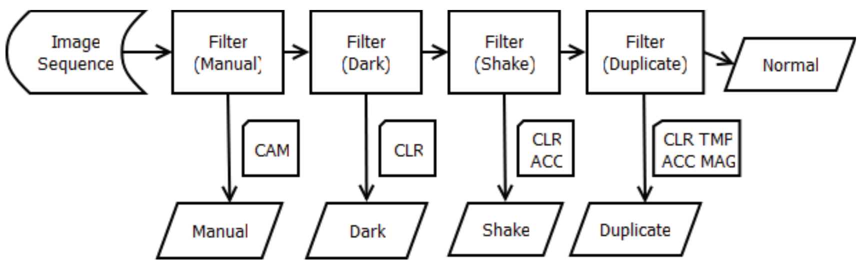

Figure 4. Process of Photo Classification

4. Implementation and Initial Evaluation

4.1 System Architecture

In this research, the SenseCam that we are using is produced by Vicon Revue [12]. When the SenseCam is connected to the computer, if the software Vicon Revue Desktop is already installed, all photos will be imported into computer. The location of SenseCam repository is in the user's document folder and the name is Vicon Revue Data.
This system is programmed using Java and runs in Tomcat as a B/S system. When using this system, Tomcat accesses the repository of SensorCam photos directly and shows them in web browser.

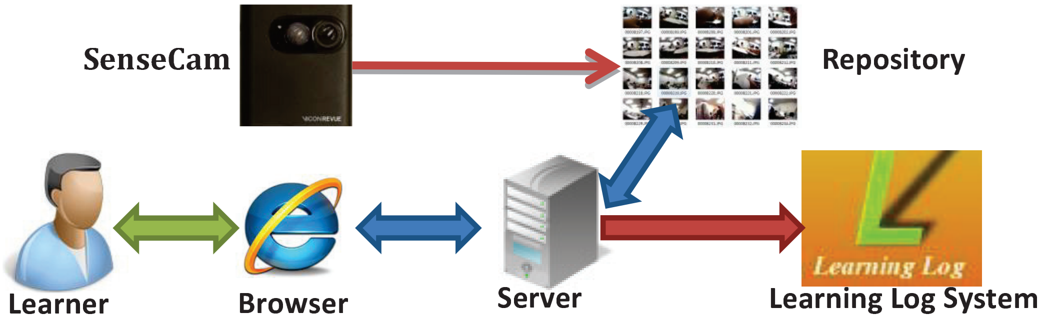

Figure 5. System Architecture

Figure 5 shows the system architecture. All the photos captured by SenseCam and sensor data are imported into repository. When a learner uses this system through browser, server accesses repository and analyzes the photos by sensor data, then returns the classified photos to learner. Then he selects proper photos and uploads them to learning log system through the server. We have a plan to use image processing technology to detect the photos which contains faces or texts.

4.2 User Interface

When the learner starts this system, s/he is required to enter the username and password as the same as SCROLL system. If this is the first time that learner logs in, system will ask learner input the location of sensor data path. This setting can be changed at any time by the setting page. The sensor data path must contain the sensor data file (data_v3.sql), and since the security issues, learner cannot choose the folder directly by file select dialog. For the Vicon Revue SenseCam, this folder is usually named "Vicon Revue Data" and located at user's documents folder. When the SenseCam connects to the computer, all the data will be import into this folder automatically.
After that, life-log picture folders will be shown to them including the name of the folder, picture number and last updated time. Each folder contains photos for a PACALL frame. Here, the name will be used to locate the folder directly in file explorer. Sometimes, if a SenseCam has no picture and is connected to a computer, a life-log picture folder will be also created with no data. Picture number makes it clear, and save the time when the learner selects life-log picture folder.
When the learner selects a new folder, the system will analyze the file SENSOR.CSV in this folder. Because in this file, the sensor data is record as event flow, we need to analyze it and get the sensor information of each picture. At the end of this process, the information of each picture will be saved into database and the life-log picture browser page will be shown (Figure 6 left). On the top of this page, classifications are shown like menus including ALL, MANUAL, NORMAL, DUPLICATE, SHAKE and DARK. The numbers of pictures in each classification are shown on the side of classification. There is also a function that let users change the lines of pictures per page. It is very useful when user wants to view all of the pictures or do not want to drag the scroll bar.

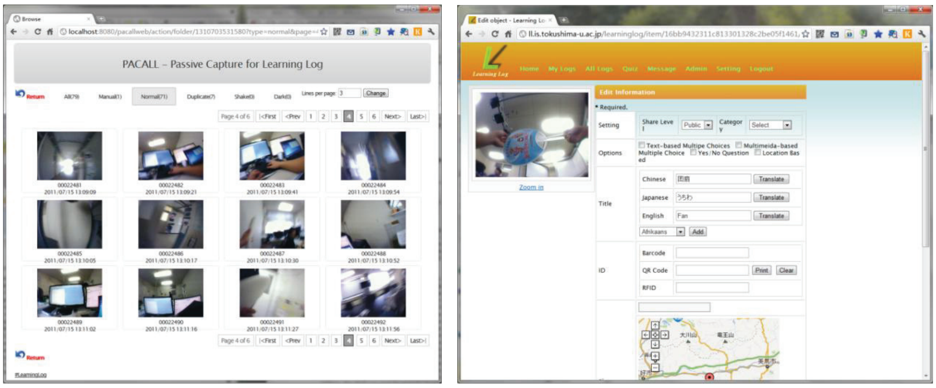

Figure 6. Interface

Once the learner clicks a picture, the system will show a page to view the large picture and help learner upload the picture to SCROLL. Currently, this page is very simple, and there are two buttons – “Upload it” and “Close” and one picture on it. However, in the future, we plan to expand this page and show the similar pictures from remote server on it.
If leaner decides to upload this picture to the server, s/he can click the “Upload it” button. Then the picture will be uploaded to the SCROLL system directly and the page will jump to the learning log registration page (Figure 6 right). On the learning log registration page, learner is required to input the title of the picture. The title is usually the name of the object in this picture. Location and other options are also supported on this page. When an object is registered to the system, SCROLL system will use “organize”, “recall” and “evaluate” model to help learner remember uploaded objects and vocabularies. For example, system will remind learner this vocabulary by quizzes.

4.3 Initial Evaluation

This is an initial evaluation experiment. We have conducted this experiment on computer and the target is to see the effect of analyzing sensor data.
Firstly, we use SenseCam to capture daily life. Then using PACALL to classify the photos and review the accuracy rate. This process has been conducted for three times. Table 2 shows the result of this experiment.

Table 2. Result of Evaluation Experiment

No.	**Capture time**	**Total number**	**Normal (correct/total)**	**Duplicate (correct/total)**	**Shake (correct/total)**	**Dark (correct/total)**
1	2.5h	683	544/579	1/1	26/28	41/73
2	4.8h	1089	377/434	383/383	8/16	166/253
3	24h	2467	46/86	1800/1800	0/5	568/568

No.1 was captured in a common daily life, and no.2 was captured in a conference, and the no.3 was captured when we left SenseCam on the table during 24hrs. From this table, we learned that duplicate has the highest accuracy rate. It means in duplicate tab, all of photos are duplicated. But the results of shake and dark were not sufficient enough. After analyzing data manually, we have noticed that value from color light sensor is not changed immediately upon the light change but photo is usually taken at that time.
On the whole, this system is helpful for reducing the workload enough and usable for reflection. In the future, we will also use image processing technology to improve this system.

5. Conclusion and Future Work

In this paper, we introduced a project named PACALL that supports passive capture for learning log using SenseCam. We have designed a model of learning process in passive capture mode including capture, reflect, store. The PACALL system has been also developed in order to support reflection and reduce the workload of reviewing photos. During this research, we found that the SenseCam that originally designed for memory aid can be also used to capture learning log for passive mode. However, it usually takes too many photos, and many of them are duplicated or dark. Therefore, we must introduce other technology to help learners find out important photos. Currently, we are using sensor data to help us do it. In the future, we also use images processing technology to detect the contents of photos. Besides, current algorithm and user interface also need improvement. In addition, we plan to conduct a full evaluation experiment and invite students to use this system in the near future.

Acknowledge

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Development of Personalized and Context-aware Model in Learning Log System

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Abstract: In this paper, we describe a personalization and context-awareness model based on learning log system. It is able to notify the learners of the location-based knowledge surrounding him in accordance with both their needs and context, detect learners' learning styles using their context history and recommend learning objects for them regarding their learning styles. What's more, by monitoring learners' reaction on the recommendation message, the model can improve its prediction. We also conduct a preliminary experiment to observe what kind of benefits it can bring to learners. The results reveal most of the learners benefit from the context-based notification and learning-style based recommendation.

Keywords: personalized learning, learning log, context-aware learning, language learning

Introduction

Since many years ago mobile technology has been believed holding out great promise for learning [1]. However, some of its limitations such as the small screen size, the high cost of 3G network and so on stopped the technology from growing as fast as we expect. Until the last few years, a real great revolution is occurring in the mobile device world with the release of the new generation smartphones represented by iPhone launched by Apple Inc. and the open sourced Mobile OS Android released by Google. Since the new generation smartphones accommodate users with many advanced functions such as the multi-touch interface, full browser, GPS, millions of applications and so on, the number of smartphones users is increasing very sharply recently. Another key feature of smartphones is that they are equipped with a range of sensors such as the accelerometer, ambient light sensor, GPS, microphone, camera, compass and so on. Several years ago, researchers forecasted that the mass of mobile smartphones equipped with sensors could be turned into a giant distributed sensing system, allowing users to benefit from information gathered via other phones and users [2].

Yet, in our research we intend to primarily investigate the capabilities of the sensors of smartphones in context-aware and personalized mobile learning. Precisely speaking, we propose a personalization and context-awareness model which can monitor and analyze learners' activities and context and recommend learning objects for learners taking into account both their learning needs and their context. Meanwhile, the model can track their contextual data as context history when they study and catch their personal learning styles through analyzing their context history. Finally, it will utilize their learning styles to support individual learners' learning. In this paper we will put our main emphasis on introducing the details of this model.

Furthermore, our research model is based on a system called learning log system which allows learners to log their learning experiences with photos, audios, videos, location, QR-code, RFID tag, and sensor data and so on, and share and reuse them with others [3].

The ambitious goals of this system are lying in helping users to easily record their learning experiences, reminding them to recall what they have learned based on the context, recommending others' learning experiences for them, finding out individuals' learning styles and supporting their learning in accordance with personal learning style. The model we propose is responsible for the latter four goals. In section 2, we will highlight the main functions of the system in detail.

The rest of the paper is constructed as follows. In section 2, we introduce the Learning Log system and a primary scenario of its use. In section 3, the personalized learning and context-aware model is presented in terms of its three dimensions. Besides, the workflow of the model is explained as well. Section 4 shows a preliminary experiment on the model and the future work derived from the participators' comments. At last, conclusions are given.

1. Learning Log system

With the evolution of the mobile devices, our lives are changing gradually. For example, usually we take memos or notes (such as schedules, planners or task lists) in our pocketbooks. But now more and more People prefer to record these messages with their cell phones. Obviously, it is a simpler way, since the information can be contained in much more ways like texts, photos, audios and videos. Many researches have focused on facilitating this kind of "informal note taking", such as [4], [5]. However, besides informal notes we also take formal notes. For example, most of the language learners have a vocabulary notebook as shown in Figure 1. We call these kinds of notes as formal notes. In this paper, formal note is defined as a recorded form of knowledge or learning experience acquired in our daily lives and this kind of notes serves as memory storage for notable or important knowledge to review, to remind and to reflect. Learning log system is a system proposed for supporting such formal notes taking and the "learning log" is defined as the electronic record of these notes organized in the form defined by the system.

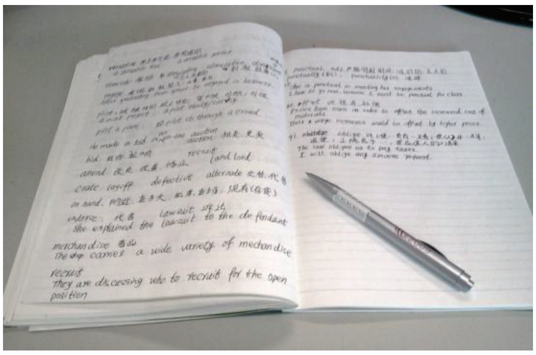


Figure 1: Language learning notes

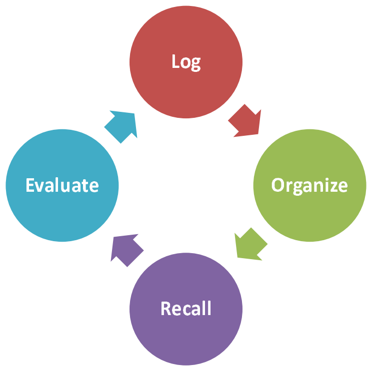


Figure 2: LORE model

Learning log system is constructed based on a LORE model which is shown in Figure 2. It aims to aid users to simply capture what they learn, review and reflect their past learning logs, reuse the knowledge when in need, be reminded at right time at right place and be recommended others' learning logs. It adopts an approach of user created content to share knowledge among users. The following parts list several basic functions of the system and describe a typical scenario of its use.

1.1 Log what we have learned

This function provides an easy way for the learners to upload their learning logs to the server whenever and wherever they learn. A well-organized form of learning logs is defined. It includes four basic elements to illustrate a learning log, which are the time when the learning occurred (when), the knowledge (what), the sequence recorded in texts, photos, audios or videos that the learning should comply (how), and the location where the learning occurred (where). Besides, the logs can be organized by tag and category. Figure 3(1) is the interface of adding a new learning log and Figure 3(2) is an example of learning log. One more property we need to explain is whether a learning log is location based or not. The purpose of this is to remind learners with the location context. This is because the place where we learned usually can remind us what we have learned there. For example, if we learned the Japanese names of vegetables in a supermarket, when we enter the supermarket next time some of what we have learned may come into our mind again.

1.2 Recall what we have learned

Learning log system is also designed to help learners remember what they have learned. Compared with only viewing what we have learned, being asked in quizzes is thought to have a greater impact on confirming whether learners have mastered the knowledge or not. For this reason, the system is proposed to provide users with quizzes after they learned something. Three types of quizzes can be generated automatically by the system, which are yes/no quiz, text multiple-choice quiz and image multiple-choice quiz. Figure 3(3) shows an image multiple-choice quiz generated based on the meta-data of learning logs.

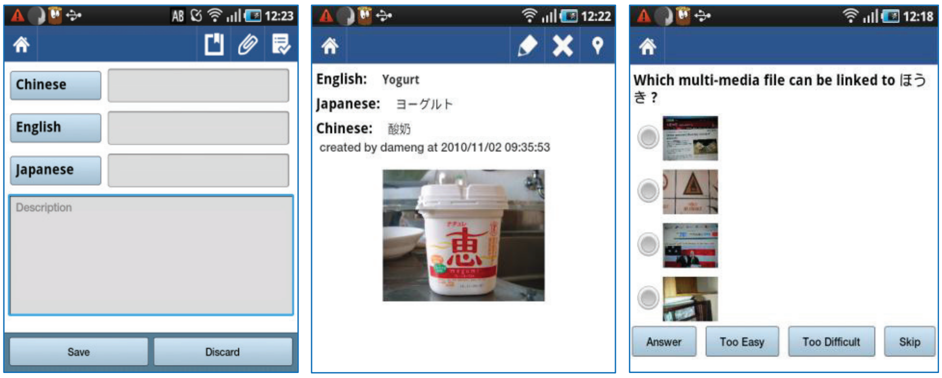
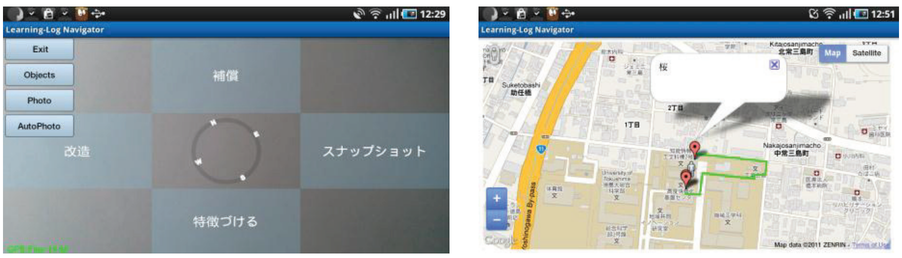


Figure 3: (1) Add ULLO (2) A learning log (3) Quiz



(4) Navigator (5) A path to learning logs

1.3 Location based knowledge awareness

Another function of Learning Log system is LL navigator. It is a function built on mobile augmented reality allowing the learner to navigate through the learning logs. It provides the learner with a live direct view of the physical real-world environment augmented by a real time contextual awareness of the surrounding objects. While a learner is moving with his mobile phone, the system sends an alert on the phone as soon as entering the region of learning logs according to the GPS data. This view is augmented, associated with a visual compass, and overlapped by the nearest objects in the four cardinal directions (Figure 3(4)). Also, it offers the learners a list of all surrounding objects. When the learner selects one or more of these objects, the Google map will be retrieved, and marked with the learner's current location and the selected objects. Moreover, the system shows a path (route) for the learner to reach to the objects locations (Figure 3(5)). This assists the learner to acquire the location-based knowledge around him/her and to recall his/her past learning logs.

1.4 The Scenario of Using Learning Log System

Up to now, the learning log system mainly focuses on language learning field. One typical scenario of its use is to assist foreign students learning Japanese in Japan. In this case, Japanese learners, who face rich learning contexts every day, can gain abundant of knowledge from their daily lives in different kinds of situations, such as shopping in the market, seeing doctor in the hospital, having a haircut in a barbershop, visiting the museum and so on. As mentioned, one objective of learning log system is to support learning in these contexts. Besides, lots of these learners have their personal learning styles, such as studying Japanese on the commuting train, or studying Japanese before they sleep. Learning log system is also responsible for aiding these kinds of learning styles. This paper is based on the case study under this scenario.

2. Personalization and Context-awareness model

As mentioned in the beginning of the paper, we propose a model for personalized and context-aware learning with two objectives:

(1) The system can be aware of learner's current context and after analyzing the context it can determine whether to notify him the location-based knowledge he have learned near his current location or the surrounding knowledge uploaded by others which may interest him.
(2) The system can catch individual learner's learning style by making use of the context data obtained when the learner studies. If a learner's learning style exists, the system can persuade him/her to study based on the learning style.

In a word, this model aims to help learners recall their past knowledge by quizzes at a proper time in a related context, recommend suitable knowledge for them based on their current context and their needs and prompt them to learn when the context is including their favorite learning styles. Furthermore, this model consists of three dimensions, which are learners' current context information, learners' preferred learning styles and the attributes of learning material. The followed sections we will introduce theses three dimensions respectively in detail and finally we will talk about the flow of this model.

2.1 Learners' context

A lot of study on context-aware computing can be found in the literature. Here we want to highlight some of them. For example, [6] has developed a location-aware system called commotion that link users' personal information to their locations in daily lives. [7] presents a system to deliver dynamical message to users according to their schedule, location and so on. [8] describes a similar system using the context information involving time, place and more sophisticated pieces of context. From the above projects, it is easy to find that lots of context-aware computing researches employ the location and time to sensor users' state but some other contextual information are rarely used and the context history which is also believed to be useful has not been fully utilized [9]. For these two reasons we proposed our model. We divide the context into three parts:

(1) Learner's activity: Learner's activity involves their motion (e.g. walking, running, travelling on the train or bus or keeping stationary) and what they do with the devices (e.g. listening to the music through earphone, surfing on the internet, and doing learning with the learning system and so on).
(2) The status of device: The status of device includes the battery, the Internet connection (3G, Wi-Fi or no connection), and the model of the ringtone (vibrate status or ringtone).
(3) The environment. The environment involves the location, time, temperature, weather and so on.

Based on the above information, we firstly analyze whether the context is appropriate to draw the users' attention. For example, whether the battery is enough, whether the Internet is connected, whether it is too late for the users and whether the user is moving in a high speed. If these conditions are satisfied, the system then will notify the users their surrounding knowledge and remind them their past knowledge if these learning objects are existed based on their location context. Finally, the system will check whether the notification is responded. If responded, the contextual information will be recorded as context history. Such kind of information will be reused for analyzing the learners' learning styles. We will introduce this part in the next section.

2.2 Learners' Personal Learning Styles and Preferences

What are the learning styles? Harold Pashler defines this term as that individuals differ in regard to what mode of instruction or study is most effective for them [10]. A variety of learning styles have been supported by many systems. For example, [11] developed an English learning recommender system capable of proving ESL students with reading lessons that suit their different interests to increase their motivation. [12] presents a personalized mobile English vocabulary learning system, which recommends appropriate English vocabulary for learners according to individual learner vocabulary ability and memory cycle. In our model, these personal attributes are also included, such as learners' memory cycle, learners' ability and learners' interests and so on. For instance, the respective learner's ability and interests can be retrieved based on the content analyzing method. In other words, the system monitors each learner's action such as what kind of knowledge s/he recorded recently, what kind of other learners' knowledge s/he looked through, what kind of quizzes s/he corrected or mistook and so on. By analyzing these data, learner's learning preferences including his/her capability and learning interests can be achieved.

However, besides these kinds of learning styles that is usually supported by many systems, we think some more personal learning styles that can only be detected by mobile learning and ubiquitous learning should be supported. These learning styles involve where a learner usually studies (such as home, school or fast-food restaurants), whether a learner has a habit of studying on the commuting train and when a learner prefers to study (e.g. after waking up in the morning or before sleeping at night) and so on. In our opinion, these kinds of learning styles play a very important role on our learning because usually they are related to learners' daily customs and habits. What's more important, these learning styles can be easily obtained by analyzing the context histories, which are thought to be important but rarely be used [9]. For example, the system can make use of the contextual data including the speed and the time to detect whether a learner commutes by train or bus and whether s/he would like to study when commuting. Besides, the system can also find the learners' preferred studying places and time phases by analyzing the GPS information and the time of studying. After achieved the learners' learning styles, the system can recommend the messages to the learners when they entered those environments and by checking the learners' response rate the system can also modify its prediction.

2.3 Learning Contents

In this study, learning contents are referred to the learning logs stored in the system. For one learner, the learning objects can be separated into three types: his/her own learning logs, the ones that s/he has looked through and the ones recommended by the system. Regarding the former two types, systems will provide quizzes for learners to recall them. But for the last type, the system should tailor the contents to suit individual learners' needs according to the difficulty of them. We use a dynamical way to adjust a learner's ability level and the difficulty level of the learning materials which refers from the [13]. Both learners' ability level and the difficulty level of the quizzes are affected by the correct rate. As the multiple-choice quizzes are generated from the learning logs the learners have learned, the selected wrong choices are also calculated. The system manages to match the difficulty level of the learning contents with the learners' ability level.

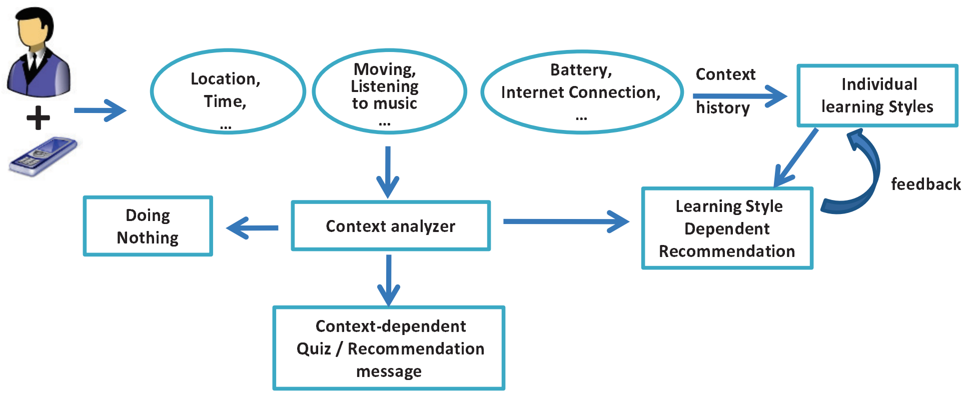


Figure 4: The workflow of the personalization and context-awareness model

2.4 The Workflow of the Model

Figure 4 demonstrates the whole processing flow of the personalization and context-awareness model. It follows the below steps:

(1) The model collects a learner's context information from three parts: his/her activity, the status of device and the environment.

(2) The model analyzes the context and check status of the device: for example, how much battery is left and whether the internet is connected. If the availability is low, the system will do nothing.

(3) If the device has a high availability, the system will check whether there is location-based knowledge surrounding the learner. If existing, the system will provide location-dependent quizzes or recommendation messages for him/her.

(4) If there is no location-based knowledge for the learner, the model will examine if the learner is in his/her preferred learning context. If so, the model will show messages to persuade him/her to study.

(5) All the data of the context is remained as context history to approach individual learner' learning styles. Finally the learner's response to the learning style based recommendation is used to improve the learning style detecting method.

3. Evaluation and Future Works

In order to evaluate our model, we conducted a preliminary experiment. Through this experiment, firstly we intend to investigate whether the learners can retain what they have learned by linking the context to their past learning logs and whether others' learning logs are meaningful for them by notifying them the context-based learning logs. Secondly, we hope to make it clear whether the system can find out each learner's individual learning styles and support them well. Finally, we are eager to know what kinds of other benefits the model can bring for learners and what kinds of improvement are demanded.

In this experiment, we organized ten foreign students to use the learning log system for two weeks. The participators are from China (3), Taiwan (1) and Korea (6). The device adopted is Galaxy Tab SC-01C produced by Samsung. Before the experiment started, they were given one week to get used to the smartphones and the system. Then, they spent two weeks to use the system and after that we interviewed them one by one. We expect to acquire the results from the interviews and the statistical analysis on the learners' data of using the system. Here we pick up the typical messages including the positive and the negative:

- When I am free at home, sometimes I receive recommendations of reviewing what I have learned. It is very suitable and helpful.
- It is very useful to use it on bus.
- It was suitable to be recommended in the past. But I suggest you to consider more parameters, because it is not easy to catch the real context with few aspects.
- It is not good enough, since sometimes I am alarmed when I am very busy.
- Because the Galaxy Tab is a little big, I seldom take it out. So it is meaningless for me.
- It is not so useful the People who do not usually take the devices out.

Besides the messages, they also evaluated the learning-style based recommendation function and the score is 3.8 (A five-point Likert-scale is used, the responses to which were coded as 1 = strongly disagree through to 5 = strongly agree.). From the messages and the score, we can infer that most of the learners who have personal learning styles can benefit from the recommendation messages from the system and while part of them have a low opinion of the function, for the judgment of the system on the learners' context is not appropriate. This is a problem to solve in the future. As for the context-based notification function, the result can be gained from the users' reaction on the recommendation messages. During the two weeks, the system sent 7 pieces of messages for the learners and 4 of them have been responded. The high response rate surpassing 57% is very encouraging. Through the interview, we also received a lot of advices on the functions they demand and we list all of them:

- It will be very helpful if I can get support from the system when I go to hospital, supermarket, and barbershop and so on. Moreover, we need not only the words, but also some daily sentences.
- I need Japanese support when I have lunch in the restaurant or go shopping.
- For example, when I see something such as exercise machines and computer, the function that teaches me how to use them is very useful for me.

These comments reveal that these learners are eager to get help instantly in lots of situations of their daily lives. It points out one of our future work on the context-based recommendation that the model can recommend the learning objects based on a similar context. For example, if one learner learned how to express headache in a hospital, when he go to another one the system can also send him/her a message to review the way of speaking headache. Another function posed by the learner is to help them a real work in daily life such as to demonstrate how to change a toner cartridge for a printer. This is another issue we will explore soon.

4. Conclusion

In this paper, we introduced a personalization and context-awareness model on the basis of learning log system. This model aims to assist learners to review what they have learned and recommend others' learning experience for them by utilizing the context. Also, it can detect learners' learning styles by analyzing their context history and prompt them to review past knowledge according to their learning styles. Finally, the attributes of the learning objects are also considered in the model. We conduct a preliminary experiment to examine our model and the results illustrate learners can benefit rom our model well both from the context-based notification and the learning-style based recommendation.

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Supporting English Course with Mobile Devices: How Can We Learn Vocabulary Seamlessly?

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Abstract: We proposed SMALL system as a blue print seeking for seamless language learning in our previous study. In this paper, we describe how far we have developed the system for the realization of intertwining in-class formal learning with outside-class self-learning. As our first step, the target has been English vocabulary learning, since vocabulary learning is one of the fundamental aspects of language learning. We also aim to create a knowledge-aware virtual learning community to promote P2P interaction in our seamless learning environment.

Keywords: Mobile Assisted Language Learning (MALL), Seamless Learning, Vocabulary Learning, Learning Log, EFL, TESOL

Introduction

English has been a dominant language in the world [1]. Therefore EFL (English as a Foreign Language) education is pivotal for non-English speaking countries including Japan. However, Japan is facing a serious problem in terms of English proficiency. "… it is rare to find a Japanese student who, after six years of English, is able to engage in even a marginal dialogue with a speaker of English" [2]. Japan ranked 3rd worst out of 30 Asian countries in TOEFL test (Test of English as a Foreign Language) [3]. One of the factors which have caused this disappointing situation is lack of learning time of English at school [4]. If time to study in class is limited, there is no other way but to learn outside class. Here our basic issue is to establish an effective method to carry out outside-class learning as well as to entwine in-class learning with outside-class learning. Along with the shortage problem, it has been long pointed out that Japanese EFL learners are in lack of vocabulary. Since it is an essential component in language as is often cited, "Without grammar, very little can be conveyed. Without vocabulary, nothing can be conveyed" [5], it is pivotal to build up vocabulary to improve one's language skill. Besides, vocabulary learning is often considered boring [6]. One solution of these problems may lie in mobile assisted language learning, which has been gaining global attention in recent years. Since mobile phones are most popularly used in Japan, the idea is realistic. So our aim is to provide EFL learners with a seamless vocabulary learning support system, namely SMALL system.

1. Theoretical Background

1.1 Seamless Learning

Recent progress of mobile and wireless technologies offers us a new learning environment, namely "seamless learning". "Seamless learning" is used to describe the situations where students can learn whenever they want to in a variety of scenarios and that they can switch from one scenario to another easily and quickly using one device or more per student ("one-to-one") as a mediator [7]. In this paper, however, by seamless learning, we mean learning which occurs with smooth and seamless transitions between in-class and out-class learning as "American College Personnel Association (1994) stresses the importance of linking students' in-class and out-of-class experiences to create seamless learning and academic success." [8]. Seamless learning can be depicted in a two-dimensional way 1) in-class and out-class learning and 2) planned and unplanned learning. Thus there are four types of learning accordingly: in-class planned learning, in-class unplanned learning, out-class planned learning and out-class unplanned learning [9]. And if the technology could help these four types of learning interact with one another and help them to be incorporated into one continuous learning beyond time and space, learning could be very successful.

In addition, we need to consider that we usually have only one instructor per class, small or large. What the teacher can do through these four types of learning is limited. So peer-to-peer (P2P) collaboration is necessary for successful seamless learning. How we can adopt P2P collaboration effectively in a seamless learning is another key issue. We aim to create a knowledge-aware virtual learning community to promote P2P interaction in our seamless learning environment.

1.2 Mobile Assisted Vocabulary Learning

Vocabulary is one of the most important components of a language. But living in Japan, students rarely have exposure to English outside the classroom. Since incidental learning is not highly expected, they should be encouraged to learn vocabulary outside-classroom on an autonomous basis. Then here come the questions: What is effective vocabulary learning? How should learners learn vocabulary? Unfortunately, researches on vocabulary learning strategies are in a lack of theoretical underpinning up to now [10]. However, along with recent development of studies on technology enhanced learning, there have been considerable studies on mobile assisted vocabulary learning such as *Vocab Tutor* [11], *Moodle for Mobile* [12], *m-iLexicon* [13] including commercial products such as *Eigo Duke* (*English Training: Have Fun Improving Your Skills!*) [14]. However, most of these vocabulary learning systems are ready-made closed vocabulary learning systems which often specialize the textbook vocabulary or chosen vocabulary of say, basic 3000 word-level. Learners cannot customize their own want-to-learn vocabulary. Besides, many of them are aiming for self-vocabulary learning, outside the classroom. There are few which challenged to entwine in-class planned vocabulary learning with out-class open vocabulary learning. Therefore our main purpose is to develop the system which links what students have learned outside-class with what they have learned inside-class, and also with what other students have learned.

1.3 Importance of Link

Why is it important to link? We learn words from the context [15]. The whole (contexts) precedes the part (words) in language acquisition [16]. Therefore we need the contexts where the words are used in order to learn vocabulary. For instance, for many Japanese learners of English, it is difficult to grasp the meaning of 'subject to' unless they encounter this phrase repeatedly in different contexts as below:

- All visitors and packages are subject to electronic scan.
- This Agreement shall be subject to the laws of Japan.
- The terms of your account are subject to change

Therefore by linking the one context to another, the system let them learn how the words are used in different contexts. It is reported that frequency of occurrence encourages incidental vocabulary learning and that reappearance of a word reinforces the form-meaning connection in the learner's mental lexicon [17]. These facts endorse the importance of linking.

2. System Design

2.1 SMALL System

Based upon the above ideas, we designed the following Seamless Mobile-Assisted Language Learning Support System (hereafter we call it SMALL System) (Figure 1) in our previous study [18].

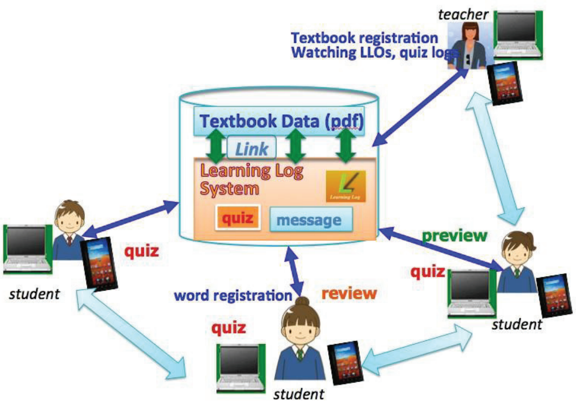

Figure 1. SMALL System (Seamless Mobile-Assisted Language Learning Support System : http://ll.is.tokushima-u.ac.jp/ecourse/)

2.1.1 Textbook Data

Texbook Data in Figure 1 consists of the whole units of the textbook to be learned through one semester. This system is available for any textbooks if they have Pdf versions. Instructors upload Pdf file textbook data to the system (Figure 2). They can add and delete files anytime.

Figure 2. Textbook data uploading interface

2.1.2 Learning Log System

Learning Log System, SCROLL is a system developed by our team. Users register what they have learned, which we call "learning log objects (LLO)" to the system and view LLOs uploaded by themselves and others, then it supports recalling of their learning logs by giving them quizzes [19].

2.1.3 Quiz

Students register textbook target words and their newly acquired words during their self-learning and the system gives them quizzes. It generates quizzes automatically based on the LLOs registered and viewed by the students. The aim of the quiz is to help the students retain their vocabulary. Quizzes will be generated until they give them correct answers. And after a certain interval, the system gives them quizzes which they have answered correctly to make sure if they are retaining their acquired vocabulary. That way it is expected that their short-term memory will be reinforced into long-term memory. Logs of all the quizzes done by the students are stored to be analyzed and evaluated. Wrong answer rates reflect the quiz generation and if the users click "too easy" or "too difficult", it also reflects quiz generation and difficulty level adjustment is made so that it facilitates their learning processes.

2.1.4 Message

Users are able to send massages to other users in this system. In "All Logs" page, it shows the names of the users who registered the objects. When a viewer clicks the nickname, new window will be popped up and can send a message to him. This function will promote the students' interaction or discussion and will lead to collaborative learning which will be inevitable where the teacher in not there outside-class self-learning.

2.2 The scenario

The scenario using this system is as follows.

2.2.1 Preview (mobile-based out-class planned/unplanned learning)

Students resiger textbook target words instructed by the teacher and read the text for preview and take target word quizzes. They answer multiple-choice quizzes. Quizzes will be generated until they make correct answers. They can read texts and answer quizzes at any time and at any location using mobile devices.

2.2.2 Lessons (PC-based in-class planned/unplanned learning)

In the electronic textbook, student registered words are hyperlinked and when the teacher clicks them, a side bar will appear and it shows the names of the students who registered them so that the teacher will be able to know how many students and who have learned them. (Figure 3).

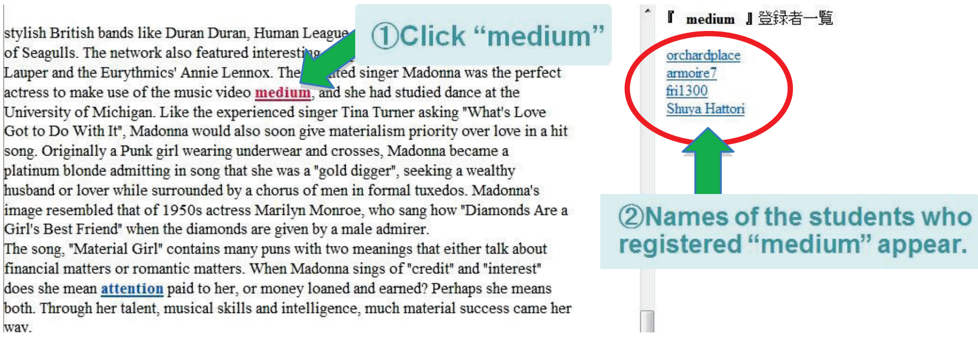

Figure 3. textbook interface

2.2.3 Review (mobile-based out-class planned/unplanned learning)

Students read the text for review and take target word quizzes. The quiz logs show the results with most frequently mistaken words and the teacher will review these words in the next class. So the learning occurs continuously.

2.2.4 Expanded Self-learning (mobile-based out-class unplanned learning):How can we entwine formal learning with informal learning?

Students are assigned to do self-learning and register new words to the system. Each student is supposed to present in-class in turn what he/she has learned through his/her out-class self-learning so that the teacher can incorporate students' unplanned self-learning into classroom activities. They are encouraged to collaborate with other students who have the same interests.

This system aims to entwine outside-class learning with in-class learning. It also entwines a students's self-learning with that of another. Figure 4 shows how in-class vocabulary learning and out-class vocabulary learning are linked. When a student, Yusuke, registers new word, "including", which he already learned in the textbook, then the system shows him the textbook context where it appears. This linking function is pivotal for two reasons. For one reason, students need to encounter as many contexts as possible to learn words. For another, generally people are likely to forget what they have learned. Therefore even though he felt " including" was totally new to him, the system let him know that he has learned it before in the textbook. If Yusuke and registered the same word, "inspire" that Miwa has already registered, then it shows Yusuke that Miwa did it too, which is expected to lead some interaction between them. It is also expected to add some fun factor in vocabulary learning to know that another classmate is learning the same word.

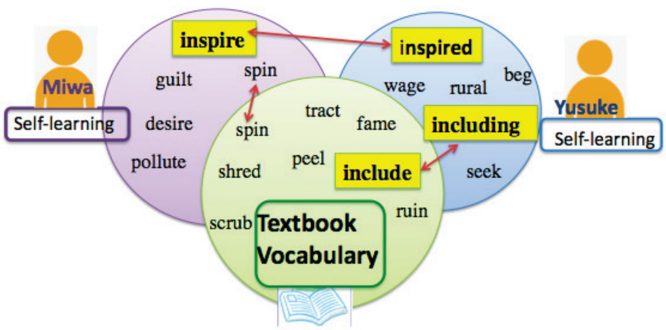

Figure 4. Link between in-class learning and outside learning

In order to motivate them to learn more, the System shows each student his degree of advancement by counting his correct answers out of total number of target words.
With the help from the system, students can be aware of what they have learned before, and what other students are learning, and the teacher can grasp what the students are learning outside-class and incorporate students' unplanned self-learning into classroom activities so that close link between in-class and out-class learning will be realized.
Generally, English education at the university level is arbitrary and leaves to the discretion of the instructors. Therefore it is easy to run the class described above. But Japanese secondary education is subject to the guidelines issued by the Ministry of Education, Culture, Sports, Science and Technology. Therefore in order to introduce students' out-class learning into 7^{th}-12^{th} class, we need a fundamental reform of the curriculum. A high-level discussion on this issue in the Ministry is strongly desired.
In order to measure how out-class vocabulary learning is linked with in-class one, we propose *link rate* which should be caliculated as follows:

$$\text{link rate} = \frac{\text{n. of registered words}}{\text{n. of words in one chapter} - (\text{n. of words learned during } 7^{th} \text{ grade} + \alpha)}$$

This equation shows the rate of overlapped vocabulary learned in- and out-class learning. The average number of words in one chapter of the textbook was 913 words. The number of words learned during 7th grade was 398 words. The 7th grade is the first year of learning English. So they are very easy, fundamental words. We excluded these words plus a few more words because collage undergraduates were most unlikely to register such words to the system. "A few more words" described as 'α' in the above equation was judged by an experienced English teacher. This notion is still in progress and we are far from being sure whether this rate shows the effectiveness rate of vocabulary learning. Further exploration would be necessary.

3. Method

Upon the completion of the system, the following experiment will be conducted.

3.1 Experiment

Forty university students will be divided into two groups with the equal English proficiency according to the pre-test result. The test consists of target words to be learned in the textbook. Each group will be engaged in learning vocabulary, where Group A will use SMALL System, while Group B will learn vocabulary with Mircosoft Excel files to make their own vocabulary lists using home PCs and classroom PCs. Evaluation will be carried out over a period of six weeks. At the end of the phase, the subjects will undergo two kinds of post-tests: the same vocabulary test as the pre-test (Post-test 1) and a vocabulary test containing self-learned words gained through unplanned learning (Post-test 2). As for Group A, Post-test 2 will be created by the System which identifies what they have learned through self-learning. As for Group B, it will be created based on each student's word list by Excel files. Both post-tests will be designed to translate the target words into Japanese. The students will also be given questionnaires. Further data will be collected from the subjects of Group A by means of the log data contained in the server.

3.2 Pilot

Before the actual classroom use, 6 university graduate students and 1 undergraduate were asked to give a trial use of the system to see if any serious problem exists to carry out the above mentioned experiment. The subjects were asked to register 5 recommended words with their contexts, to click the words they registered in the textbook pages to learn other contexts and to send messages to other users. In the end of the experiment, they were surveyed by the questionnaire. Table 1 shows the result of the questionnaire.

Table 1 Questionnaire Results (five-point-scale)

Questions	M	SD
Did you like it when the system let you know that you can find your self acquired vocabulary in the textbook?	4.57	0.49
Did you like it when the system let you know that your self-acquired vocabulary is also registered by other users?	4	1.07
Was it useful for your vocabulary learning to read textbook contexts where your registered words appeared?	4.57	0.49
Was it useful for your vocabulary learning to read other contexts of your self-acquired words which were registered by other users?	4.43	0.73
Was the message system useful for collaborative work?	3.71	1.16

Open Comments

- It would be better if I can see the meaning and contexts of the word registered by others at the same time (by one click).
- The letter size and space between lines of the textbook were small. it would be more convenient if I could see the meaning of the words not by clicking but by just positioning the cursor.
- Color coding of the words in the textbook was helpful for me to know if those are my registered words or those by others. Linking my newly registered words with textbook page would be more convenient.
- The textbook interface and layout were not user-friendly. I wanted to see the illustrations in the web textbook just like its paper textbook version.
- I could not check if I could send the message successfully.
- If I clicked the words in the textbook, it showed the names of the learners who registered the word, but I'd like to know the contexts rather than the authors.
- Word registration in this system helped me retaining the word in my memory.

Unfortunately there was no time to do some collaboration in this pilot. In order to let them do some collaborative work, longer-term experiment is necessary. We are planning to conduct a long-term experiment during the second semester 2011.

4. Early Insight and Future Works

Upon the above questionnaire results, we have found that we need to improve textbook interface and linking function of registered words and textbook contexts. We have not acquired any data on the classroom use, but possible advantages of the System that we expect are: 1) In-class and out-class vocabulary learning are closely linked so that what they learn in-class will be reinforced in out-class learning and vice versa. 2) Since we learn words from contexts, its linking function can lead to effective vocabulary learning. 3) It encourages out-class self-learning, which is expected to compensate the lack of learning time in class. 4) Linking between the students who registered the same word or who read the

same contents could trigger peer-to-peer interactive learning, which is expected to add some fun factor to vocabulary learning which is reported to be monotonous. The disadvantage of this system is that it may be unfair for the students who do not own smart phones unless the project team could provide them.
As our further future work, improvement of the system's capability of identifying related words or derived lexical items will be needed so that when the students register related words, it will be able to successfully make links. That way one's unplanned self-learning will be entwined with that of other students more deeply.

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Utilizing the HTML5 to Build a Classroom Response System

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Abstract: Until recently, there have been many studies which confirmed the effectiveness of the Classroom Response System (CRS). However, many of the existing CRSs use multiple-choice questions. In this paper, utilizing HTML5 technologies, we proposed a short answer collaborative learning CRS, called CLARES, to support group discussion. By the manner which the teacher determines right and wrong answers on-site, we propose that utilization of the CLARES may raise students to a sense of excitement and encourage a sense of expectancy and raise motivation.

Keywords: Collaborative learning, Group discussion, Classroom Response System, Smart phone

Introduction

A Classroom Response System (CRS) is also known by other names such as a Personal Response System, Audience Response System, and Student Response System. The CRS is a system where learners can answer the teacher's questions immediately with mobile devices, and the system will then display the statistics result. According to this result, the teacher can grasp the level of understanding of each learner on the course content. The system turns every learner into an active learner. For instance, 'ClassTalk' [http://www.bedu.com] is a classroom response system that shows teachers the statistics of learners' answers in the classroom immediately [1]. By using the CRS, the students who usually tend to silence in the classroom can participate actively in class. The CRS has the following advantages:

- It allows students to submit their answers immediately.
- It collects the students' answer results, and produces statistical results showing how many students chose each of the answer choices.
- It is easy to participate in class even if he is a shy student.
- Teachers can check on students' understanding on site.
- Most of the traditional classes are conducted in a one-way teaching mode that is from teacher to students. CRS changes the one-way mode to a two way mode.

Moreover, with the development of the web technologies, such as HTML5, we can only use the Java Script and HTML to develop the application, which can be run on the web browser. Many web browsers, which were published after 2008, support the corresponding HTML5 function[1]. HTML5 is the latest technology in internet to look forward to. HTML5 supports animation, local storage and canvas technology which would make the web faster and

[1] http://ja.wikipedia.org/wiki/HTML5

elegant. Utilizing of HTML5, many developers have already started developing HTML5 applications.
In this paper, utilizing the HTML5 technologies, we proposed a short answer question based classroom response system, which called CLARES, to support group discussion and collaborative learning. Students can access CLARES not only from their PC (personal computer), but also from their notebook, PDA or smart phone. In CLARES, we used HTML5 technologies such as building tables dynamically, changing fonts or images dynamically and controlling mouse action. This system is not only support 1 to 1 (One computer to one person), but also support “one to many” (one computer and a group of students).

1. Related Works

Until now, we have developed some teaching assistant systems such as Quiz [2] and Web Drill [3]. Quiz is an iPhone based quiz system to help students to understand the linguistic culture in a mobile-learning environment; Web Drill is a web-based system to support building and managing teaching materials. As a teaching assistant system, CRS is a kind of major research topics, which has been conducting various studies. In this section, we did a survey of two systems (BeeDance and Clicker) and do a comparison among BeeDance, Clicker and CLARES.

1.1 BeeDance

BeeDance is a iPhone/iPod touchs based CRS system which was developed by CSK Corporation company[2], Japan. It is a two-way communication system to faculty the interaction between the teacher and students. BeeDance is a famous system in Japan, however, some problems are as follows:
a) BeeDance can be used only on iPhone/ iPod touch, however there are not many students have iPhone/ iPod touchs. Some schools provide students iPhone/iPod touchs during class., however, they have to lend iPhones to the students before the class, and maintain and recover iPhones after the class. It becomes a burner for teachers to lend and maintenance equipment such as charging the battery.
b) BeeDance not only supports the multiple-choice questions, but also supports short answer questions. However, it is not easy to input words by the keyboard of the Smartphone, so BeeDance is not suitable for short answer questions.
c) In order to avoid students to remember the number of the correct answer, it is better to randomly each time. BeeDance does not support to arrange answer alternatives, so the teacher has to take care about this problem when s/he creates questions.
d) Using BeeDance, the client software running on iPhone/iPod touchs can be downloaded freely, however, we have to pay for the software of server.
e) Sometime the teacher wants to pose questions on site. However, using BeeDance, the teacher has to prepare questions in advance.

1.2 Clicker

Clickers are broadly used on college campuses to record student responses to questions posed during a lecture in the world. The teacher uses a computer and a video projector to project a presentation for the students to see. The presentation slides built with the audience

[2] http://csklc.jp/product/bee.html

response software display questions with several possible options, more commonly referred to as multiple choice questions. The student participates by selecting the answer they believe to be correct and pushing the corresponding key on their individual wireless hand-held devices. The hand-held remote control that students use to convey their responses to questions is often called a "clicker."

After reviewing the literature, Caldwell (2007) reports "Most reviews agree that 'ample converging evidence' suggests that clickers generally cause improved student outcomes such as improved exam score or passing rates, student comprehension, and learning and that students like clickers [4]."

However, the Clicker has the following problems.

a) It needs specialized mobile equipment, "clicker".
b) We have to pay for the system as well as the remote control.
c) Using "Clicker", the teacher has to prepare questions in advance.

2. CLARES

As shown on table 1, the characters of CLARES are as follows:

a) There is no device limit. CLARES can run on PC or smart phones. As long as there is Internet, you can use CLARES anytime.
b) CLARES does not support individual learning, it supports a group of students to discuss the answer, and then submit their discussion results to the system.
c) CLARES is short answer questions system, we consider that it is effective to make students to think about the questions and give out a short answer.
d) We will public CLARES as free software.
e) Using CLARES, teacher can pose oral questions on site, so it needs not to prepare questions in advance.

Table1. Comparison

	BeeDance	**Clicker**	**CLARES**
Devices	iPhone/iPod touchs	Specialized device	No limit: PC/iPad/SmartPhone
User	Individual	Individual	Group(Collaborative learning)
Question format	1.Multiple-choice 2.Short answer	Multiple-choice	Short answer
Fees	Have to pay for server license	Have to pay	Free
Creating Questions	Have to prepare questions in advance	Have to prepare questions in advance	Support posing question on site

Moreover, the correctness is determined automatically in BeeDance and Clicker. As the results are shown immediately, it couldn't help feeling a sense of excitement, and the knowledge isn't left in the impression. In contrast, the correctness is not determined by system in CLARES, it will be determined by teacher himself/herself. After all the answer results of each group were projected on the screen, teacher can determine the correctness on site, in the same time, the teacher can comment on each group's answer, add to explanations to the answers if necessary. By the manner which the teacher determines right and wrong answers on-site, students can think and reflect during the teacher explained, the CLARES may make students to feel a sense of excitement and encourage a sense of expectancy and raise motivation. In addition, CLARES allows students to think again before the correct answer is displayed.

2.1 Check the Adequacy of the questions

If you use this system in the foreign language classes, the system can check the adequacy of questions. That is, the system can check whether the question suit the students' current level.

2.1.1 Determine the adequacy of the questions
In this system, we use a simple way to determine the suitability of the question.

1) Checking the words which are not yet learned
The system will check the question whether it contain the words are not yet learned. The words, student learned in every class, will be stored in to database. By matching the question content with the database, the system can check the suitability of the question. Some language such as German and French are inflected languages. By storing the basic type of the words, the system will determine the inflection automatically.

2) Checking for duplication
The system can check the duplication of question. In order to check the duplication, the system will search and match by the words of the question title and content from database. If there are questions which is matching over 80% , the question will be presented to teacher, and the teacher will determine whether it is a duplicate or not.

2.1.2 Inappropriate questions
If all the groups are incorrect, we can consider that the question is too difficult and not suitable for the students. If it is not a suitable question, the system will set an unsuitable flag for the question. After the lesson, the system will collect the questions with flag for teacher to urge reconsideration. The reconsideration question will be stored to database to reuse.

3. Implementation

3.1 Architecture of system.
This system can be accessed not only from PCs, but also from mobile devices such as a Smartphone, iPod touch. We used wireless LAN (IEEE 802.11b), Tomcat 5.0 as the server on the CentOS5.0. Database schema is designed and implemented using PostgreSQL. Utilizing the Struts framework, the system was developed as a web-based application with JAVA. The Struts framework is a web-based application framework which facilitates rapid application development, and it adopts MVC (Model-View-Controller) design pattern as it naturally fits into the web architecture. Figure 1 is the architecture of the system, there are 2 parts of CLARES:

1. Web Browser.
Teachers, students use a web browser to send request (HTTP) to the web server through PC or mobile devices such as Smartphone, PDA, iPad, iPhone and iPod touch. The answer results can be projected on screen through projector.

2. Web Server.
There are 3 parts of Web Server: teacher component, student component and manager component.
a) Teacher component.
After login with an ID and password, the teacher can:

1) prepare questions in advance,
2) give out question on site,
3) determine correctness of answers,
4) commend on the answers.
5) make answer results project on screen
6) make the aggregate results project on screen

b) Student component.
The student can:
1) discuss and answer questions,
2) upload the group's answer

c) Manager component .

The manager component does the following things:
1) set the access authority
2) store data
3) calculate aggregate results
4) manage groups
5) check the adequacy of the questions
6) accumulate answer result

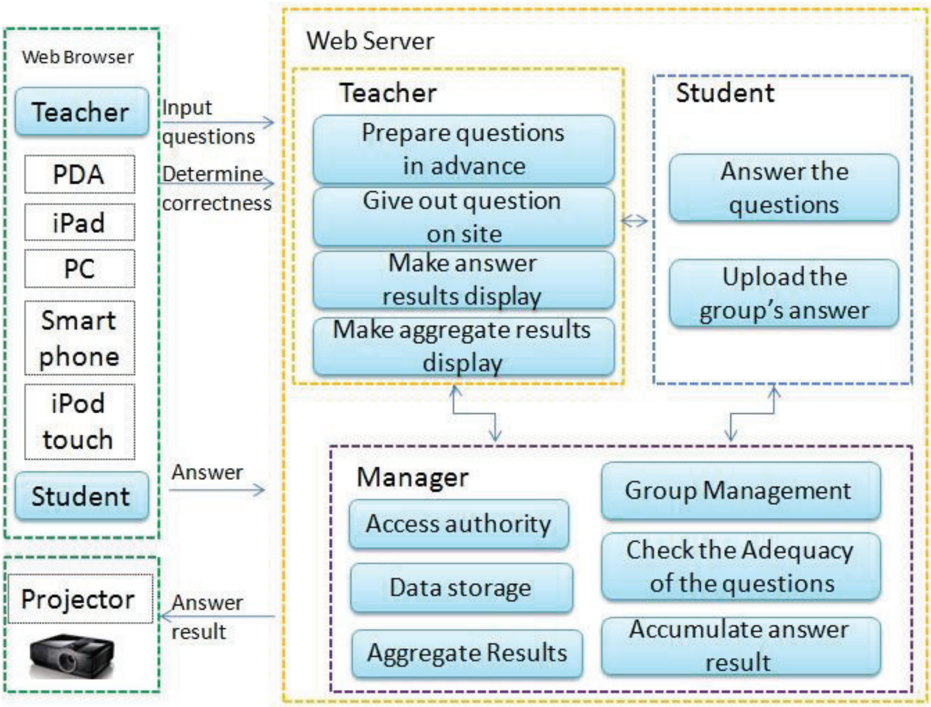


Figure 1. System architecture

3.2 Interface

3.2.1 Login interface.
The group user must register an account to use the system by "Register new account" interface. After login with the registered user account, the interfaces will be displayed according to the authority. There are three kinds of authority: "teacher", "manager", and

"group". The default authority is "group" and we can change the authority by "authorities' manager" interface.

3.2.2 Teacher interface.

Teacher can set the group number by selecting the number of "Columns" and "Rows". As shown on the figure 2, it is a sample of 4 groups. By selecting the pull-down menu of "Columns" and "Rows" and clicking "Setting Matrix" button, the interface is split in to 4 groups A, B,C and D. The group name are displayed in the top left of each group area. The answer of each group will be shown on their group areas.

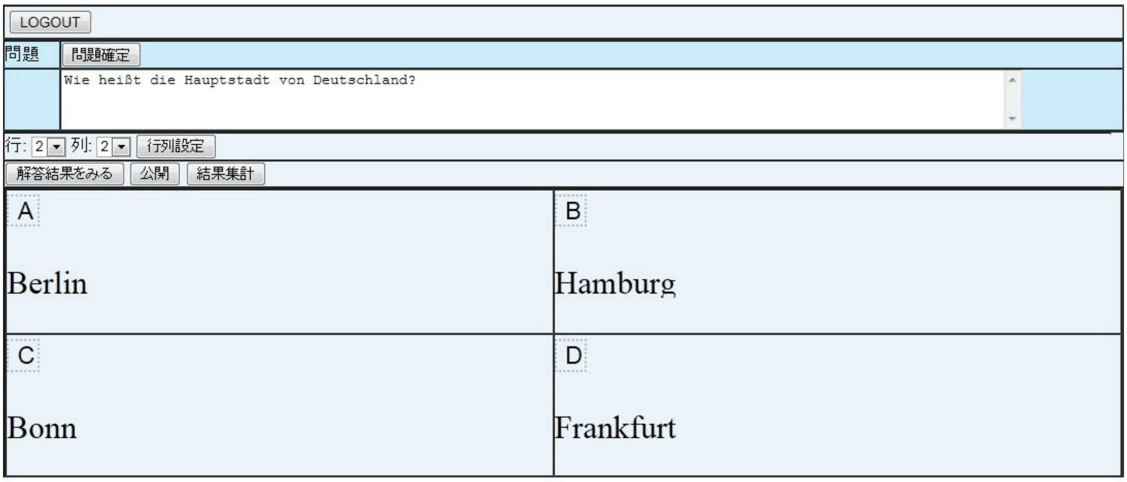


Figure 2. Teacher interface

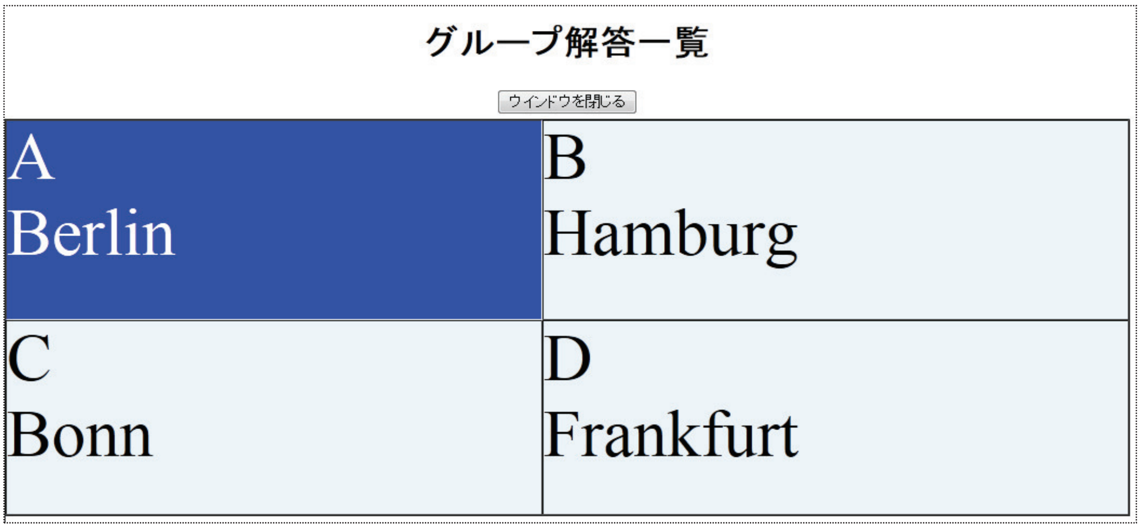


Figure 3. The interface, which is projected on screen.

After all groups submitted their answers, teacher click the "Open" button, and then Figure 3 will be shown on the screen of projector, which teacher can use it to determine the correctness of each group. As this is a short answer based system, the correctness is not determined by CLARES, it will be determined by teacher himself/herself. If the answer is right, teacher will click this group area, and this area will be highlighted in blue. As shown on Figure 3, "Berlin" is a right answer and the "A" group area was highlighted.

In order to go to the next question, teacher should click the "Public" button again, and the interface which was shown on projector is disappeared. In the same time, the performance of each group (correct or incorrect) will be recorded in the database.

3.2.3 Student interface

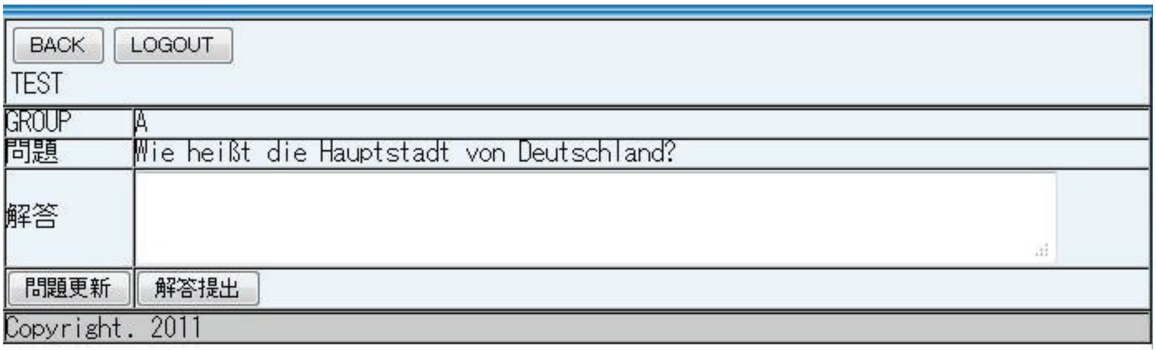
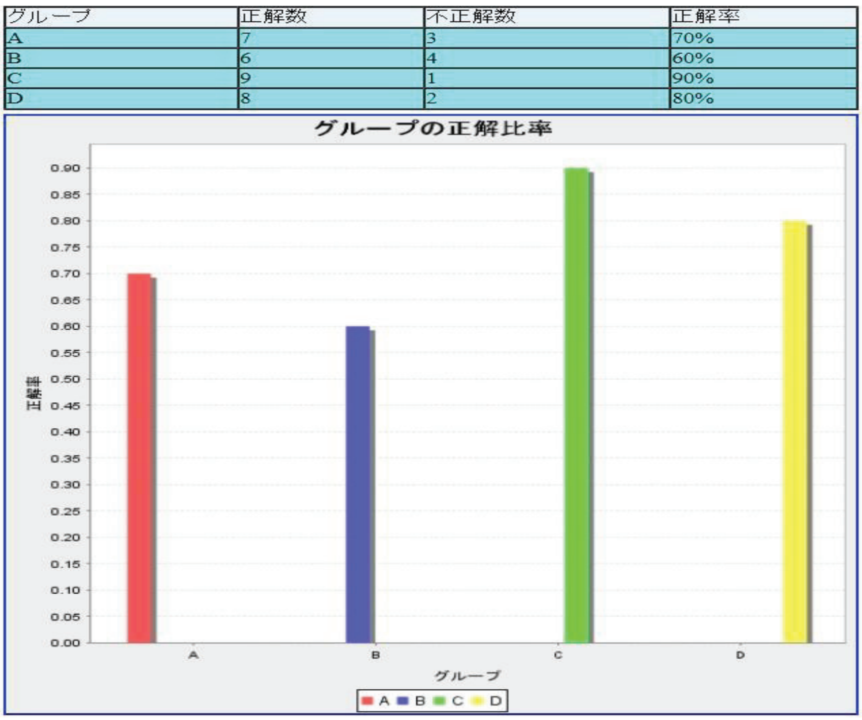


Figure 4. Answer question interface.

Figure 4 is the interface for students to answer questions. Students should login with group name, not the individual name. It allows four or five students to discuss in a group and then submit their group discussion results to the system. The system not only supports to submit answer by PC, but also supports to submit answer by mobile devices such as iPod touch, iPad , Smartphone.

The questions were prepared in advance will be show on this interface. There is a situation in the classroom where a teacher come up with a question on site and want to ask verbally to questions and know the understanding of students. In order to support this situation, CLARES allows only to input answer options while doesn't to input the contents of question.

3.2.4 Displaying answer results



グループ	正解数	不正解数	正解率
A	7	3	70%
B	6	4	60%
C	9	1	90%
D	8	2	80%

Figure 5. Aggregate data of each group.

After a few questions were answered, teacher can click "Aggregate result" button to collect the results and calculate the right answers of each group. The number of correct answers of each group will be graphically shown as Figure 5. By showing this graph, it can form competition and confrontation among the groups to raise learning motivation. The aggregate result can be saved as Excel file to evaluate the performance of students.

4. Conclusion and future works

In the paper, utilizing HTML5 technologies, we proposed a short answer system, called CLARES, which is a CRS. By using the CLARES, teacher can ask questions and determine right and wrong answers on-site. Students can think and reflect whenthe teacher explains. To comparison with the existed system, a sense of excitement and expectations has been long-lasting, so it increases the game element than the existed CRSs. Moreover, students discuss the question in a group and submit a short answer together, this facilitate collaborative learning among students.

As future works, we are planning to check the grammar automatically. By storing the grammar pattern into database, the system can check whether the same pattern is existed. Then we can know whether the pattern is learned or not. It is very difficult to check all of patterns automatically; so we only check the basic grammar.

In this paper, we only use simple function of HTML5. We are planning to use the functions such as Canvas. The Canvas can run on the low-spec devices, which cannot support the Audio, Video and Flash etc. By using the features of HTML5, we are planning to create question in audio and video format. It is also a future challenges to collect the data from Website and create questions automatically.

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Combining Learning with Patterns and Geo-collaboration to Support Situated Learning

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Abstract: Situated Learning stresses the importance of the context in which learning takes place. It has been therefore frequently associated with informal learning or learning outside the classroom. Mobile technologies can play an important role supporting this type of learning, since it mainly occurs on the field. In this paper we present a learning system and a methodology based on the use of patterns. Students learn about patterns by finding instances of them on the field, or by recognizing new patterns unknown to them so far. The teacher proposes tasks to the students consisting on finding instances of patterns or discovering new ones along a path or inside a pre defined area on a map. This work illustrates the role that geo-referenced data collected on the field can play in supporting situated learning activities.

Keywords: Mobile Learning, Mobile Computing, Geo-collaboration, Situated Learning

1. Introduction

Situated learning is a general theory of knowledge acquisition that emphasizes the importance of the activity, the context and the culture in which learning occurs [12, 13]. Social interaction is another critical component of situated learning; learners become involved in a "community of practice" which embodies certain beliefs and behaviors to be acquired. Educational technologists have been applying the notion of situated learning in the last two decades, in particular promoting learning activities that focus on problem-solving skills [11, 15, 20]. The notion of cognitive apprenticeship [5] is also close related to situated learning as: "Cognitive apprenticeship supports learning in a domain by enabling students to acquire, develop and use cognitive tools in authentic domain activity. Learning, both outside and inside school, advances through collaborative social interaction and the social construction of knowledge". Brown et al., [5] have criticized the decontextualized kind of learning that usually emerges as a result from the separation between learning and doing.

Now the integration of one-to-one computer-to-learner models of technology enhanced by wireless mobile computing and position technologies provides new ways to integrate indoor and outdoor learning experiences. The notion of "seamless learning" [22] has been proposed to define these new learning situations that are marked by a continuity of learning experiences across different learning contexts. Seamless learning implies that students, individually or in groups, can carry out learning activities whenever they are curious in a variety of situations and that they can switch from one scenario to another easily and quickly using their personal mobile device as a mediator. In these learning situations, learners are able to examine the physical world by capturing sensor and geo-positional data and conducting scientific inquiries and analyses in new ways that incorporate many of the important characteristics suggested by situated learning.

In this paper we describe our current research efforts that include the design of a learning environment that integrates learning with patterns, mobile applications and geo-collaboration tools in order to support situated learning. Learning activities in these settings take place inside and outside the classroom and encourage students to collect data on the field in order to find, relate and document patterns of any nature. An important element of the collected data is the geographical location where instances of the pattern being learned are located. The rest of the paper is organized as follows; sections 2 and 3 describe the theoretical aspects related to geo-collaboration and *learning with patterns* in order to provide the foundations that guide our efforts. Section 4 lists a set of requirements for supporting situated learning activities which it is used to classify related research efforts in the field. The articles proceeds by describing in section 5 the rationale and features of a system we have developed aiming at supporting situated learning by integrating learning with patterns and geo-collaboration. Section 6 concludes this paper by providing some conclusions and describing possible lines of future research.

2. Using Geo-collaboration to support Situated Learning

Some interesting applications supporting learning activities guided by situated learning making use of geo-referenced data over maps and mobile devices have been developed in the past years (see next section). Few of them rely upon geo-localization features that characterized Geographic Information Systems (GIS) while most of the applications are based on the notion of location-based services (LBS). A relevant difference between LBS and GIS is that a GIS application also geo-references information using visually represented maps, in addition to offering localization services as LBS does. A GIS also offers several additional functionalities, such as associating information of different nature to a geographic location, recording the history of routes, making notes on real geographic zones, determining routes, comparing different notes made in different locations, etc. These different functionalities and information layers certainly may introduce an added value to situated learning applications supported by geo-localization, as they allow to make connections between places, content, learning activities and learners.

Collaborative activities can be introduced in situated learning scenarios by letting participants collaboratively geo-reference information, as well as solving tasks in particular locations taking advantages of the affordances of mobile technologies. Students may collaboratively work at the same time and in the same place, at the same time and in different places, at different times in the same place or at different times in different places. Teacher also may be able to work collaboratively with students at the same time and in different places; for example, tracking students working outside the classroom using mobile devices, tracking students' movements on a geo-referenced map in the classroom and interacting with them remotely. These interactions may also take place at different times in the same place while both the teacher and students are inside the classroom providing feedback and analyzing activities already performed by the students. These type of collaborative activities have not been widely explored yet in situated learning settings since most of the research efforts have only focused on one or another modality (see related work in situated learning presented in section 4). Moreover, few efforts consider the benefits of other learning modalities like personalized and social learning, encompassing physical and digital worlds, ubiquitous knowledge access, combining use of multiple device types, knowledge synthesis or learning with patterns [22].

3. Learning with Patterns

Patterns play a significant role in learning. Research findings in the field of learning psychology provide some indications that human learning can be explained by the fact that learner discover, register and later apply patterns [7, 10, 17, 18]. These cognitive processes "involves actively creating linkages among concepts, skill elements, people, and experiences" [7]. For the individual learner, the learning process involves "'making meaning' by establishing and re-working patterns, relationships, and connections" [7]. Patterns are recurring models, often are they presented as solutions for recurring problems. Natural sciences, mathematics and arts also work with patterns. The exact use of the term however, varies from discipline to discipline. The first formalization of pattern description and their compilation into networks of "pattern languages" was proposed by Alexander et al., [1]. A pattern consists of a set of components including the name of the pattern, description of the problem it solves, the solution to this problem, an example and the relations it has to other patterns. This approach has been adopted by many disciplines like architecture, software development [8], interaction design [3] and pedagogy [19].

There is important evidence that patterns play an important role in learning: "learning with patterns" modality. However, they have seldom been used to support the development of cognitive and social skills apart from the field mathematics [10,17, 18]. Breuer et al., [4] present a mobile learning system supporting collaborative searching and documenting of instances of a certain pattern on the field. Learning with patterns can involve more activities than just collecting evidence on the field. It may start in the classroom with the teacher introducing the pattern approach, the pattern structure and pattern languages. The teacher then proposes a research topic, e.g. which are the most common trees in the city parks? and then he/she asks the students to collect examples following a certain path or searching randomly within a certain area. Students then explore the area, take pictures of the parks and trees, make notes and sketches, etc. In the field or at home, they reflect upon why finding a certain tree is more suitable for this city than others, which are the elements it has that makes it a good pattern, and document what they found within the given categories. Moreover, they may exchange and debate with peers for or against the patterns they want to propose and the examples they had found. Each pattern proposition is reviewed by two peers. Back in the classroom, they present their patterns on the whiteboard, and, moderated by the teacher; they evaluate their propositions and discuss the hierarchy and the relations between the patterns they intend to work with in order to create their own pattern language. Students would then go on to apply their own patterns by building models that represent ideal representations of these patterns and pattern languages for a specific context.

4. Connecting Mobile Learning and Geo-collaboration with Situated Learning

Lave & Wenger [13] suggest that learning is better when knowledge is presented in an authentic context, i.e., settings and applications that would normally involve that knowledge. They also claim that learning requires social interaction and collaboration. Brown et al., [5] list a set of procedures that are characteristic to cognitive apprenticeship in a situated learning context; starting with a task embedded in a familiar activity which shows the students the legitimacy of their implicit knowledge and its availability as scaffolding in apparently unfamiliar tasks; allowing students to generate their own solution paths which helps make them conscious creative members of the problem-solving context; and helping students to acquire some of the culture's values. In order to make the ideas guiding situated learning operational, is necessary to identify its the critical aspects in order to enable it to translate into teaching and learning activities that could be applied inside and outside the classroom [5]. In response to this challenge, Herrington & Oliver [9] suggest a practical framework for designing situated learning activities including the following requirements:

C1. Provide authentic contexts reflecting the way knowledge is used in real life.
C2. Provide authentic activities.
C3. Provide access to expert performances and the modeling of processes.
C4. Provide multiple roles and perspectives.
C5. Support collaborative construction of knowledge.
C6. Promote reflection to enable abstractions to be formed.
C7. Promote articulation to enable tacit knowledge to be made explicit.
C8. Provide coaching and scaffolding by the teacher at critical times.
C9. Provide for authentic assessment of learning within the tasks.

Recently, a few situated learning applications that rely on geo-collaboration have been tested and they are described below. Table 1 presents a selection of related research efforts in this field ranging from 2005 until today which include the usage of mobile devices and geo-localization over maps.

Table 1. Characterization of representative research projects using geo-collaborative situated learning applications. C1 to C9 rows correspond to the requirements of situated learning applications describe above. Ref=reference - year, Plc=place, Obj=objective, Trg= Target group, Tec=technology, Clm=collaborative space/time mode, Evt=evaluation

Ref	[15] -2005	[17] - 2006	[12] - 2007	[22] - 2008	[2] - 2009	[16] - 2010	[7] - 2011
Plc	Outside/Inside the classroom.	Outside/Inside the classroom.	Outside/Inside the classroom.	Outside the classroom	Outside the classroom	Outside the classroom	Outside the Classroom
Obj	Learning in a mobile scenario by sharing observations	To learn Japanese in real life situations.	Enhance content of the curricula. enriching the field experience	Game learning to analyze and learn math problems	Game learning through participa-tion and problem solving	Easily record and sharing of knowledge over maps using sketches	To learn Mandarin in real situations
Trg	Primary and secondary school students	20 to 30 year old users	4th grade students and 5th grade students	12 to 14 year old students	Secondary students	sixth graders students	23 to 42 years old users
Tec	Mobile phones with cameras	PDA with GPS, Bluetooth. Wi-Fi , and smart board	Nokia 6630 with GPRS connection. And HP iPAQ 6515 with GPS	Mobile phone with a GPS receiver	Laptops with GPS receiver and Google maps	Tablet PC, a USB camera and GPS receiver	Iphone with GPS
Clm	Same time, different places between students and teacher using a voice channel	Same time, same place and different places among users and teacher	Same time, same place among students, different place and different time between students and teacher	Same time, same place	Same time, same place and different places among students	Students interact and share with different roles. Same time, same place	Not specified
Evt	Observation	Questionnaires	Questionnaires	Observation	Simple testing.	Usability and utility	Questionnaires
C1	√	√	√		√	√	√
C2	√	√	√	√	√	√	√
C3	√						
C4	√					√	
C5	√	√	√	√	√	√	
C6	√	√	√	√		√	√
C7	√	√	√	√	√	√	√
C8	√	√	√				
C9	√	√					

Moop [14] is a learning environment supported by mobile phones, through which learners analyzes their thoughts and make observations. Moop has been designed for primary school children and has the following tools: a control for a camera, a video camera and a voice recorder. When a GPS-locator is connected, the location information will follow observations automatically. Maps can be downloaded from a server via a data connection and a GPS-positioning system. A location-bound task course is created with the help of a GPS-locator and a user can easily proceed on course to reach the set goals. Planning the route with the Moop's map view allows for a variety of learning situations and study plans. **LOCH** [16], describes a computer supported ubiquitous learning environment for language learning. It was conceived to assist overseas students to learn Japanese while involved in real life situations. Students can make use of their PDAs for writing down annotations, recording questions, taking pictures and reporting back to the teacher. At anytime, the teacher is monitoring the position of the students and can establish communication with them, either through instant messaging or IP phone, both preinstalled on the PDA. In

AMULETS [11], children use a mobile application (including GPS) to learn about “tree morphology” and “the history of the city square through centuries”. Collaborative missions were introduced in order to provide students with challenging problems. The challenges in both scenarios were based on identifying different types of objects (trees or places) and conducting some tasks (measuring the height and age of trees, or discovering data associated to specific locations). In order to solve these problems, students were required to collaborate using a number of tools including instant text messaging between the smartphones and computers at a specific location.

MobileMath [21] is designed to investigate how a modern, social type of game can contribute to students engagement in learning mathematics. It is played on a mobile phone with a GPS receiver. Teams compete on the playing field by gaining points by covering as much area as possible constructing squares, rectangles or parallelograms by physically walking to and clicking on each vertex (point). It is possible to 'hinder' other teams and to deconstruct the shapes they made; points are gained by this also. During the game, in real-time the locations of all teams and all finished quadrilaterals are visible on each mobile phone. The treasure hunt game [2] has been developed as a case study to help analyzing a specific domain and designing a generic and flexible platform to support situated collaborative learning. Students go around the city and collaborate participating in several social/group activities. When the game starts each player receives a clue to identify a”treasure”: a historical place, museum, or location within the city.

In SketchMap [15], children carries a PDA and create a map using a stylus pen by drawing streets and placing icons such as hospitals or a municipal offices. Using a USB camera attached to the tablet PC children can capture an image, a sound or a video which is shown as an icon representing the captured image, sound, or video, and added to the palette. The icon can be dragged from the palette to anywhere on the map. The system supports reflection by allowing the children to replay their map creation processes. In Micromandarin [6], a database of English-Chinese translations associated with their context of use was created. Based on the information shown in table 1, we can conclude that from the requirements stated by [9], the less frequently considered are: the access to expert performances and the modeling of processes (C3), the coaching and scaffolding by the teacher at critical times (C8), and the authentic assessment of learning within the tasks (C9). Moreover, none of the applications described above has introduced the “learning with patterns” modality so far.

5. Designing geo-collaborative application for “learning with patterns”

Based on the results described in the previous section, we can conclude that mobile geo-collaboration can be successfully used to implement learning activities grounded on situated learning. We have developed a prototype of a system (including a web visualization tool and a mobile application) to support geo-collaborative learning activities that include collecting data on the field in order to find evidence of previously known patterns, for example, knowing the patterns of neo-classical architecture find examples in the city, or discovering patterns starting from the evidence found on the field, e.g. studying the reasons of why certain patterns of trees appear more often in the parks of a city. According to the specific scenario described at the end of section 3, the following functionalities for a system supporting them have been identified:

Creating Patterns: To create a pattern means to define its components. Creating a pattern consists on defining its elements: name, goal, description, forces, etc. These components are input by free-hand writing. Additional multimedia objects (pictures, videos or sound) can be associated to the pattern. Depending on the assignment, students may also create patterns in order to document findings which following a certain pattern. Patterns and tasks can be created by the teacher during the class, as they are presented to the students before using an electronic board or projecting the screen of a touch sensitive computer to the whole class. It is important to mention that they are explained to the students before the students start their task. Figure 1 shows the creation of a task and the creation of a pattern inside a task.

Creating Tasks: Teachers can create tasks consisting of instructions to be given to the students. They may include activities such as following a certain path or to randomly explore a designated area within the city in order to find evidence of patterns. Task creation begins with defining a referencing geographic point. This will cause the system to download a map where this point is located. Currently, maps are downloaded from Google Maps using a free available API. Thereafter, the teacher can mark an area by freehand sketching the limits of it over the map. In this case, the task for the students will consist of exploring the area randomly in order to collect data about the instances of a pattern inside this area. The teacher may also define a path by marking certain points on it. In this case the students will have to follow the path and find evidence (or lack) of certain patterns in the designated points. Thereafter, the teacher can associate already defined patterns to the task or create new ones inside the task creation.

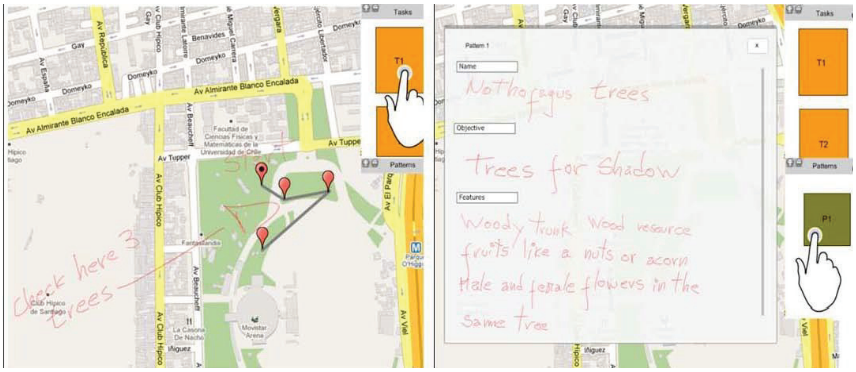

Fig 1. Task (left) and pattern (right) creation. The task consists of following a path

Assigning tasks to students: In the classroom and before leaving for the field activity, students turn on their mobile devices running the application. The teacher's application automatically discovers the instances of the student's application and displays them on the screen as an icon, as seen in the figure 2 (left). By just dragging and dropping the student's icon over the task icon, the task proposition is transmitted to the student's device and shown.

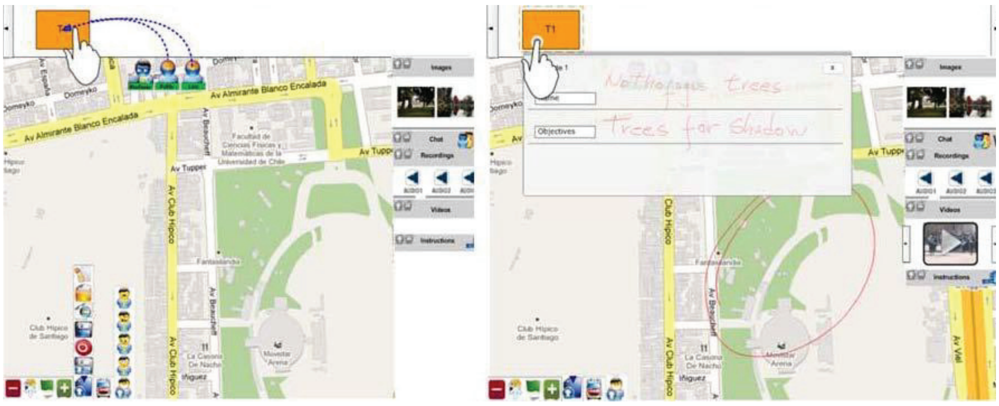

Figure 2: Assigning tasks to the students (left) and the Student's view of the task

Instantiating patterns: According to the proposed task, students may follow a certain path or explore an area of the city gathering data to collaboratively create instantiations of the pattern when they find a certain element that they think it corresponds to the pattern giving by the teacher. They can also exchange pattern instances created individually. Instantiations consist of photographs or handmade sketches of a certain object found which complies with the pattern definition.

Monitoring students' work: teachers can monitor the students' work in areas where internet is available and a client-server communication is possible. The student's application sends the current position at regular time intervals to a server. This information is taken by the teacher's application which displays the student's position on the map. It is also possible for the teacher to communicate with the students via chat to give more instructions about the task in "real time".

The system has been implemented and pre-tested by early users in an experiment with four subjects aged 22 to 24 aimed at evaluate the user interface. The task they were given was to find out which were the most common tree types in a certain park. For this experiment tablet PCs were used. The activity lasted for 1.5 hours.

6. Conclusions and Future Work

In our current efforts, we are proposing the design of learning activities that incorporate elements of situated learning that are supported by the use of geo-collaboration tools and mobile applications which incorporates learning with patterns. From our literature review, we can see on the one hand that learning activities using mobile technologies and geo-collaboration have been successful implemented and on the other hand, it has been recognized that patterns can play an important role in the learning process. Since the proposed system presented in the previous section can be used to handle patterns in any field/discipline, it can be used in a variety of learning scenarios. In section 4, we presented the requirements for designing learning environments that support situated learning. In this section, we will analyze how the proposed system fulfils them. Table 2 illustrates how our suggested solution supports all requirements for situated learning, some in a better way than others. An important characteristic of the learning approach proposed in our current efforts is that it starts in the classroom, continues on the field; proceeds then at home or in a computer lab and ends with a learning session inside the classroom again. This again can create another cycle which is interesting from the point of view that the sake system is able to support different learning modes and stages, without disruptions of methodology, interaction paradigm or data compatibility. In fact, the system is able to run on different platforms. It has been used on PCs inside the classrooms, where the teacher used an electronic board to create patterns and tasks during the class. It has been also used on tablet PCs as well as on handheld computers. The common aspect on all these platforms is the touch screen and the big difference is the size. However, the way of using sketching and gestures to control the applications was positively evaluated by the early users. They also positively evaluated the fact that they use the same interaction paradigm regardless the platform they were using, so they do not need to learn how to interact with another application interface.

Table 2: On the left the requirements. On the right, the system features fulfilling that requirement is explained

C1	Patterns instances are searched for in the very place they appear naturally
C2	Finding pattern instances in natural environments is a typical work experts often do.
C3	There are two roles: the teacher and the student. In certain cases students might also propose tasks taking the role of the teacher
C4	After completing the field work, back in the classroom the teacher provides examples from the expert's regarding the task.
C5	Students work collaboratively on the field in order to collect the relevant data and share it
C6	Students present their findings in front of the class reflecting about the patterns they found
C7	The system allows students to collect data, relate and communicate them formalizing their unsorted ideas about what they find
C8	The teacher can help students during the work on the field, as well as back in the classroom
C9	Possible patterns and patterns instances are checked by the students and the teacher during the work

Although the first trial of the system has been done implementing a rather simple learning activity, it is easy to see that this approach can be used to learn and discover more complicated patterns across different fields. Below we provide some examples of different field in which we plan to conduct some future trials in order to validate our approach: a)

Geology students must perform collaborative activities like field measurements and observations that can be monitored and controlled remotely by a teacher. Students must geo-reference their notes, take pictures and make recordings at concrete points that will be constructed jointly and/ or with their peers; b) **Architecture** students may recognize construction styles and design patterns in specific areas of an urban space. Students may also collaboratively survey construction styles or design patterns in a certain zone using geo-referenced notes to understand the changes in the construction development; c) **Social sciences**. Students of anthropology, psychology or sociology may conduct field observations for which collaboratively created data and information notes of diverse nature (text, images, video & sound), associated with its localization will enrich their observations.

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Chapter 7

Modeling, Management and Generation of Problems/Questions in Adaptive Learning Environment

Preface

Solving problems/questions is one of the most indispensable and important components in the teaching and learning process. Problems/questions with adequate quality in various testing conditions are believed to enable teachers to assess individual students' capability and readiness of transfer in specific domain knowledge.

Despite this, there are still many areas in need of systematic investigation to promote knowledge and skills on problems/questions-centered learning approach, including learning by problem solving and/or generation. For instance: what criteria constitute as adequate test item quality (in addition to frequently cited psychometric index like item difficulty, discrimination index); how to best assess learner's capability with appropriate quality level within constrains (e.g., an optimal number of items, time limitation, etc.); any feasible metadata heuristics and/or techniques for problems/questions selection; any promising alternative strategies for compiling a sufficient amount of number of problems/questions; any scaffolding techniques for question/problem-generation implementation and instructional diffusion and so on.

This is the 5th workshop focusing on the same topic. This continuous workshop will provide a good and timely opportunity to present and share the results and issues about "problems/questions" in ICCE community.

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Predictive Effects of Online Peer-Assessment on Student Question-Generation

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Abstract: The study examined the predictive effects of online peer-assessment on student question-generation. Specifically, the individual and collective predictive effects of two types of feedback (i.e., quantitative ratings and descriptive comments) available in peer-assessment learning systems on student question-generation performance were investigated. A total of 233 students participated in the study for six weeks. An online learning system that allows students to contribute to and benefit from the process of question-generation and peer-assessment was adopted. The regression result found that quantitative ratings and descriptive comments individually and collectively significantly predicted question-generation performance. Suggestions for learning system development are provided.

Keywords: online learning system, peer-assessment, student question-generation

Introduction

Both theoretical and empirical foundations of student question-generation support its beneficial effect on learning [1-6]. Recently, in view of the numerous advantageous features of network technology, a number of online learning systems with student question-generation as the focus have been developed. Most existing systems enable students to generate questions of different types and to incorporate media formats as part of the question. Also frequently included in these systems is an element of peer-assessment [6-11].

The benefits of including peer-assessment within the student question-generation context can be understood and appreciated in light of cognitive conflict theory, social constructivism and social learning [12-14]. Nevertheless, there is a lack of empirical evidence supporting the coupling effects of online peer-assessment with student question-generation. An investigation into such issues as "if and how feedback students receive during online peer-assessment affect student question-generation performance" will warrant its inclusion in online student question-generation systems. Since feedback can be expressed in quantitative and descriptive forms, its individual and collective predicative effects on student question-generation are examined. Three research hypotheses are proposed in the study:

1. The averaged quantitative ratings received from assessors on the composed questions will significantly predict student question-generation performance.
2. The quality of descriptive comments received from assessors on the composed questions will significantly predict student question-generation performance.
3. The averaged quantitative ratings and the quality of descriptive comments received from assessors on the composed questions will collectively significantly predict student question-generation performance.

In consideration of the fact that a considerable proportion of students do not experience question-generation during their formal schooling [15-16] and have viewed student question-generation as difficult or very difficult [11], answers to the above questions will help provide some directions for better online question-generation activity design and implementation.

1. Method

1.1 Online Learning System

A learning environment that allows students to contribute and benefit from the process of constructing question items and receiving feedback from their peers about the composed questions was used. Essentially, the question-generation sub-system enables multimedia files to be included as parts of the question and texts of different fonts, size and styles can be used (see Figure 1).

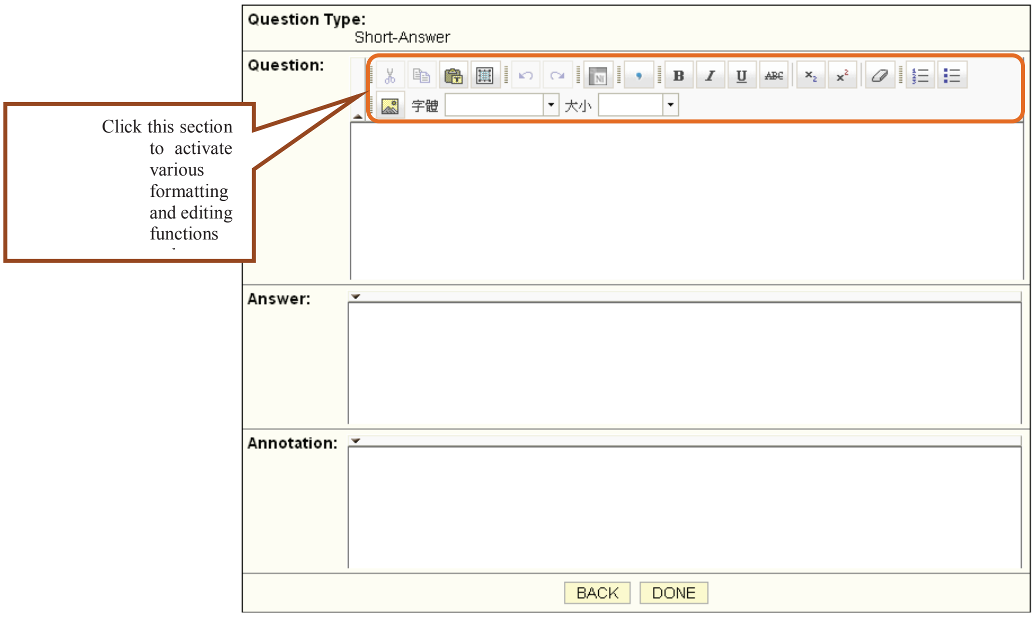

Figure 1 A screenshot of short-answer question-generation

The peer-assessment sub-system, on the other hand, enables assessors to give their evaluative feedback using an online assessment form. On the form, assessors can assess the overall quality of the generated question on a five-point rating scale (from “well below average” to “well above average”) and to rate their recommendation of the question to be included in the drill-and-practice item bank (from “Will not recommend at all,” to “highly recommend”). Also, assessors can give descriptive comments with regards to the question being examined in a designated feedback space by referring to a set of built-in criteria (see Figure 2).

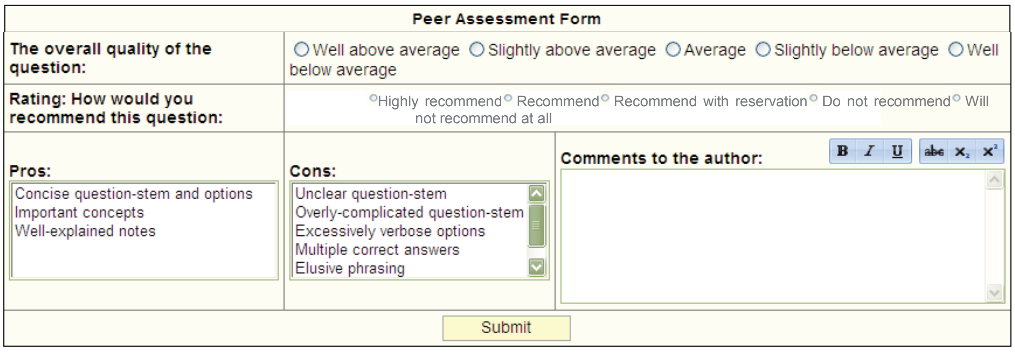

Figure 2. Assessment form for assessors to provide feedback to question-authors

1.2 Participants and Implementation Procedures

Two hundred and thirty-three 5th graders from eight classes participated in the study for six consecutive weeks. Participants were informed that the introduced online question-generation and peer-assessment activity was intended to augment their science learning.

Each week for the duration of the study, students headed to a computer laboratory to participate in a 40-minute learning activity after attending three instructional sessions allocated for science. To ensure that participants possessed the fundamental skills of the introduced activity, a training session on generating chosen question types and the coupled online peer-assessment with hands-on activity was arranged at the commencement of the study. Considering that true/false and multiple-choice questions are among the most frequently encountered question types in primary schools in Taiwan, these two types of question-generation options were chosen. Each week students were directed to individually generate at least one question for each of the two chosen question types in accordance with the instructional content covered that week and assess at least two questions from a pool of peer-generated questions for each chosen question type.

1.3 Variables

The quantitative ratings received from assessors consisted of two parts: the overall quality of the question and recommendation for inclusion in follow-up drill-and-practice sessions. The overall quality and recommendation received from assessors per question per week were averaged throughout the activity.

The quality of descriptive comments received from assessors on the composed questions and student performance in question-generation was defined against a set of criteria. For peer-assessment, all comments question-authors received with regards to a specific question item were analyzed against a pre-defined scheme and were averaged. The averaged scores per question per week were then summed up. Specifically, the quality of descriptive comments was evaluated in terms of four discrete levels: general comments, specific comments where strengths and weakness are identified, identification for improvement and explicit suggestion for further refinement of questions.

To assess students' performances in question-generation, in reference to the Torrance creativity index [17], King's question cognitive levels [18] and questions generated by students, the following criteria were adopted: fluency, flexibility, elaboration, originality, cognitive level and importance. Each of the indexes was further operationally defined to ensure objective assessment.

2. Results

2.1 Descriptive statistics of examined variables

The means and standard deviations of the quality of feedback received on the composed questions (including quantitative peer-ratings and descriptive comments) and students' performance in question-generation are listed in Table 1.

Table 1 Descriptive statistics and correlations between variables (N=233)

Variable	Quantitative ratings	Descriptive comments	Question-generation
Mean (SD)	3.45 (0.68)	6.70 (3.60)	32.11 (13.56)

Note: * p <0.05, ** p <0.01

2.2 The predictive effect of quantitative ratings on question-generation performance

The regression result presented in Table 2 supports that the quantitative ratings significantly predict question-generation performance, (β = 0.28, p < 0.01).

Table2 Regression analysis for quantitative ratings predicting question-generation performance

	B	SEB	β
Model			
Constant	12.72	4.46	
Quantitative ratings	5.60	1.27	0.28**
R-square		0.08	
F		19.59**	

Note: *a.* Predictor:(Constant), Quantitative ratings

b. Dependent variable: Question-generation performance

c. * p <0.05, ** p <0.01

2.3 The predictive effect of the quality of descriptive comments on question-generation performance

The regression result presented in Table 3 supports that the quality of descriptive comments significantly predicts question-generation performance, (β= 0.37, p < 0.01).

Table 3 Regression analyses for quality of descriptive comments predicting question-generatic performance

	B	SEB	β
Model			
Constant	22.80	1.74	
Quality of descriptive comments	1.39	0.23	0.37**
R square		0.14	

F	36.48**

Note: *a.* Predictor:(Constant), Quality of descriptive comments
b. Dependent variable: Question-generation performance
*c.** *p* <0.05, ***p* <0.01

2.4 The collective predictive effect of the quantitative ratings and the quality of descriptive comments received on question-generation performance

To avoid multicollinearity, Pearson correlations was conducted and found that quantitative ratings is not correlated with the quality of descriptive comments (r= 0.1, p =0.13); therefore, these two variables could collectively included in multiple regression analysis. The quality of descriptive comments significantly predicted a significant proportion of variance on students' question-generation performance (R^2 = 0.14, F=36.48, p < 0.01). Adding the variable of quantitative ratings significantly enhanced the R-square (R^2 change = 0.06, F=16.98, p < 0.01); therefore, the quality of descriptive comments and quantitative ratings collectively significantly predict question-generation performance (β_{qual}= 0.35, p < 0.01; β_{quan}= 0.25, p < 0.01, respectively).

Table 4 Multiple Regression analyses for Quality of feedback predicting question-generation performance

	Model 1			Model 2		
Variable	B	SE	β		SE	β
Constant	22.80	1.75		6.44	4.32	
Quality of descriptive comments	1.39	0.23	0.37**	1.30	0.22	0.35**
Quantitative ratings				4.91	1.19	0.25**
R-square		0.14			0.20	
F for change in R-square					16.98**	

3. Discussion and conclusions

Numerous online student question-generation learning systems have been developed for students to interact with the content by generating questions and to interact with their peers online for the improvement of the questions by peer-assessment. This study explored whether feedback received from peers contributed to question-generation performance.

The current study confirmed the coupling effects of online peer-assessment on student question-generation performance. Specifically, this study substantiated that the quantitative ratings and the quality of descriptive comments question-authors received from peers individually and collectively contributed to their question-generation performance. In other words, question-authors who received higher quantitative ratings tend to demonstrate better performance in composing questions. Also, the better quality of descriptive feedback received on their composed questions leads to higher performance in question-generation tasks. Furthermore, question-authors who received higher quality of descriptive feedback together with higher ratings on their questions tend to demonstrate better performance in composing questions.

The obtained findings have important empirical significance as well as implications for online system developments. First, despite that peer-assessment is coupled with question-generation in most existing online learning systems, its supportive effects on student question-generation performance has rarely been substantiated empirically. This present study, for the first time, evidenced the respective and collective effects of quantitative ratings and descriptive comments and supported the inclusion of peer-assessment in online student question-generation systems.

Based on the findings of this study, several suggestions are provided. First, instructors with students inexperienced in student question-generation and who can benefit from extra support for better question-generation performance are advised to include an element of online peer-assessment for the promotion of performance in the introduced task. Second, as this study found that the variable of descriptive feedback explained more variance of question-generation performance, the importance of providing question-authors with descriptive feedback could not be ignored. Finally, online student question-generation system with peer-assessment should consider including both quantitative ratings together with descriptive comments key-in space for maximal question-generation performance.

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Toward better Collaborative Problem-solving in Programming Learning: Use of Pair Programming and Its Observation

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Abstract: To realize better programming learning, we have adopted "pair-programming" method to the introductory programming course of a university. Pair-programming is a programming method that two persons get involved with a single programming task using a single computer terminal, where only one person types the keyboard. Though there have been several researches on pair-programming learning practice and been reported its usefulness, only impressions were reported. Through the actual pair-programming practice, we could observe both successful case and failed case in solving the problem that arose in the course of completing the assigned task, and found that there seemed to be difference in utterance patterns between the successful case and the failed case.

Keywords: Pair-programming, Programming learning, Problem-solving, Computer-supported collaborative work (CSCW)

Introduction

The ability to understand the grammar of a programming language, to write a program, and to assemble an algorithm, is required in programming education. When a learner actually creates a program, some problems typically occur, even if the grammar and a (relatively easy) example of the program language are understood [12]. In programming education, numerous practices, including the support of problem-solving, have been developed to date. Education and study methods have also received considerable attention [10].
The programming method called 'pair-programming' originated in industry as a key component of the Extreme Programming (XP) development methodology [1]. As the name suggests, two programmers work together at the same machine while developing code. One programmer (the driver) operates the keyboard and focuses on entering code, while the other programmer (the navigator) observes the work of the driver and offers suggestions in the code. The programmers regularly exchange roles. Creating a program by pair-programming is collaborative work, and offers further benefits in respect of sharing and enhancing programming expertise and refining collaborative technique [16]. In the Computer-supported cooperative work (CSCW) context, interruptions of software teams have been investigated [4], and studies have explored interruption patterns among software developers who program in pairs versus those who program solo.
In some programming education, pair-programming has been conducted as one of the programming learning methods. Especially in introductory programming courses, for example, it has been reported that pair-programming is better than solo-programming in respect of improving the quality of programming [6,7,8,11,15]. However, there were numerous instances in which the pair-programming had faced the problem which

problem-solving did not go well. Of course, the effect of pair-programming varies with the actual composition of the pairs, but failure on the part of one of the pair, in the introductory stage, can easily spill over into later, more involved tasks. Moreover, if problem-solving does not go well, a decrease in motivation to study will typically occur. In this case, we must seek to support the pair, with a view to improving their pair-programming learning.

In this study, pair-programming was conducted in an introductory programming course. Success and failure cases in pair-programming were compared. In the comparison, we focused on the conversation between the pair in pair-programming. In the failure cases, it was found that speech length tended to be long, and there might be a great deal of continuous speech.

Our research objective in broader sense is to support programming learning. Pair programming has been focused as one of the promising techniques of programming learning. We do not intend to just using pair programming. We intend to expand pair programming to computer-supported pair programming (CSPP). This means that a computerized environment (not the computer used for programming basically) senses the learning status of the pair, and once the environment senses something wrong with the pair it intervenes in the learning. This could be a mixture of ICAI (Intelligent Computer-Aided Instruction) and CSCL (Computer Supported Collaborative Learning) under the ubiquitous computing technology. To realize such CSPP, we thought we need some symptoms to indicate the status of pair programming. This led to the study in this paper.

1. Related Works

1.1 Pair-programming in an Introductory Programming Course

Previous research suggested that pair-programming was better than solo-programming in numerous respects. For example, it was better in respect of the quality of program code [6,7], the success rate in programming courses [7,8], results of mid-term or final examinations [8], and/or submission rate of assignments [15]. Rountree et al. reported that understanding and/or ability to create program code were improved after pair-programming was conducted [11].

The aforementioned research reported the positive effects of pair-programming, but did not analyze the process of pair-programming or the pairs whose problem-solving did not go well. In this research, the conversations of some pairs in pair-programming were analyzed, and specifically, pairs that failed in problem-solving were studied.

1.2 Communication Analysis in Pair-Programming

In previous research (which did not focus on introductory programming courses), conversations of the pairs in pair-programming was analyzed. Chen et al. recorded the utterance of pairs and described the context of pair-programming. They suggested that there was a mental distance between the driver and the navigator, and communication supports such as visualizing the rules of the pair were necessary [3]. Chong et al. also recorded the utterance of pairs and described the context of pair-programming. They suggested that the distribution of expertise among the members of a pair had a strong influence on the tenor of pair-programming interaction, and keyboard control had an effect on decision-making within the pair [5]. Bryant et al. investigated the distribution of utterance categories in pair-programming, and suggested that there was no significant difference in the distribution between the driver and navigator, and both driver and navigator work at similar levels of abstraction [2].

These studies analyzed the conversation of pairs, but did not compare success and failure cases in pair-programming. In this study, interactions between the driver and navigator have been observed, communications in pair-programming have been analyzed, success and failure cases have been compared, and the characteristics of failure cases have been studied.

1.3 Roles of Conversation in Pair-Programming

Wray [16] described the roles and effects of conversation in pair-programming from his own experience. He mentioned that the roles of conversation were sharing expertise among pairs and getting on the track for problem solving. He predicted that programmers who chat about their programs more should be more productive and that those who pose deep questions for each other should be most productive of all.

His description suggests that problems occurring in pair-programming might be solved through conversation among pairs, and that conversation may be a significant indicator in comparisons between success and failure cases in pair-programming. In the present study, differences in conversation between success and failure cases in pair-programming were explored.

2. Pair-Programming Practice

2.1 Practice Setting

In this study, pair-programming was conducted in an introductory programming course, “Programming I”, which targeted freshmen in the university’s department of information. The goals of the course were as follows:

- Learners understand the description and composition of software and the mechanism of programming.
- Learners can compile and execute a program written in C language.
- Learners understand the basis of C language, such as variables, control of flow, functions, arrays, character and string handling, and file I/O.

The course involved ten weekly 75-minute lectures, from September 2010. Pair-programming was conducted in six 30-minute practice sessions as the part of the lecture.

As preparation for pair-programming practice, the training session was conducted. The training was conducted in the same setting as the following pair-programming practice, because of the possibility that some learners had not experienced pair-programming.

In each pair-programming practice session, a program-creation assignment, involving contents hitherto studied, was given to the participants. An example of the assignment is shown in Table 1. The following six instructions were given to the learners:

- Only the driver can operate the keyboard and mouse. The navigator must not touch them, but may point to the display. The navigator must observe and support the work of the driver.
- The assignment ends when the program is executed and a correct answer to the assignment is obtained. Please end the assignment as soon as possible.
- The driver and navigator may refer to the textbook [14]. You must not refer to any web pages.
- The teacher and teaching assistants (TA) do not accept any questions concerning the assignment while practicing. Please call on them only in the event of equipment trouble.
- Please create the program easy to understand by adding pertinent comments.
- You have 30 minutes to success the assignment. Please submit your code even if failure, when the time limit is reached.

A total of 62 learners participated in the practice session (52 freshmen and 10 upper-years). Pair combinations were decided by one of the authors. The participants did not exchange roles (of driver and navigator) in each practice session because the practice time was short. Figure 1 shows a screenshot of the practice session. Figure 2 shows a scene from the practice session. Three cameras were used for recording communication.

Table 1. An example of the exercises in the pair-programming class.

Assignment 1:

Create a program for permutation and combination according to the following specification.

Specification

* Input: n, r (integer)

* Output: "nPr = ?, nCr = ?"(? is calculated value)

Example

When 8 is input to n and 3 is input to r, the calculated result is displayed as follows:

8P3 = 336, 8C3 = 56

Hint

As for permutation and combination, the general formulas are given as follows:

$$n\mathrm{Pr} = \frac{n!}{(n-r)!} \quad (n \geq r > 0), \quad nCr = \frac{n!}{r!(n-r)!} = \frac{n\mathrm{Pr}}{r!} \quad (n \geq r > 0), \quad n! = \begin{cases} n \times (n-1)! & (n \geq 2) \\ 1 & (n = 0,1) \end{cases}$$

Figure 1. Setup of the cameras for data collection.

Figure 2. Scene from the practice session.

2.2 Definition

In this study, "Success" , "Failure" and "Problem" are defined as follows:

- Success: "Success" is the identifier of showing the problem was solved. It does not relate to the learner's "success" of learning.
- Failure: "Failure" is the identifier of showing the problem was not solved within the given limited time. It does not relate to the learner's "failure" of learning.
- Problem: "A problem" is a compilation error that occurs when learners compile their program, or a runtime error that occurs runtime including whose result does not meet the learners' expectation.

Although we know those concepts of Vygotsky's Zone of Proximal Development and Lave and Wenger's Legitimate Peripheral Participation, and "failure" is not just failure there [9], we do not deal with that "failure" in this paper. There failure can be resource for learning. Here the term "failure" is used as an identifier of unsuccessful result of solving the error that occurred during programming. In other words, the term "failure" and "success" in this paper do not imply any notion known in learning sciences. They are simple and clear identifiers of the result of solving the errors.

2.3 Problems Occurring in the Practice Session

Table 2 shows the problems which occurred among the pairs whose communication was recorded. These problems occurred in pairs of first-year students. Table 2 shows six success cases and three failure cases. Some pairs attempted to solve two or more problems in a given practice session. Problem-solving went well in the success cases. The problems listed in Table 2 were causes of the error that the pair finally identified. In Failure Case A and B, problems which the authors recognized by observing the video are listed, because the respective pair did not recognize the cause of error. There were only three failure cases in this practice session. This is because the assignments given to the participants were easy. Most of the pairs completed the assignment within the time limit.

Table 2. Problems occurring in the practice session.

Case	Pair	Problems
Success A	Pair A	Compilation error Semicolon was not written at the end of a line.
Success B	Pair B	Compilation error The string "enum" was a reserved word.
Success C	Pair B	Compilation error The source file was not preserved in the superscription.
Success D	Pair B	Compilation error, Segmentation error The "scan" sentence was written like 'scanf("%d", a);'. – "&" was missing.
Success E	Pair C	Run-time error Beginning of a block did not correspond to the end. There were some spelling mistakes.
Success F	Pair C	Run-time error The return value of a function was not correctly returned.
Failure A	Pair D	Run-time error The case divided by 0 was included in the "for" sentence.
Failure B	Pair A	Run-time error The value of a variable was not correctly substituted by the global variable declaration.
Failure C	Pair E	Compilation error Neither the main file nor the header file was correctly linked.

3. Difference between Success and Failure Cases

Success and Failure cases in problem-solving were analyzed and compared in term of pairs' conversation. The utterances of the pairs and the context of pair-programming were recorded with iCorpusStudio [13], which is a video-analysis support tool. With the tool, we can simultaneously view the recorded data as multiple video, audio, and motion, while annotating the interpretations of the interactions as labels.

3.1 Examples of Success and Failure Cases

We show two example sequences including utterances and some descriptions; one for "Success" case and the other for "Failure" case.
Table 3 shows a conversation in Success case A. In this case, the following error message "19: error: expect ';' before 'return'" was output. The learners solved this problem in 100 seconds. Speech length marks the time from the point that the learner started his/her speech, to the point that the learner ended the speech.
Table 4 shows a part of conversation in Failure case B. In this case, there was no output though the program was executed and the driver input a value to a variable. The learners tried to move the "while" sentence to another line. The learners spent 588 seconds solving this problem, but the problem was not solved. The driver uttered 19 times in this case, while the navigator uttered 61 times.

Table 3. A conversation in Success case A.

Utter. no.	Spe-aker	Speech length (sec.)	Utterance
1	D	0.9	The 19th line.
2	D	0.9	Ah… This line.
3	N	1.5	Ah… "return 0".
4	N	4.1	Line numbers are shown when a setting is changed.
5	D	0.9	Really?
6	D	1.8	I do not compile this program.
7	N	2.7	Did you save this program? Ah, you did.
8	D	1.9	I try to delete unnecessary lines.
9	D	1.1	(I think) the way is not good.
10	N	1.6	return 0…
11	D	0.7	This point
12	N	1.4	Ah… after the "printf" sentence.
13	N	0.7	Um…
14	N	1.5	functional…
15	N	1.2	The 19th line
16	N	1.3	No changes are appeared.
17	D	1.5	This program consists of 17 lines.
18	D	1.7	Ah…, 19, the last line…
19	N	3.1	Parentheses… Let's make sure the position of parentheses
20	N	1.7	The number of braces is wrong? …
21	D	0.7	Ok. (the problem was solved)

* Speaker - D: Driver, N: Navigator
* Speech length - The length more than 2 seconds is highlighted.
* Utterance - Description in the parentheses is the supplement by the authors.

Table 4. Part of a conversation in Failure case B.

Utter. no.	Spe-aker	Speech length (sec.)	Utterance
14	N	1.2	The “while” sentence...
15	D	0.4	Umm.
16	N	1.6	Let’s move outside of the ”main” function.
17	D	1.1	”Main”?
18	N	1.1	Please move above the function.
19	D	0.7	Umm.
20	N	1.7	From this line to this line... Ok.
21	D	1.1	Umm.
22	N	2.6	Please cut the selected lines.
23	N	0.7	Next...
24	N	1.2	Let me see...
25	N	1.2	”While” sentence... (The driver operates.)
26	N	2.9	Not ”while” sentence. Sorry, please undo.
27	N	2.1	Sorry, it became strange.
28	N	4.4	You may move this function outside. (The driver operates.)
29	N	3.5	From this line to this line... (The driver operates.)
30	N	5.6	Because this function was moved outside, the declaration of the variable might be wrong.
31	N	4.0	”jyun” (= a variable) is ok. ”ans” (= a variable) is ok. ”n” (=a variable) is ...
32	N	1.3	”n” is...
33	N	1.9	Is it correct to declare this variable outside the function?
34	N	3.0	Global...?
35	N	0.7	Index...
36	N	4.5	Global... global variable.
37	N	1.6	Ok. It is possible to declare this variable outside the function.

* Speaker - D: Driver, N: Navigator
* Speech length - The length more than 2 seconds is highlighted.
* Utterance - Description in the parentheses is the supplement by the authors.

3.2 Findings obtained from the Examples

As for the speaker, in the failure case, the driver and navigator spoke alternately from utterance 14 to 22. From utterance 23, however, the navigator spoke continuously; that is, the driver did not talk. The navigator spoke more continuously in the failure case than in the success case. As for the speech length, there were 9 utterances that are more than two seconds in length in the failure case. Especially, from utterance 26 to 31, the navigator spoke continuously and all of his succeeding utterances were more than two seconds in length.

The investigation of these example dialogues suggests that there may be a relationship between speech length and/or speech continuity and success/failure of problem-solving.

Discussion of the relation may require further investigation; for example, through observing more cases in the practice sessions.

4. Conclusion

We have adopted pair-programming method in software engineering to programming learning. Naturally there occurred both successful case and failed case in solving the problem when the problem arose in the course of completing the task. We observed a few such cases and found that there seemed to be difference in utterance patterns between successful case and failed case. We will analyze the learners' conversation and behavior more in detail to obtain clearer symptoms to indicate the status of pair programming. Then we will develop a computer-supported pair programming system that uses the symptoms.

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Experimental Study on Failures in Composing Solution Structures in Mathematical Problem Problems

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Abstract: Problem posing is identified as an important activity in mathematics education and a critical skill to be acquired. Several studies implemented support systems for learning of problem posing which aid novice learners in successfully posing appropriate problems. However, such learners may not necessarily success in posing appropriate problems without the support. Toward further support for novice learners in acquiring problem posing as a mathematical skill, we have to understand failures occurring in problem posing by novice learners. This study experimentally investigated problem posing by novices and empirically described their failures. In our investigation, participants were engaged in a learning task to study an example by reproducing it and a novel generation task to pose their own problems, with the results indicating that some participants composed problems whose texts and solutions were inconsistent in the learning task.

Keywords: Mathematical learning, problem posing, learning from examples

Introduction

Problem posing is identified as an important activity in mathematics education, as well as problem solving is [12, 13]. Although problem posing is rarely adopted in general education due to certain constraints in practical classrooms, it is as critical a skill as problem solving. One of the reasons why problem posing is unadopted may be that problem posing is extremely difficult for novice learners. Because problem posing is a production task that requires idea generation and synthesis of structures, it imposes heavy cognitive load on learners.

Several studies have addressed support for problem posing by learners. For example, some e-learning systems adopt problem posing as a learning task and aid it through the peer-assessment of learner problems [1, 4, 14, 16]. Hirashima and his colleagues implemented several systems that can evaluate problems posed by learners [3, 15]. Their environments offer computer-supported learning exercises to generate problems solved by specified solutions and to alter instance problems into new ones. These studies have also reported that learning with the systems improved learner understanding of domain knowledge or solution methods embedded in problems. Our previous studies proposed a support system that facilitates diverse problem posing through learning from examples [5, 6], and experimentally confirmed that our system could improve problem posing by learners to some extent.

Although problem posing is difficult, learners can successfully pose problems with support by the systems mentioned above. However, they may not necessarily success in posing appropriate problems without the support. Toward further support for novice learners in acquiring problem posing as a mathematical skill, we have to understand failures occurring in problem posing by novice learners. Leung and Silver [10] studied problem posing by prospective elementary school teachers and empirically obtained a certain number of non-mathematical or unsolvable problems, even though, their focus was not on analysis of such inappropriate problems.

This study experimentally investigated problem posing by novices and empirically described their failures. In the investigation, we used a learning task of problem posing proposed in the previous study [6].

1. Experimental Method

In our investigation, participants were engaged in two problem posing tasks. One of them was a learning task to reproduce a problem given as an example, and the other was a task to generate novel problems.

1.1 Tasks

In each of the experimental tasks, participants were required to generate one or more problems in the domain of a problem initially given as a base. In the first learning task, they were provided with a base and an example problem as a good response in the task, which was generated by altering the base. They were then asked to reproduce the example. When reproducing, the example itself was hidden and information indicating how to generate the example from the base was shown. The generation process information of the example was automatically generated by our support system implemented in the previous studies, which included sufficient information to reproduce the example. This activity in the task had been designed to provide novice learners with ideas feasible in composing novel problems through *imitation* of varied examples. We empirically confirmed that learners could successfully transfer what they learned from an example through imitation with the system into novel problem posing by the learners. Figure 1 indicates the basic framework of the learning task (For more detail on the support system, see [6, 9]).

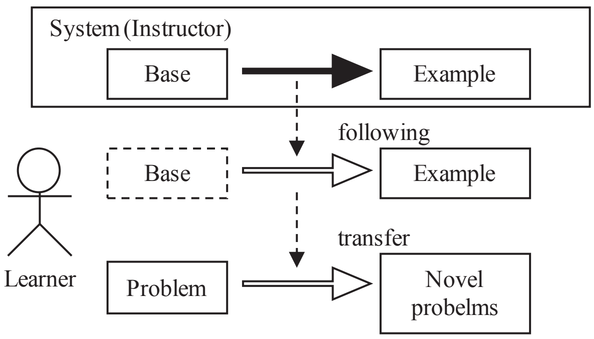

Figure 1. Basic framework of learning task

The learning task was followed by the novel generation task where the participants were asked to pose problems as many, varied and unique as possible from another base problem. In this task, participants' problems were evaluated based on four categories shown in Figure 2. These categories indicate similarities in *situations* and *solutions* between their problems and the base. Situations of problems denote surface features of contextual settings in problem texts (e.g., purchase of goods or transfer by vehicle), and solutions mathematical structures of the problems. Therefore, Category I / I indicates problems almost the same as the base, D / I indicates those generated by altering a situation of the base, I / D indicates those generated by altering a solution, and D / D indicates those generated by combining both alterations. It is desirable for mathematical learners to pose diverse problems across these categories controlling features of situations and solutions. However, previous studies revealed that leaner problems tend to lack diversity [2, 11] and have simple or inappropriate structures in their solutions [8].

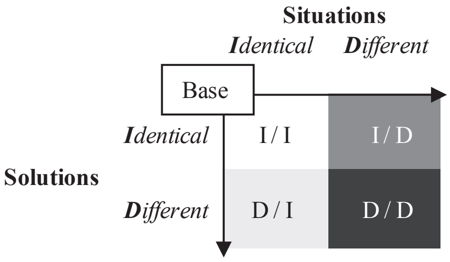

Figure 2. Categories for evaluating the variety of problems

1.2 Procedures

Undergraduates were participated in the investigation conducted in a lecture class of cognitive science. They were fist engaged in the learning task without the support system. The participants were told that the aim of the task was to learn what is problems posing and how it is done through an example before their own problem posing task. Prior to start of the learning task, the following problem was presented as a base.

> *Base*) I bought some 60-yen oranges and 120-yen apples for 1020 yen. The total number of oranges and apples was 12. How many oranges and apples did I buy?
> Solution.
> Let x denote the number of oranges and y denote the number of apples.
> $x+y=12$
> $60x+120y=1020$
> According to the equations above, $x=7$, $y=5$.

The base was printed in sheets of paper provided the participants. The participants were also presented the following problem as an example on a big screen of the classroom.

> *Example*) Last year I bought some 40-yen pencils and 110-yen pens. The total number was 13. This year I bought 2 times as many pencils as last year, the same number of pens as last year, and a 300-yen pen case for 1430 yen. How many pencils and pens did I buy last year?
> Solution.
> Let x denote the number of pencils and y denote the number of pens.
> $x+y=13$
> $40*2x+110y=1430-300$
> According to the equations above, $x=10$, $y=3$.

The example has the setting of purchase of goods identical to the base, and a solution formed by adding a third object other than x and y objects and an operation to calculate a coefficient of x in the lower equation to the base. Thus, it belongs to Category I / D in Figure 2.

When starting the task, the example was removed from the screen. The participants were asked to reproduce the example based on generation process information printed in the sheets. The generation process information contained the situation, numeric parameters appearing in the text, a basic structure of the solution, mathematical operations added in the solution, and keywords in the text of the example. It explicitly indicated that the situation of the example was identical to the base and the solution was altered. The participants were also instructed that they didn't have to completely literally reproduce words in the text of the

example as long as the contextual setting and equations in the solution were appropriately reproduced.
The participants were then engaged in the novel generation task. In this task, the following problem solved with a unitary equation was presented as a base.

Base) I want to buy some boxes of cookies. If I buy some 110-yen boxes of cookies, then I have 50 yen left. If I buy some 120-yen boxes of chocolate cookies, then I need 20 yen more. How many boxes do I want?
Solution.
Let x denote the number of boxes.
$110x + 50 = 120x - 20$
According to the above equation, $x = 7$

They were told that their problems had to be necessarily solved with unitary equations and any problems in other domains were unacceptable.

1.3 Data Analysis

Participants were classified into groups based on problems they reproduced in the learning task. The groups were as follows.

Reproduced Appropriately (R-A): succeeded in composing a problem whose contextual setting and solution were identical to the example
Reproduced Sufficiently (R-S): almost succeeded in composing a problem identical to the example but partially changed its contextual setting (actually, *2 times* in the problem was not used as the number of pencils, but as the price of a pencil)
Reproduced but Modified (R-M): succeeded in composing the same solution structure but partially changed its surface parameters (numerals and their objects)
Altered solutions (A): composed a problem whose solution was different from the example
Lacked parameters (L): didn't succeed due to absence of numeric parameters, such as 300 (the price of a pencil box) or 13 (the total number).
Inconsistently composed (I): didn't succeed due to inconsistency between a text and a solution of a problem composed, although the solution was identical to the example

Problems newly composed by the participants in the novel generation task were categorized into the four categories in Figure 2. We also analyzed problems posed by altering solutions, from the aspect of structural complexity. However, this paper doesn't present more detail on the results in the novel generation task due to limitations of space. They will be reported precisely in another paper.

2. Results

One hundred and thirty-two undergraduates participated in the investigation. In the results below, eight undergraduates who didn't complete the learning task were excluded.

2.1 Problems Reproduced in Learning Task

Figure 3 indicates the proportions of participants in each group in the learning task. Although half of the problems were appropriately or sufficiently composed, the others were different from the example in some ways.

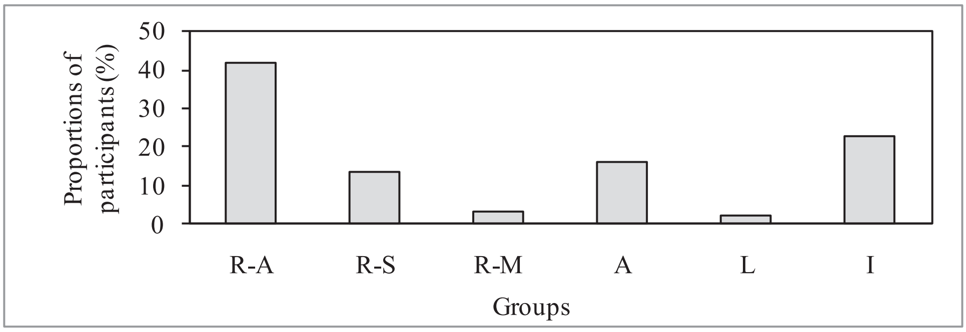

Figure 3. Proportions of reproduced problems in each group

2.2 Problems Posed in Novel Generation Task

In the following results, problems in domains different from the base and unsolvable problems were excluded. Figure 4 indicates the proportions of posed problems in each category in the novel generation task. “C” in the figure, denoting a *control* group, is the result of undergraduates who were engaged in the same novel generation task in the previous study [8] without learning of any example. This revealed that few problems in I / D were posed without supportive intervention. Although no significant differences between most of the groups and the control group were found due to the small numbers of participants, there was a significant difference between the R-A and control groups ($\chi^2(3)=15.29$, $p<.01$). Residual analysis revealed that the number of I / I problems was high in the control group and low in the R-A group ($p<.05$), and that of I / D was high in the R-A group and low in the control group ($p<.01$). Thus, appropriate reproduction of the example increased posed problems in I / D.

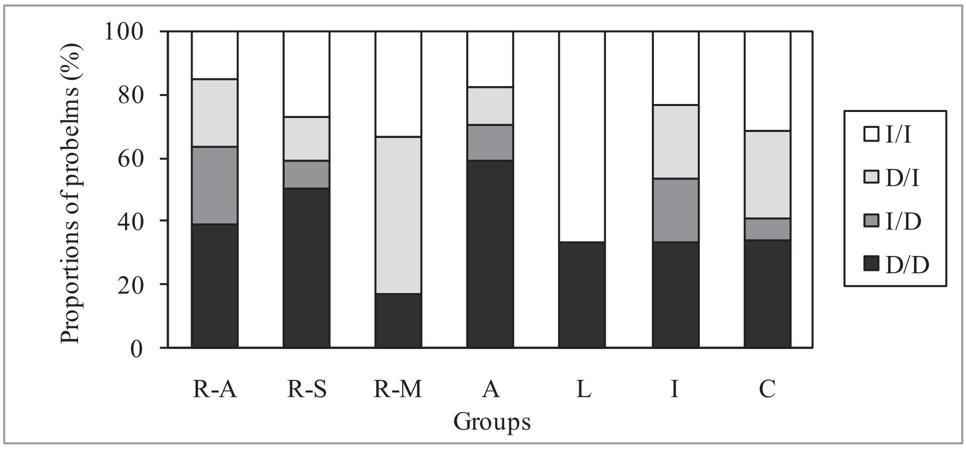

Figure 4. Proportions of posed problems in each category

Figure 5 indicates the proportions of problems posed by altering solutions whose operations in the solutions increased or decreased from the base. In the control group, half of the solution-altered problems were simpler than the base. The I group also posed many simple problems, whereas the R-A group posed many complex problems. There was also a significant differences between the R-A and control groups ($\chi^2(2)=11.36$, $p<.01$), and no difference between each of the other groups and the control group. Residual analysis revealed that the number of increase was high in the R-A group and low in the control group ($p<.05$), and that of decrease was high in the control group and low in the R-A group ($p<.01$). Thus, the appropriate reproduction also increased posed problems more complex than the base.

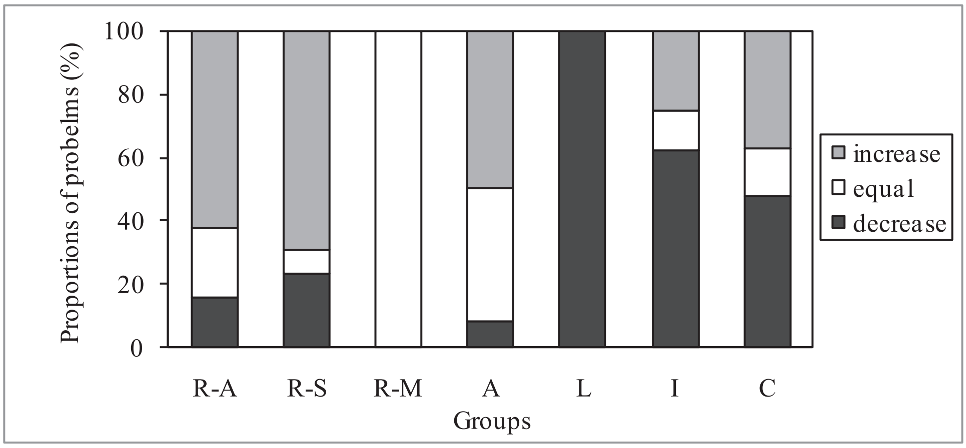

Figure 5. Proportions of solution-altered problems whose operations increased or decreased

3. Discussion

3.1 Failures in Reproduction

Despite sufficient information to reproduce the example was provided in the learning task, not more than half of the participants exactly reproduced it. The R-S and R-M groups didn't exactly do, though, their problems had solution structures identical to the example. Thus, it can be regarded that the two groups almost succeeded in the reproduction.

The A group didn't reproduce the example but composed problems different from the example. Therefore, the participants in the groups must have merely misunderstood the instruction in the learning task.

The participants in the I groups failed in reproducing the example. Although they described the same solution as the example, their problem texts were inconsistent with the solution. In the texts, some mathematical relationships were incorrectly described or inappropriate relationships were included[1] so that the solution was never formulated from the texts. Therefore, the participants didn't understand the inconsistency. Of course, none of the participants must fail in solving the example, which is a quite simple problem for undergraduates. We preliminary confirmed that undergraduates can successfully solve it [7].

The L group also failed in the reproduction. However, all of their problems could be completed by adding a description such as "the total number of the pencils and pens was 13". Thus, the participants must have carelessly forgotten to include some numerals into their problem texts.

As described in Section 1.1, the reproducing task adopted in this investigation is used in our support system [6]. No participants failed in the same reproduction task in an experimental evaluation of the system [9], although a few participants composed problems different from the example like the A group did. According to the facts, novice learners who successfully poses problem with supporting intervention can fail in appropriate problem posing without the intervention. Another important insight is that novice learners occasionally pose problems whose texts and solutions are inconsistent. To improve problem posing of novice learners, hence, further support is needed to endow the learners with a skill to appropriately compose problems.

[1] Some examples of problems in the learning task are presented in Appendix.

3.2 Novel Problem Posing after Learning

As described in Section 2.2, learning through appropriate reproduction of the example increased posed problems in I / D. It also increased problems whose solutions were more complex than the base, because the example allowed the participants to learn how to add operations. These results in the current study are consistent with experimental evaluation of the support system in the previous study [9]. On the other hand, sufficient learning effect wasn't gained through inappropriate reproduction.

According to the results in Figures 4 and 5, half of problems posed by the I group were in I / D or D / D, which fact indicates that many of the problems had solutions different from the base. The I group varied solutions in their problem posing to some extent. However, such problems in the I group were mostly simpler than the base which was quite simple and elementary. Therefore, the participants in this group didn't thoroughly learn the example, although they were examined it.

4. Conclusions

This study experimentally investigated problem posing by novices and empirically described their failures. In our investigation, participants were engaged in a learning task to reproduce an example and a novel generation task to pose their own problems, with the results indicating that some participants composed problems whose texts and solutions were inconsistent, in other words, they failed in reproduction. Our next task is, of course, to study and design a supporting method to prevent such failure in the learning activity.

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Appendix: Examples of problems in Learning Task

A group

I bought some 100-yen apples and 30-yen bananas. The total number was 13. I gave a 1000-yen bill and received 190 yen as the change. How many apples and bananas did I buy?

Solution.

Let x denote the number of apples and y denote the number of bananas.

$x+y=13$

$100x+30y=1000-190$

According to the equations above, $x=6$, $y=7$.

I group

Last year I bought some 40-yen pencils and 110-yen pens. The total number was 13. <u>This year I also bought 13 pencils and pens</u>. The number of pencils this year was 2 times as many as last year. In addition to pencils and pens, I bought a 300-yen pencil box. The payment was 1430 yen. How many pencils and pens did she buy?

Solution.

Let x denote the number of pencils and y denote the number of pens.

$x+y=13$

$40*2x+110y=1430-300$

According to the equations above, $x=10$, $y=3$.

(The total number this year is wrong)

A girl bought pencils and pens. The total number was 13. <u>The number of pencils was 2 times as many as pens</u>. A pencil was 40 yen and a pen was 110 yen. She found a 300-yen lovely pencil box near the cash desk, and took it with pencils and pens. The payment was 1430 yen. How many pencils and pens did she buy?

Solution.

Let x denote the number of pencils and y denote the number of pens.

$x+y=13$

$40*2x+110y=1430-300$

According to the equations above, $x=10$, $y=3$.

(Parameters associated with the relationship "2 times" are wrong)

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A Phone-Based Question Management System to Facilitate Questioning and Comprehension Monitoring

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Abstract: Research showed that only very small proportion of questions in class was posed by students. Students tended to ignore the questions encountered in class. They were unlikely to actively tackle their confusion or questions. Therefore, the goal of this study is to develop a mobile phone based questioning management system. By integrating mobile phones, course materials with online discussion forum, the system can assist students to ask, trace, monitor and solve comprehension questions encountered in class or after class. From functional perspective, in class or after class when studying, students can: (a) capture contents of paper slides or online courseware, assemble the contents with questions as a whole, and post the assembled questions on a discussion forum via mobile phones; (b) monitor and track the status of post questions via mobile phones as well as organize their personal notes based on the questions during the processes. From the result of formative evaluation for the question management system, students thought the mark mechanism helped questioner enhance the clarity of the questions and thought the progress icons helped them monitor question resolving state and comprehension regarding instructional materials.

Keywords: Comprehension monitoring, questions management system, mobile learning

Introduction

Effective learners are sensitive to their knowledge deficits. They adopt self-regulatory strategies to improve their knowledge deficits [8]. Research also showed that effective learners can monitor and correct their failures in comprehension [16]. Students inevitably will confront with difficulties regarding course contents or teaching materials. In many cognitive models, questions and confusion are the foundation of the text understanding and social behavior [9], as well as the basis of problem solving [10]. However, according to research, a very small proportion of questions were asked by the students in the classroom settings [8]. Students seldom ask questions or take meaningful strategies during or after the classes. Many factors and costs affect a student's motivation to ask [13], which Graesser [8] pointed out that physical and social factors affect the way in which students deals with their confusion. Physical factors include the gap between the questioner and the answerer. Social factors include the colleague's negative feelings towards the questioner. Only when students break the social and physical barriers, the students will have the motivation to ask questions and try to solve the questions.

Many studies has been attempted to enhance student's quality of questions and the motivation to ask questions through computer supported systems. Among these systems, a discussion forum is the most common and popular components [11]. Some Web-based or mobile discussion forum systems provided students with a place to review and express their confusion regarding instructional materials [e.g., 12, 14]. Student discussed together on a forum and resolved their questions collaboratively. However, the design goal of these Web- or phone-based forums seems mainly for discussion but not for the support of question solving. Mechanisms that help learners monitor and evaluate the status of questions were not explicitly supported. Several studies also employed mobile devices to facilitate information organization [e.g., 6], collaboration [e.g., 17], or communication with messages [e.g., 5]. However, few of these tools emphasized the integration of mobile devices with paper-based materials and supported the process of question resolving.

Q&A (Question and Answering) system [e.g., 1] provides a place for students to find answers based on questions. Some of the systems are featured in learning communities and others provide FAQ lists. These systems provide well-designed knowledge structures to help learners find out the answers of questions. These structures also require learners to have certain skills or background knowledge so that they can find target answers effectively. On the other hand, class communication tools [e.g., 3] provides an interactive channel between teachers and students in class. These tools assist teachers to instantly assess students' learning status and adjust the teaching strategies accordingly. However, this kind of tools generally requires dedicated equipments or settings.

Although resolving question has become a major role in student knowledge acquisition process, most computer supported systems seldom emphasize the process of the questioning resolving. Practical classroom environment seldom guarantee personal computers for every students. This will leads to a problematic situation that student's confusion and context of their questions are difficult to be captured. With advance of mobile and computer technologies, mobile phones become popular and create possibilities of ubiquitous learning. Due to the requirements of questioning in classroom environments, the goal of this study is to develop a mobile phone based questioning management system. By integrating mobile phones, course paper-based materials with online course-based discussion forum, the system can assist students to ask, trace, monitor and solve comprehension questions encountered in class or after class. From functional perspective, in class or after class when studying, students can: (a) capture contents of paper slides or online courseware, assemble the contents with questions as a whole, and post the assembled questions on a discussion forum via mobile phones; (b) monitor and track the status of post questions via mobile phones as well as organize their personal notes based on the questions during the processes.

1. Stages for questioning management

When students confront with difficulties and attempt to solve them, search for answers, self-regulation and decision making are involved. To ask a question, Graesser [8] suggested three components of question asking: anomaly detection, question articulation, and social editing. In this paper, we based on Graesser's model and extend it with self-regulatory components for question asking and management. As shown in Figure 1, regarding a question, suggested stages are confusion discovery, question formulation, question announcement, response evaluation, and Q&A organization. For the confusion discovery stage, according to Piaget's cognitive-developmental theory, the mismatch between external information and a learner's internal knowledge structures causes cognitive disequilibrium [15]. This mismatch initiated by new information generates confusion. This stage corresponds to anomaly detection component of Graesser's questioning model.

If the confusion discovered cannot be transformed into a form of questions, it will be difficult to assess and manage. Therefore, question formulation not only encourages students to retrieve their prior knowledge but also enables devices for students to evaluate or construct knowledge base on the questions. This stage corresponds to question articulation component of Graesser's model and requires support to help students formulate questions with clarity. For the question announcement stage, students uncover their questions to a learning community. According to Vygotsky's zone of proximal development, student's cognitive development requires help from more capable peers or teachers [15]. The display of questions may enhance the interaction, discussion, or collaboration among classmates or teachers. This stage corresponds to social editing component of Graesser's, which suggests that a questioner evaluates the benefit and cost of questioning in order to decide whether to raise questions for help in the public. This stage requires the support to lower the cost and increase the benefit of questioning.

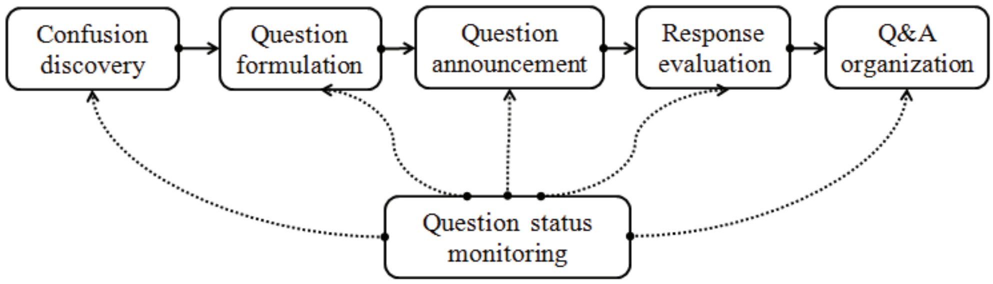

Figure 1. Process of question monitoring

Feedback for questions from peers and teachers is crucial for questioners to evaluate whether they have resolved the questions. During the evaluation, the questioners themselves have to critically assess the contribution of replies, which benefits the construction of knowledge [2]. The response evaluation stage also requires questioners synthesize from difference sources and filter out irrelevant information. Finally, the Q&A organization stage provides students with support that enables connections between questions and corresponding answers. Based on the results of question evaluation stage, students draw conclusions from relevant feedback. Research found that making notes and summary help students establish their own knowledge architecture [4], and create effective knowledge structures. The proposed questioning stages make question-resolving explicit and systematic. Students can follow the suggested steps and expect the arriving tasks for the planning and management of their learning resources. As showed in Figure 1, five-stage question resolving framework is used to develop the phone-based question management system.

2. System design

Figure 2 shows the system architecture of the question management system. The system incorporates mobile phones, paper-based slides, and online discussion forum to facilitate students to trace, monitor and to solve their comprehension questions. The paper-based slides are embedded with unique barcodes so that students can use a camera-based phone to scan the codes and formulate their questions regarding specific confusing areas of slides. The questions together with confuse-marked slides can be post on an online discussion forum. Trough discussion by other students, feedback and answers are gathered and stored in a learning portfolio database. Students can monitor the current status and know the latest feedback and questions updates. Students can evaluate the feedback of questions which are most relevant and mark the feedback as useful messages. Finally, students organize questions and answers for future reference.

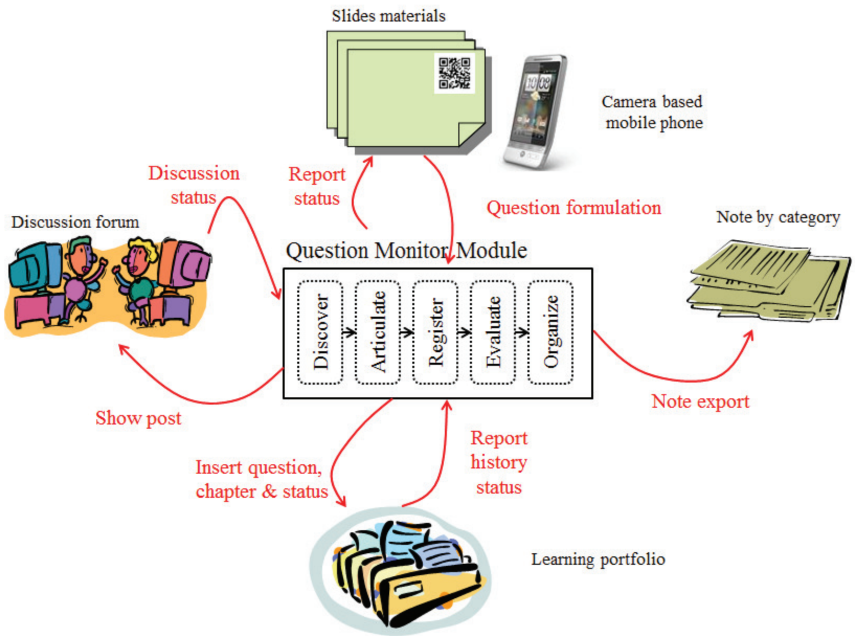

Figure 2. System architecture

2.1 Support for question asking

On a tradition discussion forum, a questioner often has to descript the question clearly. But most of the person who asked is only a beginner and the knowledge is limited. Some student thinks that asking directly with a book is much faster and easier because they can point out the question and describe using symbol and draft. We take this scenario into a classroom, we need to ensure that when students face difficulties they can capture the difficulties immediately and transform them into questions which can be discuss with others. For this point some students may only need examples to understand or they totally don't understand with the content of lecture slides. As shown in Figure 3(a), a lecture slide evenly divided into 9 regions, each region is selectable by touching the regions. The marked regions are highlighted with green color. Students can mark the areas where the students feel confused. They can either find related question on this slides or create a new question based on the marked areas.

With these marks students can intuitively know where they are confused and it is helpful for other students who would like to answer the questions. When the student click the "Ask a question" button, another form for question formulation appears (Figure 3b). A question bank is prepared for students to choose suitable questions. This saves time for students as mobile phones may slow down text input process. After choose the most suitable question the student can add-on additional description for questions at the box provided. At the left side of the screen the marked slide is sown for reference. The students have the choice to keep the question to their self or post out to public area for discussion. After posting questions, students can see their questions are shown on a discussion forum from a question register list (Figure 3c). The system automatically sets the title as a combination of question description, the details of the questioner and the marked slides. Students can freely switch the display of questions between traced and non-traced questions.

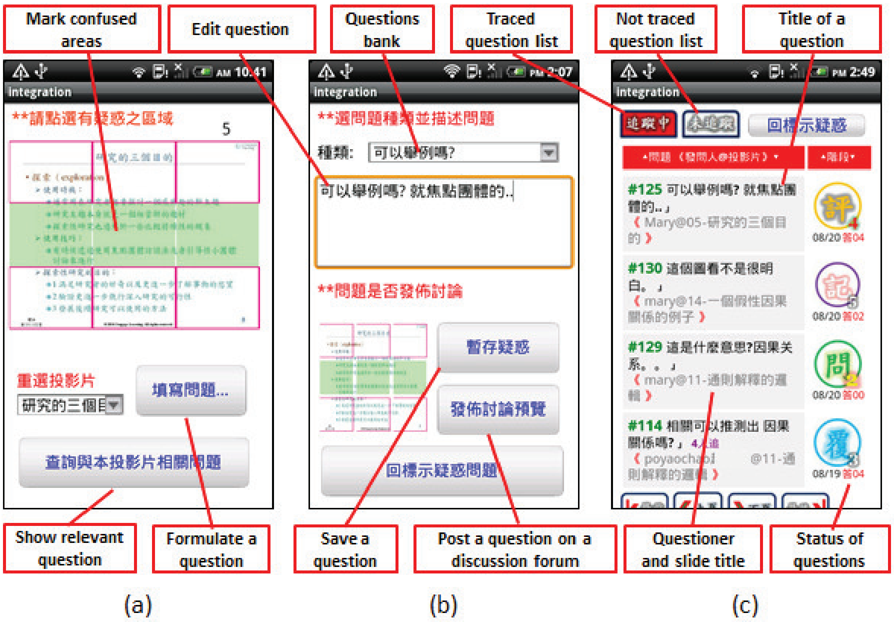

Figure 3. (a) Mark confused areas of a slide; (b) formulate questions based on marked regions; and (c) a list of questions with status icons

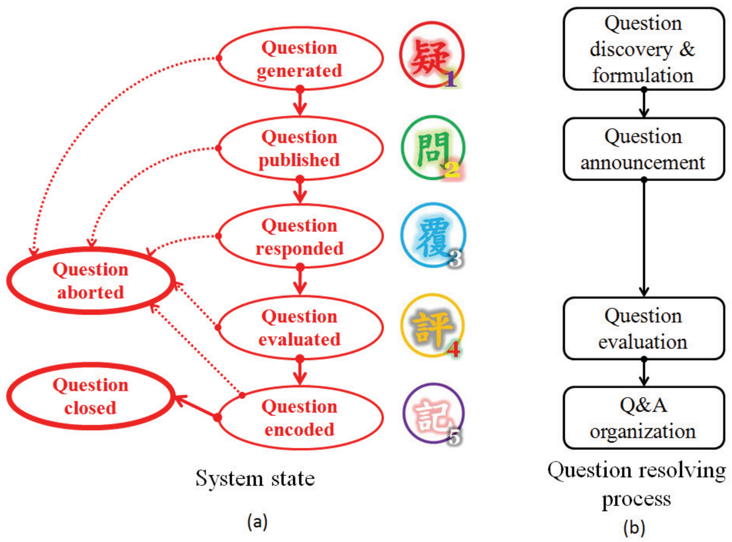

Figure 4. System state and question resolving process

2.2 Support for question resolving and monitoring

Students can monitor the progress of their question as shown in Figure 3(c). Question status represented in the system are categorized into 5 states (Figure 4a). Except the question responded state, each stage in question resolving process is initiated by questioners and corresponds to one state represented in the system. For example, the question generated state stands for the time when students mark down where they are confused and formulate corresponding questions. Therefore, from student's discovery of confusion to organization of Q&A notes, the system has corresponding state in every stage (Figure 4b).

Figure 5(a) shows a student respond to a question. Students name and time of responses will be recorded when a student makes a post. Students can choose to reply the post or evaluate the post when enough post is available. Student who asked the question can delete the question if he/she found out that the questions is not suitable. Students who trace a question can stop tracing the question if no longer of interested. Figure 5(b) shows a post being selected as useful. When the questioner decides to evaluate the answer, he/she will choose appropriate answers from different students and mark it as useful. These answers then will be transfer to Figure 5(c) which shows the editing of the selected post and being transformed to a note.

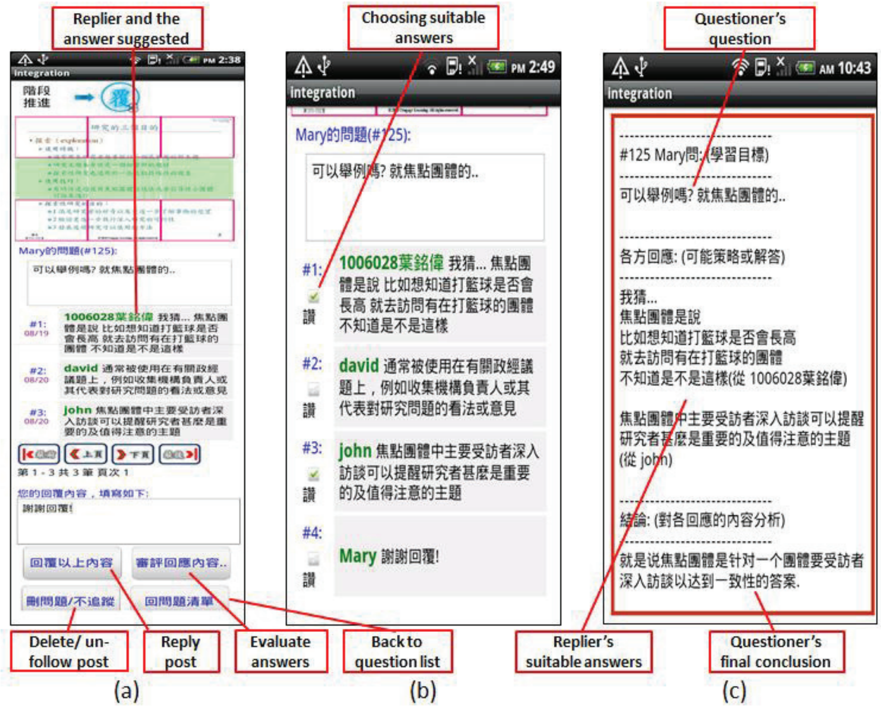

Figure 5. (a) Respond to questions; (b) evaluate replies from different sources; and (c) organize questions and useful replies

3. Evaluation

A formative evaluation was conducted to examine the system's usability and it's implication on question resolving. Flagg [7] stated that formative evaluation is one of the most critical steps in the development of learning materials. The goal of the formative evaluation is to help system designers during its early development stages improve system's quality.

3.1 Participants and procedure

We adopt user-based evaluation that involves users completing tasks in an appropriate environment. In this study, five graduate students aged around 23 (4 male and 1 female) majoring in information communication in a university participated in the formative evaluation. Each participant was given a camera-enabled mobile phone. These mobile phones can read barcodes and connect with the Internet through wireless networking functions. Paper-based slides included 50 A4 printed pages and each page is embedded with two dimensional barcodes. Participants were asked to study the paper-based slides during one week evaluation. They are also asked to use the question management system for comprehension question resolving.

Participants were asked to write down operational difficulties and opinions in diary. At the end of the evaluation, participants are asked to perform specific tasks and interviewed. Therefore, observation, interview, and computer logs were collected for analysis.

3.2 Question formulation

There are 43 questions posted by participants using the question management system during the evaluation (9 in stage 2, 13 in stage 3, 18 in stage 5, and 2 questions been deleted). Overall there are 70 replies message during the one-week evaluation and a total of 33 notes has been generated (15 duplicated notes which copied by other students).

From question formulation aspect, three out of 5 students used to generate questions without posting it on discussion forum first. They thought that the clarity of the questions was important before announcement of questions. They would make sure that other people could understand what they were asking about. For example, one of the student states “I usually generate a question whenever I think the confusion exist without posting it out first. After finishing the chapter, I will then refine the question…” The register of questions helps them find answers from rest of the chapter and then refine the questions.

We also found that all participants thought the mechanism of marking confused regions would benefit them. The mechanism helps them shorten the questions when asking. Since there is a marked slides aided, the question would be expressed in a more clear and specific way. Moreover, with the help of marked slides, students can better understand other students' questions and provide feedback. This mechanism is especially beneficial when asking questions regarding figured-based slides.

3.3 Question resolving and monitoring

Representing questioning stages by icons provides students with guidance in question resolving and helps them develop a processing priority. Students finished question resolving stage by stage. These progress icons assisted students to predict incoming stages and the course toward their goals. For example one student said “I would go from post stage to evaluation stage and then create my notes…” The progress icons also helped students develop personal processing priority and adopt different strategies accordingly. For instance, one student said “I would first read questions which have reached the final stage because the questions usually have specific conclusions. Then I will read questions that most students have responded to them…”

Students also used the progress icons to assess the degree of comprehension to the lecture slides. The overall state of the questions may also influence students' confidence to the mastery of lecture slides. Most students reported that the more questions in organized stages, the more confidence to a test they can have. On the other hand, if most of a student's questions still stay in question published stage and no followers trace the student's questions. The student will come to a conclusion that he/she may post questions with low quality or importance.

All participants' thought the questions organized as notes was beneficial to questioner and the students tracing them. Four out of 5 participants reported that they would copy their notes in the system and annotate the notes on their textbooks or slides. They all confirmed that these notes are useful when preparing for a test.

4. Conclusion

The goal of this study is to develop a mobile phone based questioning management system that assist students to ask, trace, monitor and solve comprehension questions encountered in class or after class. Students use mobile phones to capture contents of paper slides, assemble the contents with questions as a whole, and post the assembled questions on a discussion forum. The system tracks questions stages and provides students with progress icons to help monitor and trace the status of post questions as well as organize their personal notes based on the questions during the processes.

From the result of formative evaluation, students thought the mark mechanism could help questioner enhance the clarity of the questions. This is especially useful for novice students with limited background knowledge. Students also thought the progress icons could guide them to the final stage of question resolving and help them assess the comprehension regarding instructional materials. Some students provided useful suggestion for the system. First, a summative status report was suggested. Students could know the distribution of question stages and tackle with different strategies accordingly. Second, a function of anonymous reply seemed useful for students to provide advice or feedback. This is especially beneficial for students who would like to contribute their opinions but fear to make mistakes.

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Stepwise Selection of English Multiple-choice Cloze Questions Based on Difficulty-based Features for Keeping Motivation

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Abstract: We had constructed the automatic generation system of English multiple-choice cloze questions. By using the system, plenty number of questions can be generated automatically, but learners become difficult to find appropriate questions. Therefore, objective of this research is to develop the method for providing questions that fit for learners. In the self-learning, questions that increase motivation for learners are effective. This research determines features that affect to difficulties of questions (difficulty-based features) and proposes the method for selecting questions according to the difficulty-based features for the stepwise learning. In order to manage the relations among questions, a question network is introduced in which questions are structured based on differences of each difficulty-based feature. Questions are selected by following appropriate links according the learners' answers..

Introduction

Multiple-choice cloze questions are often used in English learning. Such type of question is effective for checking the knowledge of grammar and lexicon. In addition, by tackling these questions repeatedly, the knowledge of English grammar and lexicon is able to be acquired. Only limited number of knowledge is included in one question, so many questions are needed to be solved for the purpose of acquiring whole grammar and lexicon knowledge. We have constructed the automatic generation system of English multiple-choice cloze questions; MAGIC [1]. By using the system, multiple questions can be generated automatically. However, to fit questions to learners' understanding situation is not focused. If difficult questions are posed to learners repeatedly, they do not feel like studying with the system for a long time.

Since questions contain plenty knowledge of grammar and lexicon, it is sometimes difficult to determine acquired/ in-acquired knowledge. In addition, learners' motivation is affected by their feelings whether they think "difficult" or "easy" for the questions. Such feelings may arise from the superficial features of questions. If the features of questions indicate that the question is too difficult, learners do not feel like tackling the questions. If the question is too easy, learners think questions are meaningless for them.

Traditional Intelligent Tutoring System or computer-adaptive testing tends to provide learning con-tents/test items that are appropriate for learners' understanding knowledge [2-4]. These systems analyze learners' acquired/in-acquired knowledge from their learning activities, such as answers of exercises. However, questions that are selected based on such knowledge-based approach do not always keep learners' motivation. Therefore, the objective of this research is to develop the method that provides questions based on the features that affect to learners' motivation (difficulty-based features). Difficulty-based

features consist of more than one feature, and learners' feelings for these features may be different for each learner. So, the basis for selecting questions should be dynamically changed according to the learners.
Currently, target questions are questions that are generated automatically by MAGIC. So, the difficulty-based features need to be acquired systematically from the generated questions. Target learners are non-native speakers who do not understand basic grammatical knowledge.

1. Difficulty-based Features of English Multiple-choice Cloze Question

Figure 1 is an example of English multiple-choice cloze questions. A question consists of *sentence*, *blank part*, and *choices*. Choices include one correct choice and three distracters. Learners select one from choices for filling in the blank part.
There are various definitions or findings about difficulty features of English questions. Kunichika et al. defined difficulty features of English passage reading questions for non-native speakers as difficulties of *understanding of original texts*, *understanding of question sentences*, and *understanding of answer sentences* [5]. In English multiple-choice cloze questions, both original text and questions sentence correspond to question sentence, and answer sentences correspond to distracters. Therefore, following difficulty-based features are defined.
1) Difficulty of sentence --- Readability is one of the features that prevent learners of understanding the meaning easily. Researches about readability of English sentences insisted that lengths of sentences or difficulties of words affect to the readability [6]. Based on this result, *lengths of sentence* and *difficulties of words* are defined as one of the difficulty-based features of a sentence.
2) Difficulty of distracters --- There are various relations between distracters and a correct choice. In some questions, all distracter types are the same. The number of the distracter types affects to the difficulty of questions. If all distracter types are the same, it is easier to find the correct choice. On the other hand, questions become more difficult if similar types of distracters exist in it. Therefore, *the number of distracter types* in choices is defined as a difficulty-based feature. As the distracter types, 12 types defined in MAGIC are applied.

2. Question Selection Method Based on Question Network

Learners are motivated to learn repeatedly if difficulties of questions become gradually increasing. If questions seem easy, learners feel that they cannot acquire new knowledge from it. Appropriate questions for learners should contain a little difficult difficulty-based feature than those in solved questions.
In order to represent the stepwise relations among questions, a question network is introduced that organizes all questions based on difficulty levels for each difficulty-based feature. In the question network, questions in the same levels for all difficulty-based features form one node, and nodes whose levels are next to each other are connected by links. By following this question network, learners are able to tackle questions from easier one to more difficult one according to their understanding levels. Figure 2 illustrates the conceptual framework of the question network. Nodes without incoming links correspond to the easiest questions. Nodes without outgoing links have the most difficult questions.
The levels of each difficulty-based feature are defined as follows.

- Length of sentence---The number of words is regarded as one of the viewpoints of defining the length of sentence. Based on the analysis of 1500 questions in the database of our laboratory, it is revealed that sentences consist of 4 to 32 words. Thus, we

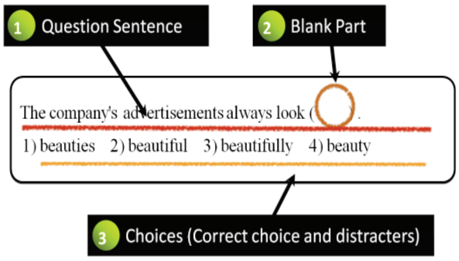

Figure 1: Example of English multiple-choice cloze question

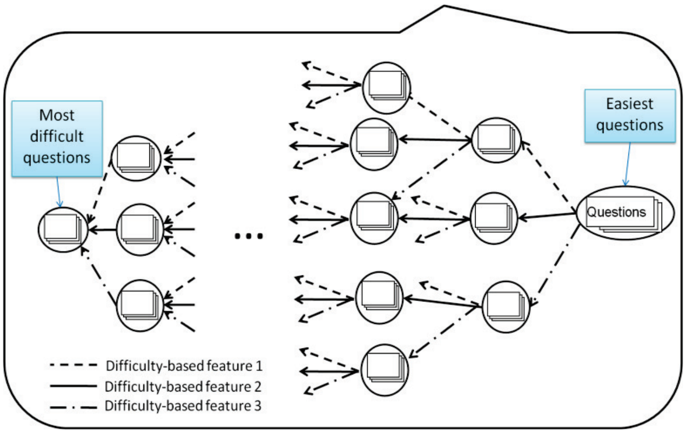

Figure 2: Conceptual framework of question network

categorize the length of sentence into four levels according the number of words. Table 1 shows the levels of the length of sentence.

- Difficulty of words---In this research, the difficulty of words followed SVL12000[7], which is the list of word difficulties defined by ALC. In SVL12000, 12000 words that are useful for Japanese are classified into five levels of difficulty. The level of a question is defined as the highest level in all words including the sentence and choices.
- The number of distracter type---Distracter types correspond to generation rules to generate distracters in MAGIC. Since choices of the same distracter types may be more difficult than that of the different one, the difficulty based on the number of distracter type is set as Table 2

Table 1: Levels of length of sentence

Level	1	2	3	4
# of words	less than 11	12 to 18	19 to 25	more than 26

Table 2: Levels based on the number of distracter type

Level	1	2	3
# of distracter types	3	2	1

Using the question network, learners' next questions are selected based on the answers of former questions. Figure 3 shows the process of selecting questions from question network. Currently, we assume that the set of questions is given at one learning.

STEP1: Based on the answers for questions in the last learning, learners' levels for each difficulty-based feature are determined. Levels for each difficulty-based feature *i* for time *t* are calculated as Equation 1. The average differences of solved questions from current level are added to the current level. In the first learning, *Level (i, t-1)* is zero.

$$Level\ (i,t) = Level\ (i,t-1) + Av.distance\ of\ solved\ questions\ from\ current\ node \quad \ldots (1)$$

STEP2: The number of solvable nodes becomes large if the learner solved questions in farther node, while it becomes small if the learner only could solve the questions in the nearer nodes. The range of solvable nodes at time *t* is calculated by Equation 2.

$$Range(t) = Range(t-1) + \begin{pmatrix} Ave.distance\ to\ solved\ questions - \\ Ave.distance\ to\ incorrectly\ answered\ questions \end{pmatrix} \quad \ldots (2)$$

STEP3: Questions are selected from several solvable nodes. More questions should be selected from nodes that are nearer to the learner's current node. The probabilities for selecting questions for each node *i* is calculated by Equation 3. The ratio of questions from node *i* in all questions is determined by following the normal distribution based on the distance from the current node.

$$Probability(i) = \frac{1}{\sqrt{2\pi}} exp\left(-\frac{Distance\ of\ node\ i\ from\ current\ node)^2}{2}\right) \quad \ldots (3)$$

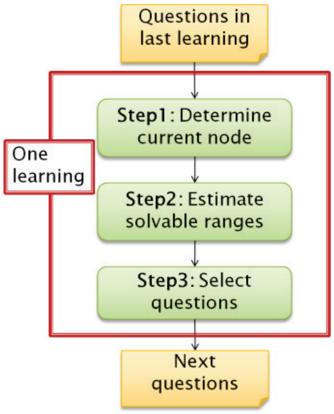

Figure 3: Process of selecting questions

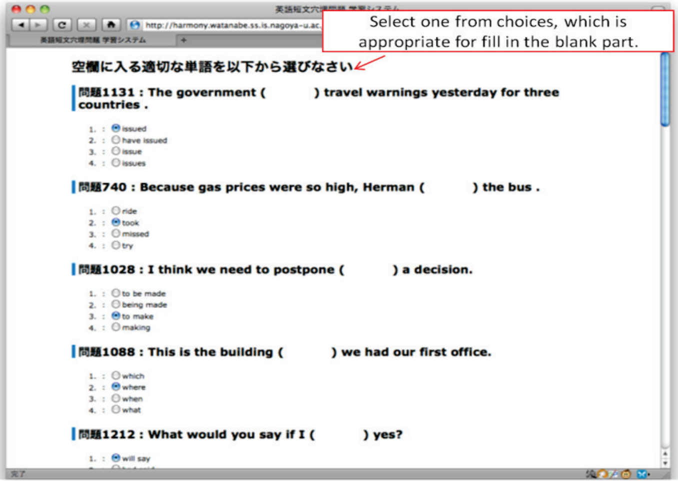

Figure 4: Interface of Prototype System

3. Evaluation

Experiments were conducted using the prototype system. The prototype system is implemented as a web-based system. When the learning starts, the selected questions are shown in the web page as shown in Figure 4. Currently, 10 questions are selected in one learning phase. Learners answer the questions by selecting the radio buttons of the correct choice. After learners select all answers and push the send button, their answers are evaluated, and the result and explanation are displayed.

12 members in our laboratory became examinees of the experiment. First, examinees were asked to solve a pretest which consists of 20 questions and examinees' initial levels were calculated based on the result of the pretest. The questions were carefully prepared by authors to include all levels of difficulty-based features as the equal ratio. In the learning phase, they were asked to answer 10 questions for 10 times. All 10 questions are different.

As the counter methods, we have prepared following two methods:

- **Random link selection method (RLSM)** which selects links randomly in selecting nodes in the question network,
- **Random question posing method (RQPM)** which selects questions randomly from the database.

In RLSM, the movement of the node occurs when the learner can solve 70 percent of the questions in the node. 4 examinees were assigned for each method. Averave understanding levels of examinees who assigned for each method were almost the same.

The correct questions in each learning were evaluated. Table 3 is the average number of correct questions and its variance for each learning. The average numbers are almost the same for all three methods. However, the variance of our method is the smallest of the three. This indicates that the number of correctly answered questions is almost the same for every learning. This result shows that our method could provide questions whose levels are similar to the learners, even if the understanding levels of learners change during the 10 learning.

Table 3: Result of learning phase

	Average # of correct questions	Variance of # of correct questions
Proposed method	5.725	1.585
RLSM	5.850	2.057
RQPM	5.825	2.665

The questionnaire result for acquiring the consciousness of examinees for the proposed questions is shown in Table 4. In each questionnaire item, 5 is the best and 1 is the worst.

Items 1 and 2 got high values. Based on the result of item 1, examinees felt questions become difficult as the learning proceeded. Based on the item 2, they also felt that words were getting more difficult. Table 5 shows the number of links that examinees who use the prototype system with proposed method followed during the learning. All examinees follow links of *difficulty of words* more than 2 times. The worst result of item 4 may be caused by the small number of following links based on *the number of distracter type*. Based on the result, if links are followed, learner can feel the difficulties of questions. Therefore, questions are arranged appropriately by its difficulties in the question network.

Table 4: Questionnaire result

	Contents	Average value
1	Did the questions become difficult?	4.00
2	Did the words in questions become difficult?	4.00
3	Did the question sentences become difficult?	3.50
4	Did the distracters become difficult?	2.75

Table 5: # of links that examinees followed

	Difficulty of words	Length of sentence	The number of distracter type
Examinee 1	3	1	1
Examinee 2	2	2	0
Examinee 3	2	3	1
Examinee 4	3	1	0

4. Conclusion

In this paper, the method for posing questions based on the subjective difficulty-based features was proposed. Based on the experimental result, defined features are intuitive and match to learners' consciousness. In addition, using the question network which arranges questions according to the levels of difficulty-based features, questions that fit for learners' levels were able to be selected in spite of change of learner's situation during the learning. In our future, we need farther experiments with students of various understanding levels for confirming the effect of our method.

Currently, three difficulty-based features have been prepared. However, there are still several other features in questions, such as grammatical structure. Thus, for our future work, to investigate other features of questions is necessary if they become difficulty-based features or not.

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Incorporating Framing into SQL-Tutor

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Abstract: In this paper, we present our work on framing with the view of implementing it in an Intelligent Tutoring System (ITS). The process of framing a learning activity, in our case problem solving, consists of having the activity in between a pre-action (or priming) phase and a post-action (or reflective) phase. In previous work, we found that simulated framing, in which the priming and reflection phases were led by a human teacher while the learning activity itself was performed in an ITS, significantly reduces learning time and requires less effort for similar gains. This paper presents the next stage of the project, in which the priming phase is implemented in the ITS. We performed a pilot study using the extended system, which resulted in the same trends as simulated framing.

Keywords: Intelligent tutoring systems, framing, teaching strategies

Introduction

In previous work [1] we have presented the initial results on the framing teaching strategy. Framing is a pedagogical strategy that we have distilled from educators' practices in tertiary institutions and high schools. The strategy consists of three sequential phases whereby the learning activity (action phase) is preceded by a pre-action (or priming) phase and followed by a post-action (or reflection) phase. All three phases together form a learning session. In the classroom, students generally participate in the pre- and post-action phases as a group, while the action phase is done either individually or as a group.

The purpose of the pre-action phase is to prepare the student for the learning activity by helping them focus on the concepts that will be used in the learning activity. The aim of this phase is not to teach them the declarative knowledge required but to "set the scene" for the learning activity. Teachers could lead the short, interactive session by (re-) introducing the target concepts, linking them to previously learned concepts, working through examples, discussing common misconceptions, and setting the "boundaries" for the session.

The learning activity phase immediately follows the pre-action phase. Here, the student takes part in some activity that helps them interact with material relating to the target concepts. For example, students might solve problems, engage in discussion, conduct exploratory research, or run experiments. This phase is self-directed, enabling the student to put into practice what they have learned, and the teacher might provide feedback.

Once the learning activity is complete, the teacher leads the students in the reflection phase. The purpose of this phase is to encourage students to reflect on what they have learned in the previous two phases. Students are encouraged to analyze their errors (including the source of these errors) thereby uncovering misconceptions.

There are several theories that make framing a plausible teaching strategy. Cognitive Load Theory [3] suggests that problem solving for novices generates heavy working memory loads, which could be detrimental to learning. To balance these loads, teachers should provide guided instruction, help narrow the problem search space by creating "boundaries" to each session, and alleviate the working memory restriction by making sure that only items relevant to the task are loaded into the working memory. This is exactly what happens during the priming phase.

Meta communication about the presentation of the subject is important for learning [4]. Prior to the learning activity, the student needs to know the boundaries of the lesson segment (exactly what the lesson will contain), which should be well defined by the teacher. The student needs to know the content of the session, differentiating between the old and the new material. They also need to know the links between the new knowledge and previously learned knowledge [4].

Many learning models view learning as a cyclic process, around which knowledge acquisition, knowledge application and reflection occur. Andreasen and Wu [5] discuss a few of the commonly used experiential models. Framing is a simplified (and thus possibly easier-to-implement) version of many of the models.

Reflection promotes deep learning [6, 7, 8]. Critically analysing the learning experience helps challenge the student's underlying perception of the domain, identify and correct misconceptions, and integrate new knowledge with existing knowledge [9]. This also allows the student to transfer the newly acquired knowledge to other types of problems or scenarios. Self-explaining one's actions [10] and monitoring one's progress via open student models [11, 12] have been shown to be useful reflective tools that benefit learning.

Our project consists of three main stages:

1. The learning activity is implemented within SQL-Tutor [2], while the pre- and post-action phases are facilitated by a human tutor. The purpose of this stage was to investigate the potential of framing to improve learning before actually implementing it in the ITS. The results of this stage were presented in [1] are reviewed in Section 1.
2. The pre-action and learning activity phases are implemented in SQL-Tutor. This is the current stage of our project.
3. The reflection phase is also implemented in the ITS.

We chose a suite of metrics early on to validate whether the way in which we implemented Framing helps to achieve the intent. These metrics include Learning Efficiency [13], help-usage metrics e.g. High-Level Help, Requests for Help [14, 15], meta-data about problems solved and problems attempted (including difficulty levels), learning curves, and pre and post-tests. The pre and post-tests were designed by a teacher to measure students' knowledge. The same pre and post-tests are to be used in all stages.

1. Stage 1: Simulating the Framing Strategy

As stated earlier, the purpose of this stage was to simulate the Framing strategy in the manner in which we planned to implement it in the ITS. This helped us gather some information about framing with regards to learning and test out our decisions prior to implementation. We selected a set of target SQL concepts, namely the concepts covered by queries using the *Group By* and *Having* clauses, which students generally find difficult to learn. SQL-Tutor was restricted to only present problems relating to these target concepts. The study was held immediately after the relevant concepts had been covered in lectures. The learning activity was problem solving in SQL-Tutor. The pre- and post-action phase were interactive, whiteboard, group sessions, led by a human teacher. The pre-action and post-action phases were limited to 10 minutes each, while the whole session lasted 100 minutes. In the pre-action phase, the teacher briefly reminded students of the target concepts (taught in lectures previously) and, eliciting student participation, worked through a few examples of varying difficulty. The teacher also discussed typical misconceptions. After interacting with SQL-Tutor, the students were prompted to reflect on their learning experience by commenting on some of their own mistakes. The teacher also showed them the most common mistakes that are usually made during the problem-solving phase. Students were asked to find the errors (in terms of concepts and methods) in those incorrect solutions before collectively working through to reach a correct solution.

Thirty-eight students from a second year database course participated in the evaluation for no monetary reward. We divided participants randomly into two groups: experimental and control. The idea was to perform the evaluation in a setting that was as close to the normal learning environment faced by students. As such, the experimental and control sessions were held during regular course lab sessions. Students in both groups completed a pre-test and a post-test, which were of comparable difficulty and contained three questions relating to the target concepts with the maximum mark of 12. After the pre-test, the experimental group went through priming, followed by problem-solving and reflection phases, which were run as described. In contrast, the control group entered the problem-solving phase immediately after the pre-test. The pre-test, post-test, and problem-solving phases for both groups were identical.

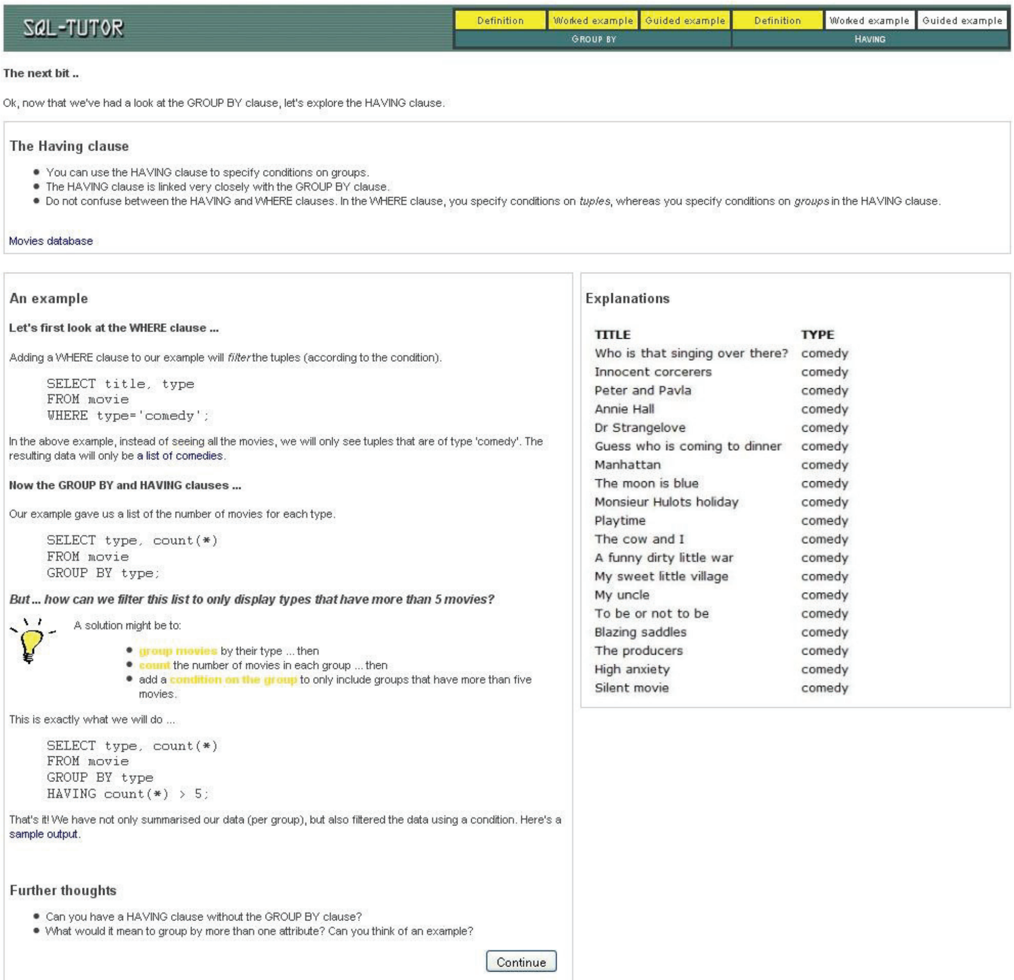

Figure 1: Information about the Having clause

The results of this preliminary study [1] showed that the experimental group had a higher problem-solving speed even though they attempted and solved problems of similar difficulty while using similar levels of help. Furthermore, the experimental group was significantly more efficient in their problem-solving phase than the control group. In other words, while they did not learn more than the control group, they expended significantly less effort and therefore were more efficient.

2. Implementing Priming

We implemented the priming (pre-action) phase within the ITS using the lessons learned from stage 1. The design of this stage was similar, except that we excluded the post-action phase. The pre-action phase contained three steps for each of the target clauses (i.e. three for the Group By clause followed by three for Having clause). Each of the three steps increased from passive to more active in terms of student interaction. The first step contained the declarative knowledge about the clause followed by an example (see Figure 1). The example provided detailed explanation on how to solve the problem, and a possible solution. Students could also click on a link to display the result of the query. A "Further thoughts" section at the end gave more information to extend their knowledge of the clause. Once the student read the information on this page, they proceeded to the next step.
The second (and fifth) step contained a worked example. Students could hover over parts of the solution to get a detailed explanation for that part of the solution. Figure 2 shows the worked example and the explanation for the condition in the Having clause. Hovering over each part of the solution also highlighted the relevant part of the problem statement, allowing students to link the problem to the solution. Students could also click on a link to view the intended output of the query, or view the database schema.
The third (and sixth) step contained a strictly guided example. Similar to step 2, this step contained a problem statement and an empty solution statement (with blanks that the student had to fill in). When the student clicked on one of the blanks, the explanation for solving that part of the problem was displayed. Figure 3 shows the situation when the student asked for the explanation for the blank in the Having clause. The student could click the "Check" button to check their solution. If the student made an error on one of the parts of the solution, the explanation also contained a bottom out hint telling the student what to enter.

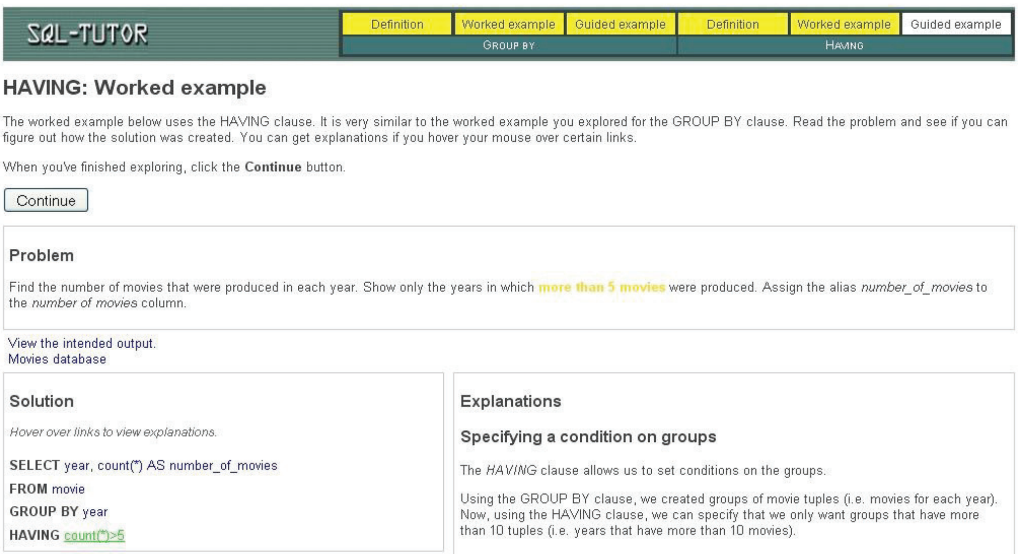

Figure 2: Worked example

The learning activity (problem-solving) immediately followed the six steps of the pre-action phase. This phase was identical to stage 1, where students worked on problems in SQL-Tutor. The problem set was restricted to problems using the target concepts.

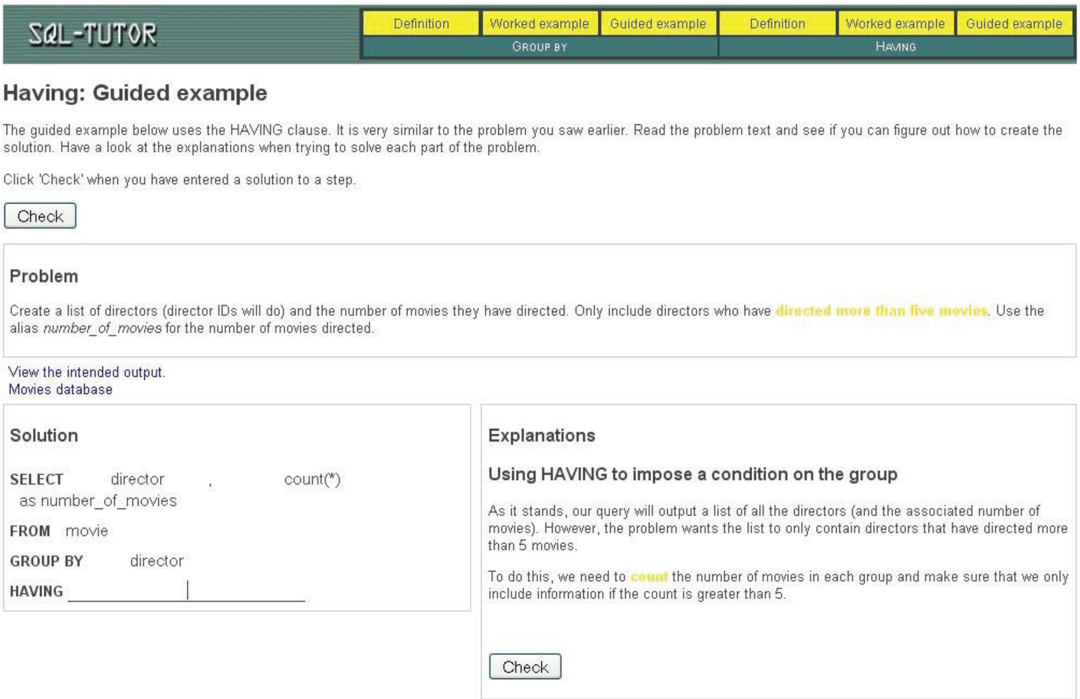

Figure 3: Guided example

3. Results

Thirty students participated in the evaluation for no monetary reward. We divided them randomly into two groups: experimental and control. Two sessions were held during regular course lab sessions (100 minutes long) on 13 and 14 May 2009 respectively. The students participated in the study during the lab session they normally attended throughout the course. Students in both groups completed the pre- and post-test (the same ones used in stage 1 of the project). Following the pre-test, the experimental group went through the pre-action phase in the newly added component, while the control group went directly onto the problem-solving phase.

Table 1: Matched means and standard deviations for test scores (%) and gains

	Pre-test	Post-test	Gain
Experimental group (*n*=5)	57.14% (*s.d* = 39.7)	75% (*s.d* = 16.6)	33.3% (*s.d* = 39.5)
Control group (*n*=12)	52.9% (*s.d* = 26.3)	88.3% (*s.d* = 11.2)	36.6% (*s.d* = 24.7)

The data we collected and analyzed included the pre/post-test results and just over 29 hours (total) of SQL-Tutor student models and logs in which 30 students collectively made 1,769 submissions to the system. There were 17 students in the control group and 13 in the experimental. However, only 17 students sat both tests, and we give the matched results in Table 1. There were no significant differences in the performances of the two groups on the pre-tests, post-tests or between gains (the gain is the difference between post- and pre-test score). There was a significant difference between the pre- and post-test performance of each group, indicating that students improved their domain knowledge during the session.

These results provide us with "trends" even with the low number of students from the experimental group that sat both tests (n=5).

The rest of the analyses were carried out on all the thirty students and the results are reported in Table 2. The trends in this stage were very similar to those found in stage 1. The experimental group spent less time solving problems; this was marginally significant (t(25)=1.3, *p*=.09). Students in both groups solved a similar number of problems. This means that the experimental group solved problems at a slightly faster rate, which was also marginally significant (*t*(19)=0.46, *p*=.09).

We analyzed the problem difficulty levels for both groups. Did students in one group attempt or solve problems that were significantly more difficult than the other that might account for the differing speed of problem solving? Each problem in SQL-Tutor is assigned a difficulty level by the SQL expert who authored the problems. Difficulty levels range from 1 (easy) to 9 (difficult) with non-trivial differences in difficulty between levels. SQL experts have checked problem difficulty levels such that problems with the same difficulty level are of similar difficulty. The problems attempted and solved were also of similar difficulty between groups. This was also confirmed for the highest and lowest difficultly level of problems attempted and solved in both groups i.e. students solved similar types of problems. On average, the experimental group made 49 (26.6) attempts while solving problems, while the control group made 68 (49.3) attempts; the difference was not significant showing that the both groups got similar amounts of feedback from the system. However, to check that students from one group did not receive higher levels of feedback (e.g. they used full solution much more than the other group), we calculated the high-level help used for both groups. *High-level help* (HLH) [14, 15] is defined as the type of help given by a system that provides (part or all of) the correct solution to the student rather than having the student to *solve* the problem; e.g. full solution is a type of HLH. Another important characteristic of HLH in SQL-Tutor is that the HLH levels have to be manually requested by the student whereas the ITS might automatically provide other types of feedback (Low-level help). The *HLH ratio* is the number of HLH attempts divided by the total number of attempts. This shows us the proportion of HLH use, from 0 (no HLH use) to 1 (the student used HLH on every attempt). Students from both groups used similar amounts of high-level help during this phase; 0.46 (0.26) for the experimental group and 0.43 (0.34) for the control group.

Table 2: Results for experimental and control groups

	Experimental	**Control**
Difficulty of problems attempted	5.02 (0.59)	4.95 (0.53)
Difficulty of problems solved	5.01 (0.55)	4.91 (0.56)
Lowest difficulty of problems attempted	3.53 (0.51)	3.64 (0.49)
Highest difficulty of problems attempted	7.0 (1.35)	6.82 (1.7)
Lowest difficulty of problems solved	3.61 (0.50)	3.64 (0.49)
Highest difficulty of problems solved	6.92 (1.32)	6.70 (1.82)
Number of problems solved	10.15 (5.03)	10.5 (6.4)
Time spent on problem solving (min)	52.46 (18.09)	65.17 (33.9)
High-level Help (HLH) ratio	0.46 (0.26)	0.43 (0.34)
Request for Help (RFH) attempts	1.84 (0.68)	1.88 (1.40)
Relative learning efficiency (E)	0.11	-0.12

The relative *learning efficiency* (E) is defined as the performance gained in one condition (the experimental condition) over the effort expended in relation to another condition (the control condition). A condition is more efficient if "1) their performance is higher than expected on the basis of their effort and/or 2) their invested effort is lower than might be expected on the basis of their performance" [13]. To calculate the efficiency of problem-solving for each group, we used "time" as the effort spent and "test gains" as the performance measure. The relative efficiency is found by first converting each of the raw scores to a *z* score by subtracting the grand mean from the raw score and dividing by the standard deviation. E scores then are found by calculating the perpendicular distance between each *z* score and the E=0 line when plotted on a Cartesian graph. As with stage 1, the efficiency of the experimental group (E = 0.11) was higher than that of the control group (E = -0.12). This was marginally significant ($t(28)=1.11$, $p=0.1$, one-tailed, assuming unequal variances).

We also plotted learning curves for both groups (4). Although the differences were not significant, the trend lines indicate that the experimental group learned at a higher rate than the control group.

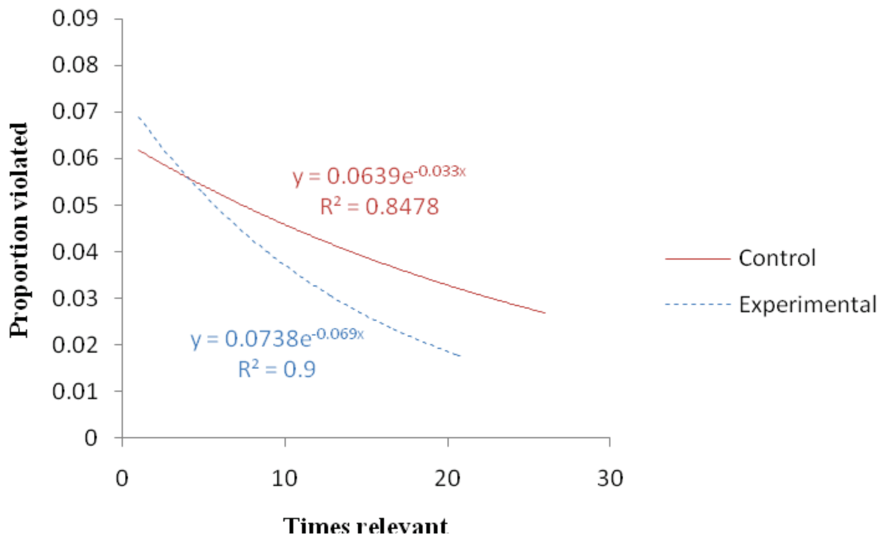

Figure 4: Case study 2: Learning curves for experimental and control groups

4. Discussion and Conclusions

This paper presented the second stage of our project, aiming to implement the framing teaching strategy in an ITS. In previous work, we performed a preliminary study with simulated framing, in which the pre-action and post-action stages were led by a human teachers instead of being implemented in the ITS. The aim of stage 1 was to see whether framing is an effective strategy for an ITS before actually implementing it and therefore committing significant recourses. The results of Stage 1 show that Framing results in significantly faster and more efficient learning.

In this current (second) stage of the project, we implemented the priming phase in SQL-Tutor. This is the first time framing has been implemented in ITSs. The trends gathered from the evaluation of this stage suggest that this implementation worked in a similar manner to that in stage 1. Note that this does not mean that we have achieved an ideal implementation. In fact, although the trends were similar to stage 1, the results gained were not as significant. We have pinpointed at least four possible reasons. First, we had a small number of participants, and therefore cannot make solid conclusions. Secondly, even though the pre-action phase in stage 1 was non-adaptive to the individual, the human teacher adapted to the group as a whole, especially during the worked examples step (when the teacher interacted with the group). This might have increased the effectiveness of the pre-action phase in stage 1. Thirdly, we decided to omit the “common misconceptions” step and only concentrate on correct knowledge. One reason was to keep the pre-action phase reasonably short (to stop it encroaching on the problem-solving). Another reason for the omission was that presenting correct knowledge followed by incorrect knowledge (common misconceptions) did not seem intuitive using our method of presentation. Finally, the method of presentation differed in both stages. While we had a human teacher (animated, expressive, utilizing the student's visual and auditory senses) presenting in the first stage, we had a series of web pages with limited interaction in the second stage.

The results from this stage, added to that of the previous stage, increase our knowledge and give us a more detailed picture about various decisions we made and aspects of this strategy. Due to the evidence gathered in these stages, it is possible to implement the post-action phase in stage 3 and thus have a system that fully employs the Framing strategy in SQL-Tutor. However, information gathered from this stage suggests that we also could split the development path into a spike that evaluates some of the reasons given in the discussion above and tries to improve on the pre-action phase (say, stage 2B) while continuing development on stage 3. As we have gathered baseline information in stage 2 regarding the pre-action phase, the two stages (stage 2B and stage 3) can be undertaken concurrently. If the spike in stage 2B is successful, the improved pre-action phase can be added with confidence to the system at a later date.

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Preliminary Evaluation of an Intelligent Authoring System for 'Graph of Microworlds'

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Abstract: *Graph of Microworlds* (GMW) is a framework for indexing a set of microworlds for computer-supported adaptive and progressive learning with microworlds. It is difficult to describe a GMW because an author must make a set of microworlds and organize them with model-based indices. Therefore, we proposed a method for semi-automating the GMW-authoring and evaluated it by hand simulation. In elementary mechanics, a GMW of practical size could be described with the method and each microworld was judged to be effective as a learning material. Additionally, by 7 subjects, the explanations generated by the method were judged to be useful in describing a GMW.

Introduction

In physics education, it is important for a student to acquire the ability to make appropriate models of various phenomena in the domain. For this purpose, a set of problems are provided in which he/she must think about some physical systems and their behaviors. In each problem, the range of systems and their behaviors are usually limited from some educational viewpoint in order for him/her to be able to understand the laws/principles behind the phenomena. This is called a *microworld*. For the systematic understanding of the domain theory, therefore, it is necessary to sequence a set of microworlds of various complexity (from relatively simple systems/phenomena to more complicated ones) adaptively to the context of learning.

In designing ITSs (Intelligent Tutoring Systems) with such a function, it is essential to appropriately index a set of microworlds. Especially, it is important to explain why, in the situation given by a microworld, the laws/principles are applicable and why the model is valid. It is also important to explain why/how the model changes if the situation is changed. In order to make such explanations, it is necessary to index a set of microworlds based on their models and the process of modeling.

Therefore, we proposed the *Graph of Microworlds* (GMW), which is a framework for indexing the microworlds and the relations between them based on their models and the process of modeling [4]. We also showed, by using GMW, it becomes possible to design a function for adaptively selecting the microworld which a student should learn next, and a function for assisting a student in transferring between microworlds.

However, it isn't easy to describe a GMW because an author must make a lot of indices in a model-based way. He/she must have the expertise in the process of modeling. Therefore, we also proposed a method for semi-automating the description of GMW by introducing an automatic modeling mechanism [5] (i.e., compositional modeling [3, 6]). Though the authoring system which implements this method is currently under construction, we described the domain knowledge for it which covers elementary mechanics and successfully simulated its behavior by hand. In this paper, we report the result of a preliminary experiment which was conducted by hand-simulation and validated the usefulness of our method.

1. Graph of Microworlds and its Authoring

An example of GMW for elementary mechanics is shown in Fig. 1. Each microworld is indexed with the situation it deals with, the model of the situation and the process of modeling. A student can learn the physical law(s)/principle(s) necessary for the modeling and the skill(s) for the model-based problem solving in each microworld (they are called a learning item). Two microworlds which deal with similar situations but different models (i.e., different law(s)/principle(s) is(are) necessary) are linked to each other with an edge. Parameter-change rules [1] are attached to such an edge which relate the difference between the situations of two microworlds to the difference between the behaviors of their models. This means one model is the necessary evolution of the other (with the perturbation of situation). Such a relation between two microworlds is called an educationally meaningful relation. In order to make a student learn the domain theory progressively [2], a GMW should include as many such relations as possible.

Fig. 2 shows the framework for authoring GMW. An author describes a GMW as follows: Suppose a learning item network is given which consists of a set of concepts and their partial ordering to be learned. First, he/she finds a situation for learning an item. Then, he/she perturbs the situation to make a new situation for learning another item adjacent to the former. For each situation, the system generates its model and indexes it with its modeling assumptions automatically by *compositional modeling* [3, 6]. By repeating such perturbation, he/she finally gets a GMW which covers the learning item network. In this process, the system generates explanations about the differences between situations to help an author judge whether they have 'educationally meaningful' relation or not (the detail for generating explanations is described in [5]).

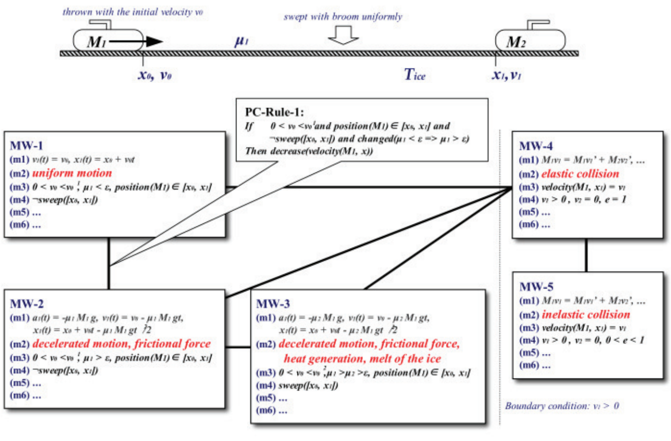

Fig. 1. An example of Graph of Microworlds.

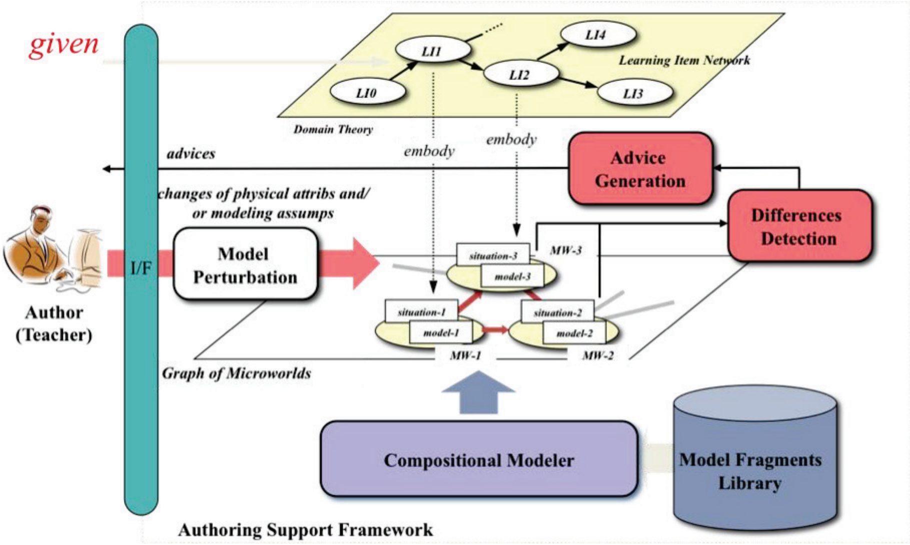

Fig. 2. Framework for authoring GMW

2. Preliminary Experiment

2.1 Design of the Experiment

First, we examined whether one can describe a GMW covering a given learning item network of practical size with our method. We made a learning item network of elementary mechanics (which includes 38 learning items and is partially shown in Fig. 3) by analyzing 2 textbooks in physics for senior high schools. We then tried to describe a GMW which covers it with the method.

Second, we examined whether each microworld made in the above process can be effective in learning the corresponding learning item. A microworld was judged to be effective if a problem which deals with the same item and the same situation as it was found in text/exercise books[1].

Third, we evaluated the ability of the method to generate explanations about the differences between microworlds. In text/exercise books, there aren't always 'educationally meaningful' relations between two situations of the problems which deal with adjacent learning items. Therefore, after selecting 6 such pairs of problems from text/exercise books, we made the 'bridging' microworlds with our method (a 'bridging' microworld has 'educationally meaningful' relations with both problems in a pair). We then asked 7 subjects (who were under/graduates majoring in engineering) to judge whether these microworlds were effective in facilitating progressive learning and whether the explanations generated with the method about their differences were useful.

2.2 Results

First, a GMW covering the learning item network shown in Fig. 3 could be described with the method. It, besides the microworlds corresponding to the given items, has 4 extra microworlds each of which was inserted to bridge the gap between two microworlds (where one couldn't make the adjacent microworlds corresponding to adjacent items by perturbing the situation). Though the GMW was described by the authors, we think it reasonable

[1] We assumed the situations of the problems in text/exercise books were guaranteed to be effective in dealing with the corresponding learning items, and tried to reproduce as many such situations as possible when describing the GMW.

because the purpose of this experiment is to evaluate the ability of the method to make models by perturbing situations (not the usability for end users).

Second, every microworld except one[2] in the GMW (partially shown in Fig. 3) could be made the same as the situation of the problem in text/exercise books (we referred 5 ones). Therefore, the microworlds made with the method can be effective in learning the corresponding learning items.

Third, the evaluation result by the subjects about the effectiveness of the 'bridging' microworlds is shown in table 1. It reveals that the inserted microworlds between those of too different situations were effective in complementing the gaps with 'educationally meaningful' relations, and that the explanations generated with the method were useful in understanding the differences between microworlds (in case-1 and 4). Even though the effectiveness of the microworlds was negatively evaluated since they were inserted between those which weren't judged to be too different, the usefulness of the explanations by the method were positively evaluated (in case-2, 5 and 6). That is, in all the cases, the method could generate useful explanations for understanding the differences between microworlds.

In this experiment, because we tried to reproduce as many situations of the problems in text/exercise books as possible when describing the GMW, some edges became ineffective in facilitating progressive learning (i.e., in case-2, 5 and 6). This matter, however, could be improved when such constraint is removed.

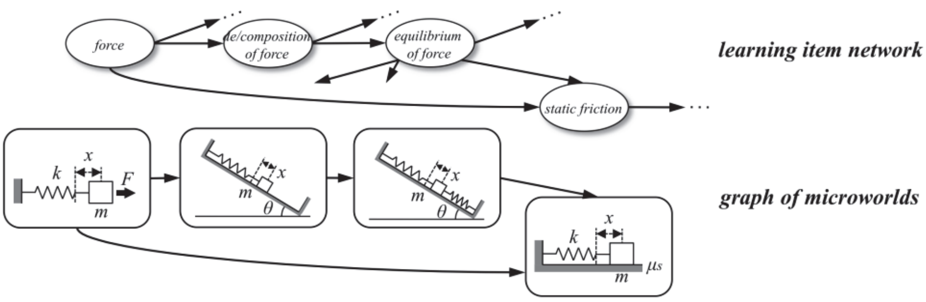

Fig. 3. Learning item network and a GMW covering it

Table 1. Evaluation result about bridging microworlds

	Case-1	Case-2	Case-3	Case-4	Case-5	Case-6
Q1	0.86	2.43	2.00	1.43	3.29	3.57
Q2	3.57	1.43	2.14	3.29	2.43	1.29
Q3	3.43	2.86	3.00	3.71	3.00	2.57

Q1: Are the situations of two microworlds close enough to facilitate progressive learning?
Q2: Is the microworld inserted between two microworlds effective in facilitating progressive learning?
Q3: Is the explanation by the system useful to understand the difference between situations?
*Each score is the average of five degree ratings by 7 subjects (0: the most negative - 4: the most positive).

3. Conclusion and Future Work

These results suggest our method is useful in describing a GMW covering a learning item network of practical size which effectively facilitates progressive learning. One of our important future work is to complete the prototype by adding a GUI-based interface and examine what GMWs could be described by end-user authors.

[2] Thirty-one microworlds (out of thirty-eight learning items) were examined because seven microworlds dealing with 'work' and/or 'energy' became the same situation as the others. Though the only exception was a microworld dealing with 'de/composition of forces,' its situation wasn't ineffective because it was a part of the situation dealing with the following learning item 'angled projection.'

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Chapter 8

Innovative Design of Learning Space

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Preface

In the past few years, we have witnessed the rapid development of several key technological areas, such as the Internet and mobile devices. The availability of wireless access everywhere is promising to change learning space. It provides learners a new way to communicate, collaborate, and interact. Therefore, computer supported ubiquitous learning is an emerging term to acquire knowledge. Students, using a variety of digital devices, can turn almost any space outside the classroom into an informal learning space. As students become increasingly digitally literate, education needs to be concerned about the innovation and support of virtual learning spaces. As we can see, innovative design of learning space has a great potential for learning by enhancing motivation and engagement. We have received studies that have implemented innovative design of learning software, applications or evaluation methods for learning spaces. We would like to thank all authors for their contributions, the program committee members for their reviewing the submitted papers and the advisory committee members for their useful suggestions.

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Understanding Learners' participative motivation in *Reading Challenge*

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Abstract: The study is based on related motivation theory to explore the learners' participative motivation in an English reading contest. Total 30 winners in high school are subjects in this study. After analyzing interview content, we divided learners' participative motivation in contest into: participative intrinsic motivation, participative extrinsic motivation, and participative interpersonal motivation. This study also presents the future work for further research.

Keywords: learning motivation, participative motivation, English reading challenge

Introduction

There are many English online learning communities that provide rich materials and content, and thus users can utilize many features, such as the convenience of the Internet and personalized learning. This is a unique departure from traditional ways of learning English in the classroom. Furthermore, the culture of online learning communities has gradually grown and changed as more and more people join websites and learn from each other. Members of these communities can share and exchange their experiences during the learning process in interactive ways.

When students learn English, Wible et al. [1] argue that a strong emphasis on reading can significantly improve a student's English comprehension, particularly when these students read high quality English reading materials recommended by teachers and experts. In order to advance the use of excellent English books and to enhance English comprehension for high school students, IWiLL, an English online learning community, has held annual English *Reading Challenge* contests since 2000. On average, these contests draw thousands of students, many of whom are also IWiLL members. However, the motivations of students who participate in these annual contests are unclear. Are students volunteering to join such a national large-scale competition, or are they forced by their classroom teachers? What is their primary motivation for taking part in these events?

The purpose of this paper is based on related motivation theory to discover the learners' participative motivation in *Reading Challenge* contest on an online learning community. After analyzing the collected data, we will find out the factors for learners to participate in the contest. Then, these factors will be induced as the participative motivation for Reading Challenge contest based on related motivation theory.

1. Literature Review

1.1 Motivation

Motivation has been a term widely used in educational and psychological study fields for decades. Motivation is an internal status and process making an individual physically take action and maintain the action toward a goal [2]. Motivation is the internal drive to learn again. With this drive, individuals could continually learn until achieving their learning purposes. It means that any learning behavior must be driven by the learning motivation [3]. It shows that motivation is an internal psychological status and also an internal factor to facilitate an individual to be engaged in certain activity.

We will discuss the following several important related theories about the development of the motivation theory for past several decades.

(1) Need hierarchy theory

Maslow's need hierarchy theory [4] puts human need in hierarchical levels. He thought motivation is related to human multi-level needs. The needs could be arranged and described by the hierarchical method from low-ordered physiological needs to high-ordered mental needs - pursuing self-actualization. In general, higher-ordered needs will not be produced when lower-ordered needs are not satisfied yet.

(2) ERG theory

Alderfer's ERG (Existence - Relatedness - Growth) theory [5] deemed that individuals could pursue more than one kind of needs at the same time without priority. In other words, all kinds of needs could exist and stimulate motivation at the same time. This theory is generally similar with Maslow's hierarchy need theory. Alderfer classified humanity's needs into three levels from bottom to up.

(a) Existence needs

It is equal to Maslow theory's physiological needs and safety needs.

(b) Relatedness needs

It is equal to Maslow theory's social needs and esteem needs.

(c) Growth needs

It is equal to self - actualization needs in Maslow theory.

But Alderfer thought that a person may be affected by more than one need to affect. Moreover, when the satisfaction of higher-ordered needs is suppressed, willingness to seek for the satisfaction of lower-ordered needs would be increased. Accordingly, the extent of need for relationship and growth would be strengthened following higher satisfaction level [5].

(3) Learned needs theory

McClelland et al. [6] thought needs are deeply affected by culture and society, including three needs, namely, need for achievement, need for affiliation, and need for power. Everyone usually would have more or less three kinds of needs mentioned above. However, individual has different focus. The theory content is as follows:

(a) Need for achievement

This indicates a person is not only willing to do but also dedicating themselves to achieve with internal drive for an very important or valuable job in their minds.

(b) Need for power

It is an internal drive of individual's hope to have an influence on others and do their best for their work.

(c) Need for affiliation

It is an internal drive of individual's expectation to maintain good relationship and gain friendship with others.

Because of the theory above, needs are triggered by motivation so that different needs are created under different environments. And different needs would lead to different motivation. When individuals have needs, motivation is developed. Either the motivation is resulted from the internal psychological satisfaction or the external incentives cause, personal drive is created to have motivational behavior.

1.2 The participative motivation of online learning community

Most studies of participative motivations of online communities are based on the shared knowledge of online communities. This paper first focuses on the motivations of knowledge community sharing. Then it summarizes the participative motivations of individuals within online learning communities.

Research on the motivations of knowledge sharing communities is mainly divided into four different perspectives or viewpoints: psychological, sociological, economic, and technological [7][8]. From psychological viewpoint, Deci [9] emphasizes that motivation of knowledge sharing behavior could be divided into intrinsic motivation and extrinsic motivation. Intrinsic motivation includes goal achievement, expectation of completing tasks, and desires to make a decision. Extrinsic motivation involves the receipt of rewards. Wrting from the perspective of psychology, Kollock's [10] views on intrinsically motivated learners are similar, adding that intrinsic motivations are rooted in: (a) expectations that the community's members would provide feedback to others after being helped; (b) enhancement of their own reputation and status; (c) discovery of their personal value for the community; (d) realization of their sense of belonging within their community.

From the viewpoint of economics, Walster et al. [11] argued that motivations behind sharing are best viewed as a kind of reciprocal expectation. If the sharing resource is equal to the reward, sharing behavior will be created accordingly. From the viewpoint of sociology, Constant et al. [12] proposed that knowledge sharing is affected by self-interest and environmental factors of society and organization.

Lastly, Kwok and Gao [8] provide yet another alternative to understanding motivation, by combining these three perspectives (psychological, sociological, economic) and then dividing the concept of motivation into three, rather than two, types: intrinsic, extrinsic, and interpersonal. Their definition of these concepts is as follows:

(1) Intrinsic motivation includes altruism and reputation, with altruism simply defined as the ability for an individual to benefit others without accepting something in return. The quality of the reputation and qualification are assessed by other members in the community.

(2) Extrinsic motivation is still rooted in reward, or personal desires. Rewards are the feedback from a community after an individual contributes to that community. Personal needs mean the need for a person to be useful or beneficial. For example, when an individual makes contributions to a group, the resulting respect for the individual will further enhance that individual's position and level within the community.

(3) Interpersonal motivation contains liking and affiliation which both play important roles in the knowledge community. The value obtained by joining and participating in the community is derived from true enjoyment and the desire to discuss as well as interact with community members.

From Kwok's and Gao's theories [8], we know that individual motivation is divided into intrinsic motivation and extrinsic motivation. Intrinsic motivation includes altruism and reputation. Extrinsic motivation contains reward and individual need. And individual motivation could affect interpersonal motivation to affiliate with each other and establish friendly relationship between members.

The development of online learning communities leads traditional learning techniques to face a series of evolutions in the previous sections of literature reviews. In terms of learning style, personal learning transforms into collaborative learning. Learning structures change from closed to open. During the process of learning, it was knowledge delivery but now it is knowledge construction. When technology is integrated into education, the original interaction mode transforms from one-way human-system interaction into two-way instructor-learner, as well as peer-to-peer interaction [13]. Additionally, learning motivation is also gradually changing for integration with element of technology.

In our research, we established an online learning community, where community members could participate in *Reading Challenge* contests the community holds annually. The primary research purpose of this study is to explore the motivations of the contest participants for participating. Furthermore, this study intends to identify the motivations of these learners using the framework proposed by Kwok and Gao [8].

2. Reading Challenge contest

Intelligent Web-based Interactive Language Learning (IWiLL, http://www.iwillnow.org) is a Taiwanese large online learning community for learners who wish to learn a foreign language. IWiLL regularly holds a nationwide English reading contest – *Reading Challenge* (see Figure 1). It has been held since 2000, and thousands of high school students have participated in this contest. The details of the contest are described as follows:

(1) Purpose

The purpose of the contest is to test the English reading comprehension of students from the online learning community.

(2) Goals

The goal is to introduce excellent English books in order to cultivate students' interest in reading.

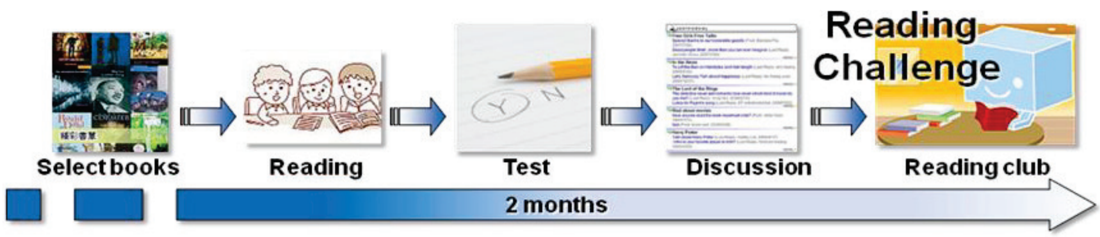

Figure 1. The procedure of *Reading Challenge* contest

(3) Activity Period

Every year, this contest starts from the beginning of summer break to the end.

(4) Participants

People who would participate in the *Reading Challenge* contest must first join the IWiLL online learning community as an online member.

(5) Rules

a. Participants should select any novels from the *Reading Challenge* lists, including six books for beginners, three for basic level, intermediate level, and advanced level, respectively.

b. Participants must add in the books they choose to personal bookcases before starting the challenge activity.

c. After reading every novel, participants start to answer 20 questions at most in a comprehension test. The test time is 15 minutes. (The Beginner reading has 20 questions at most and the examination time is 10 minutes.)
d. In order to pass the comprehensive test, participants must score 80 points or higher. Furthermore, participants may retake the test as many times as necessary in order to pass.
e. While participating in the contest, participants will have access to discussion boards through which they can interact with other participants. The numbers of articles and discussion posts made by participants on the website during the contest will affect each participant's final score.

The contest style of IWiLL has changed since the 13th *Reading Challenge* in 2009. From the online learning environment perspective, members own their individual learning blog, My Cube, allowing the rest of the internet to know what they think and what they learn. Additionally, participants join the Reading Club they like for more discussion and interaction. It also allows users to add friends in their lists for knowledge and ideas sharing. Furthermore, participants in the Reading Club can read other members' comments on books to understand more about them. They can also run My Cube to establish personal sharing spaces and present their ideas on the reading. Lastly, members can share their own learning experiences and further encourage others to earn rewards and prizes.

3. Method

This research takes the related motivation theory as the foundation to explore the learners' participative motivations in these contests. Because the previous literature found few studies of this type, the concept is still in its preliminary stages as an exploratory study. Methodologically, this research is primarily based on qualitative methods with support of descriptive statistics. Regarding the data collection, researchers acquire data by using web-based open-ended questionnaires, in-depth interviews, observations, and learners' log files.

3.1 Subjects

The research in this study was conducted from July 1, 2010 to August 31, 2010, for a total of eight weeks. Each participant's record of his online learning portfolio during the contest was stored in a personal profile in IWiLL for data analysis.

After the contest was completed and all 30 students were publicly awarded by the sponsor, the researchers started the interview process. The average interview time of each subject was 10 to 20 minutes. Overall, the interview process took one month to complete.

3.2 Instruments

The questionnaire was developed by consulting both the existing literature, as well as the professional opinions of five high school teachers within the IWiLL online learning community. The questionnaire recorded basic personal information as well as answers to four open-ended questions.

Furthermore, we asked five senior teachers in high school who know the IWiLL *Reading Challenge* well to assist in the questionnaire design process. This study contends that the content in this questionnaire could meet expert validity to ensure stability and accuracy of the research conclusion.

4. Results and discussion

4.1 The demographic analysis of subjects

The subjects in this research are 30 high school students from all over the country who were rewarded by IWiLL. In this *Reading Challenge* contest, there were 27 females (90%) and 3 males (10%). The majority of participants were also high school students in northern Taiwan (25, 83%). The secondary highest numbers were from southern Taiwan (4, 14%) and then central Taiwan (1, 3%). Regarding their age and grade levels, there was a mix of high school freshmen (9, 30%), sophomores (15, 50%), and seniors (6, 20%). Furthermore, 25 students (83%) expressed that they had entered similar competitions before, and 16 students (53%) had received rewards in the past. This shows that the majority of subjects had some past experience with these contests, and that half of the surveyed students had previously won the contest. In terms of registration, 24 of the 30 students were encouraged by teachers to sign up (83%), while six students signed up by themselves (20%). This implies that most of the students who signed up for this contest did so because of their teacher's announcement and encouragement. Lastly, the average time the participants had been using IWiLL was 20.3 months, which suggests that they had some time to experience and use many of the functions that IWill provides.

Figure 2 shows the comparison of the average number of posted articles and responses in the discussion board. The average amount of activity by the 30 subjects is obviously higher than that of the other participants at different stages. The average number of posting articles and responses by both the subject group and all participants tends to rise after week 5. As the contest drew to a close, it appears that the members' interactions were more enthusiastic in the discussion board, and that members had a higher frequency of log-ins.

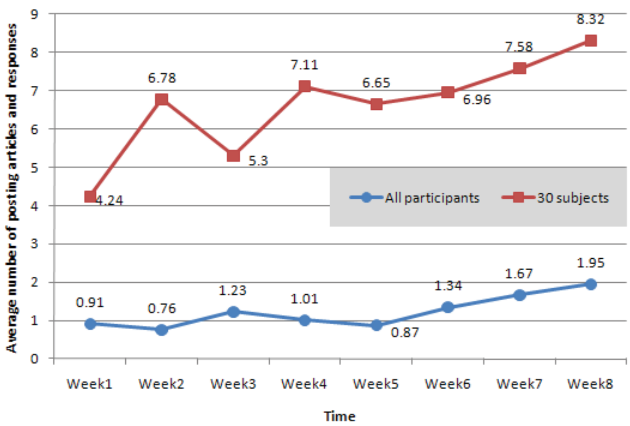

Figure 2. Comparison of the average number of posting articles and responses

4.2 The motivation for participating Reading Challenge Contest in IWiLL

- Learning English through reading novels is interesting
  Many subjects indicated that the important reason why they joined the IWiLL online learning community was because they agreed with IWiLL's vision: to introduce excellent English books and to promote strong reading habits in order to inspire students' interest in English reading. *(FHSH01, TFG09, WULING06, AHS01, TFG02, WULING04)*
- Enjoy the fun of wide reading English
  Respondents replied that the fun of learning English could be enhanced by extensive

and considerable reading. Subjects thought that reading diverse material could foster broader global views. *(TFG05, CYGSH02, CLHS03, WULING04)*

- Learn how to contribute knowledge to the community
  When more and more members in the community are willing to share knowledge and to exchange learning experiences, this creates a growing pool of accumulated knowledge that can benefit everyone. *(WULING02, CYGSH03, TFG10)*
- Apply for university admission or study abroad
  All subjects are senior high school students. The next phase of their studies is to enter university for further education or study abroad. Foreign language proficiency examinations are one of most important criteria when applying for university admission, and test scores directly affect the chances of acceptance. The online learning community provides an interactive learning environment to prepare students for these advanced tests. *(TFG11, TFG07, WULING04)*
- Awards and scholarships
  After the contest is finished, students with excellent grades are awarded in public by different ranking level. Some subjects indicated that this is also one of the incentives for signing up for the contest. *(TFG04, WULING05)*
- Enhance learning interaction with peers
  Most subjects indicated that they no longer felt lonely whent learning through online learning communities. Learners could get together with a group of peers who have the same learning goals and desire to share their knowledge and learning experiences. *(TFG01, TSVS01, TRGSH01, TFG03, WULING01)*

Through in-depth interviews, we find their reasons and motivations to participate in the contest. After analyzing the content of these interviews, the learners' participative motivations in the *Reading Challenge* contest are induced as follows:

1. Participative intrinsic motivations

(1) Learning English through reading novels is interesting
(2) Enjoy the fun of wide reading English

2. Participative extrinsic motivations

(1) Apply for university admission or study abroad
(2) Awards and scholarships

3. Participative interpersonal motivation

(1) Enhanced learning interaction with peers
(2) Learned how to contribute knowledge to the community

5. Conclusion

This exploratory study is mainly based on qualitative research with the support of descriptive statistics to help understand learners' participative motivation in *Reading Challenge* contests within an online learning community. After analyzing interview content, we divided learners' participative motivation into: participative intrinsic motivation, participative extrinsic motivation, and participative interpersonal motivation. In the future, this study will develop Participative Motivation Sales of English reading contests for quantitative research, and help discover the casual relationships between additional variables with which we are concerned.

Acknowledgement

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The Learning Effectiveness of Pervasive Game Integrated with Inquiry-Based Navigation System

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Abstract: Recently, the application of information technology on the local history teaching has become a most important research topic for the researchers. With information technology, we can bring teaching outside of the classroom, and students can be involved in the situation themselves. But teachers have to design a proper learning content to let students absorb the whole information. This study applied two teaching methods to compare the teaching effectiveness; one is the traditional web-based learning in which teachers provide complete information to the learners; the other is to implement pervasive game into inquiry-based navigation system with which students focus on the leaning contents allocated in routes .provided in the mobile device. In the research, smart phones were used with Open Data Kit (ODK) system and web integration system to let the teachers to extend the teaching environment to outside the classroom. By comparing these two teaching methods, we found out that the learning effectiveness of pervasive game integrated with inquiry-based navigation system is significantly better than traditional teaching method.

Keywords: Mobile learning, Inquiry-based learning, ODK, Pervasive Gaming

Introduction

People's lifestyles are gradually affected by the advancement of information technology from supercomputer to laptops and smart phones. From the perspective of education, traditional learning environment is limited in weather, time, and space. However, the advances of technology have brought digital learning into the era of mobile learning, and ubiquitous learning. Today, ubiquitous learning has been widely applied to all levels of education. The content of this study focused on local history and culture, and aimed to enhance students' learning achievement with the concept of pervasive game which use mobile device to help students to learn in the context both in the virtual and real world. We integrated inquiry-based navigation system to allow students to explore the learning environment individually.

1. Literature Review

1.1 Mobile learning

Mobile learning enables learning anytime and anywhere using mobile devices with learning content in it. The learning content was designed by teacher or experts for the demand of learners. The characteristics of mobile devices, including convenience and portability, allow learning activities to be extended from the classrooms to the outdoor. It goes beyond the restrictions of time and space, and makes learning more flexible. Students could enjoy the learning process anytime and anywhere [1]. Therefore, the main purpose of mobile learning is build a flexible learning environment, and support it to be a joyful learning environment in the real-world at the right time at the place [2].

Learning activity could extend from classroom to the outdoor through mobile learning. Therefore, it could provide practical benefits in local culture course in which the learning experience is needed to be enhanced by field exploration. Chuang, Shih, and Hwang (2008) used mobile device with context-aware computing to support historic exploration activities with cooperative learning [3]. It guides the student to conduct independent learning and to enhance their cognition on local culture. Akkerman et al. (2009) used mobile device with GPS positioning function to teach students to learn the history of Amsterdam and organize the collected data to write stories [4]. It is beneficial for learners to learn the local history and culture.

1.2 Inquiry-based learning

Inquiry-based learning helps students learning with a proactive attitude and constructs their own knowledge structures. It could train students' inquiry, thinking, and communication skills, and also promote their lifelong learning ability. It enables learners to become self-directed independent learners. In the Inquiry-based learning, students are the active constructor of knowledge, and teachers are the enabler of learning. Teachers explore the issues raised and provide relevant information to support students to predict, explore, validate, summarize, explain, and discuss [5].

1.3 Pervasive Gaming

Pervasive gaming refers to play games which combine reality and virtual environments. Comparing with the virtual reality game, pervasive gaming puts emphasis on the user interaction with the reality. Its main concept includes three aspects [6]. (1) Movable: People could play games at any place not limited to the stationary PC or TV. When they play the games, they are moving the whole body instead of just the fingers. The game is played both in virtual and real environment. (2) Interactive: The core of pervasive gaming is the social interaction between players. The game only provides the main goals or tasks to the players, and the players need to use a variety of tools to communicate or interact with each other in order to reach the goals. (3) Integration of virtual and real environments: The main characteristic of pervasive gaming is combining with reality and virtual environments. It extends the games on the original PC Game and Console Game, and allows players play games through the mobile devices. Players could play games anytime and anywhere, and they would not be limited in certain space.

The core technology of pervasive gaming contains three parts [7]: (1) Mobile Display Devices: It can transmit the digital content to users by mobile phones, handheld computers, and wearable computers. (2) Sensing Technologies: It can detect the user's location by GPS sensor, camera, microphone, and other physical sensors. (3) Wireless Technologies: It allows user to communicate with remote users. It contains 3G, GPRS, GSM, and Bluetooth technology.

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2. System Design and Content

The system is divided into the experimental group and control group. The control group is taught using web-based materials built by MediaWiki. History related information is provided online. The experimental group used mobile devices with Google Open Data Kit to upload cloud data that were provided on consolidated web page. Users could upload collected data to the website to share and discuss with classmates. It is the realization of Inquiry-based learning and Pervasive Gaming.

2.1 MediaWiki

MediaWiki is an open source content management system (CMS) for Wikipedia in the beginning. It is implemented with MySQL database, Apache Server, and PHP. Most of the wiki-websites were built by it.
Before building the MedieWiki teaching website, we collected history materials and place them into the database with instructional design methods. The learning materials include books, Web pages, and textbook content. The learning content in the system includes the introduction of Fort Zeelandia, the architectural features, history (before and after Koxinga entered), Guo Huaiyi Rebellion, museum of Fort Zeelandia, and related links.
MediaWiki does not only have simple web page text, but also have functions such as directories, search, and extended reading.. The directory function allows users to jump tocertain sections quickly. The search function uses keyword search to retrieve related information. The extended reading function (Figure 1) was a design that automatically compares page titles and keywords in the text and generate hyperlinks between the matches. Therefore, the users could follow the hyperlinks of the keywords to read further information. It could establish the information chain to enhance readers' reading effectiveness.

Figure 1. The extended reading function of MediaWiki

2.2 Open Data Kit

Open Data Kit (ODK) system is an open source tool which was built by Google. It provided a form to assist users to collect data, so it could be an Inquiry-based learning tool. The tool is implemented in the Android mobile device and allows users to upload data to the cloud server. The server could integrate the data and then output into other formats. The data type collected could be text, location information, images, videos, sounds, and bar codes.

Therefore, the ODK system is a tool that should not be underestimated. It can be used to fulfill a variety of purposes such as data integration, decision-making, and data mining. This study assisted students to collect texts, images, and location information through the ODK forms, and become the basic data source for the instructional website. First, learning tasks and data types should be decided (Figure 2). This study expected students to write down their observations, collect images and location information in specific locations. Then, students uploaded the data they collected to the cloud server. These data would be saved in the database and be exported to the Excel files for the consolidated web page.

Figure 2. Data type chosen for learning tasks

2.3 *Forum*

The forum is implemented with Apache Server, PHP, and MySQL database (Figure 3). It could save and classify a variety of information. Students could get information they want quickly. In addition, every member had personal data including the number of published and reply articles, points, and GP. All these records were the proof of the activities they did on the system. These values could give them a sense of achievement and become the grading reference for the teachers.

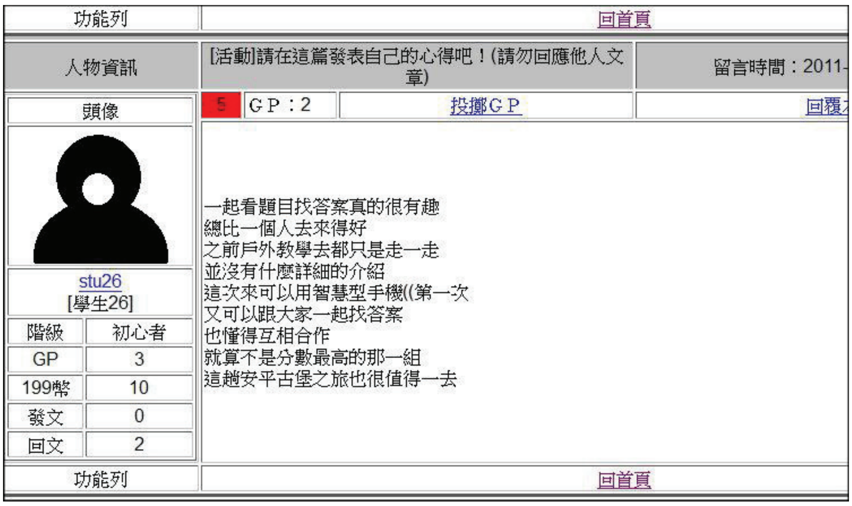

Figure 3. Discussion board for user interaction

2.4 *Consolidated Web Page*

In order to allow the students to easily view the collected data, the students' collected data were transformed into Google Docs. Related research data were also collected through the web page for subsequent analysis. The tables on the web page were created by Google Visualization API. Google Map API was used to show the landmarks. Records of each group of students would be shown with the images collected from the ODK server (Figure 4). The web page provides detailed data each group of students collected including the location information and images. Such information presentation supports both researchers and teachers for post-analysis and discussions.

Figure 4. Consolidated Web Page provides the index of data, images, and location information.

3. Method

3.1 Experiment Design

This study was conducted with experimental group and control group. The students in the experimental group were guided to learning by inquiries with tasks, and the students in the control group were learning with MediaWiki. The learning activity was conducted in Fort Zeelandia in Tainan County.

The experiment design is shown in Figure 5. Before conducting the learning activity, each group of students received the basic instruction about the learning activities and learn to use the mobile devices; at the same time, a pre-test was conducted to analyze the students' pre-knowledge of Fort Zeelandia.

There are four stages in each group. In the first stage of the learning activity, the students in the control group can tour around Fort Zeelandia freely and they could access the relevant information from the mobile devices as they feel needed. In the second stage, they were guided by a tour guide in the museum before they go free for exploration. In the last stage, students discussed and shared their experiences in the classroom, and the teacher would give feedbacks. Finally, the post-test was conducted after the learning activity.

The students in the experimental group were learning with Inquiry-based learning and Pervasive Gaming. They were guided to learning by tasks with ODK system in the first stage. After listening to the museum guide by the tour guide, they should answer the questions in the mobile device in the second stage. When they finished this stage, all of the data they collected would be uploaded unto the cloud server. In the third stage, the students could discuss in the online forum when they go home. There was a class discussion in the fourth stage. The data the students collected in the ODK system were presented on the consolidated web page, and they could compare and discuss their data in the class discussions. The teacher gave as many feedbacks as in the control group. Then, the post-test was conducted.

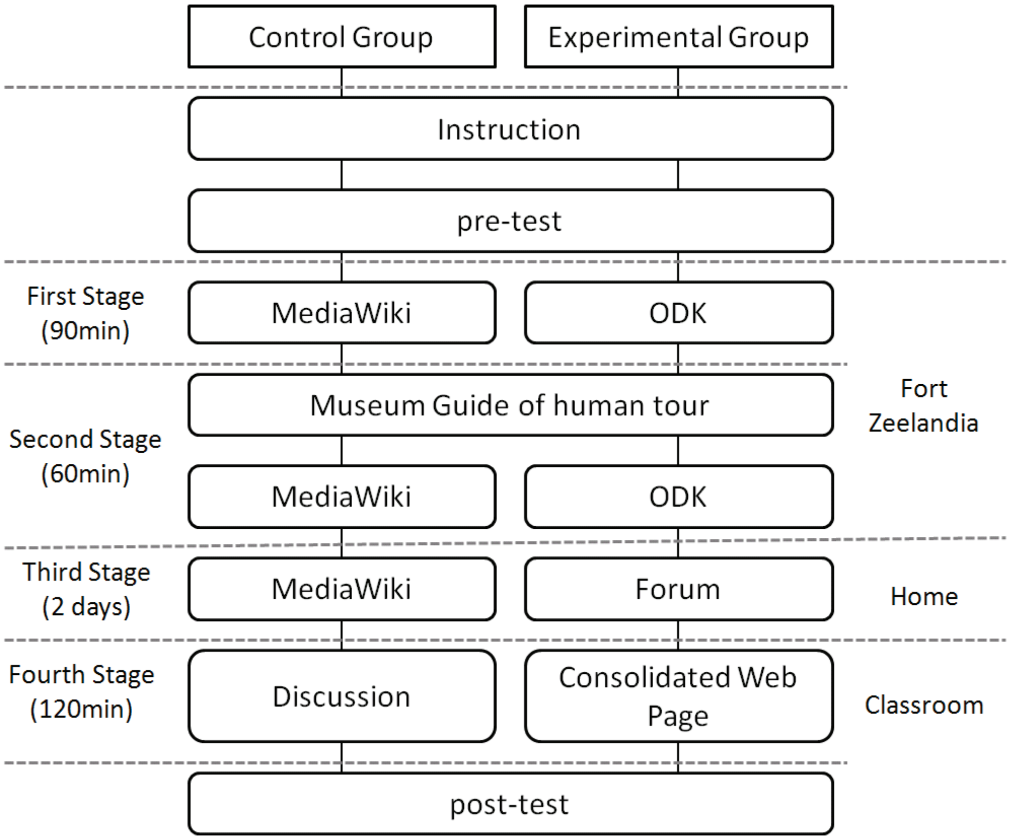

Figure 5. Research design

3.2 Participants

The learning content in this study was designed according to the seventh grade students' local culture course. We hoped they could identify the culture and history of Fort Zeelandia. The participants were the seventh grade students in Tainan City. Their average age was sixteen years. Eighteen students are assigned to the control group and 15 students are assigned to the experimental group. They were divided into small groups of two or three people. They would conduct the learning activity together. Most of them had the experience of using mobile devices, but only a few had used the mobile device for tour guide.

3.3 Experiment Environment

The learning activity was conducted in Fort Zeelandia in Tainan County (Figure 6). There were many monuments in Tainan. Fort Zeelandia is one of distinctive monuments and there is a wealth of historical knowledge in it. The teaching resources in Fort Zeelandia were related to local culture course of middle-high school, so it was selected to be the experiment environment.

Figure 6. Experiment Environment

4. Results

The t-test was performed for the pre-test results. There was no significant difference between the pre-test results of the students between the two groups. After conducting the learning activity, an analysis of Covariance (ANCOVA) was performed on the post-test results, in which the pre-test was the covariance, and the post-test results were the dependent variable. The ANCOVA results are given in Table 1, and show that the learning achievements of the experimental group students were significantly better than the control groups students. Accordingly, it was found that the pervasive game design with inquiry-based learning was helpful to improve student's learning outcomes.

Table 1. Analysis of ANCOVA of the learning achievement test

	N	Mean	SD	Adjusted Mean	F
experimental group	15	82.67	11.18	80.52	15.20**
control group	18	63.44	11.43	65.24	

**p<0.01

5. Conclusions

In recent years, the local cultures content was included in the compulsory education. The students in the elementary school start to learn about the local culture of Taiwan.

This study tried to find the effect on learning achievements with web-based teaching and inquiry-based learning. The web-based teaching could provide a large amount of information, but was easy to lose students' attentions. Although the inquiry-based learning system can provided only limited information, the advantage is to create an individualistic learning environment that can hold up to students' attention. This shows that information overload does not improve students' learning effectiveness and can reduce the students' learning motivation. In contrast, if the teacher could guide students' learning with goals or tasks which are accompanied with a small amount of information, and provide appropriate teaching methods such as gaming, the students' learning outcomes would be improved significantly.

In order to compare the two teaching methods, two learning systems were designed and used in the research. The research results show that the learning achievement of inquiry-based learning was better than the web-based teaching. Besides, adding pervasive gaming design into the inquiry-based learning system has brought learning into a new dimension. Both the real and virtual learning materials were integrated into the learning tasks so that the students can experience what the textbook describes in person. The gaming elements have added more fun into learning so that students have more interests in learning. In this study, we only tested students' learning achievements. In the future, learning motivations, learning behaviors especially when students in the outdoor learning environment with mobile devices, and their cooperation patterns can be analyzed and described in details to provide more information for research.

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Caption Readability Improvement of Language Learning Videos on Mobile Devices

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Abstract: To promote the readability of multimedia and captions shown in mobile devices, we developed a system for processing listening materials to reduce and hide easy words which are the top 2200 highest frequent usage words, for better English proficiency and learners who have mobile phones. On the basis of information processing theory, this study set different thresholds for the most number of words displayed each time for diverse mobile devices. We further evaluated whether the results of caption filtering satisfies the thresholds. Results show that more than 71% of all the captions are hidden. Moreover, the proposed system achieves the expected values of the requirements for different device screen sizes, and readability improvement is remarkable.

Keywords: caption, mobile device, readability, information processing theory.

1. Introduction

This study developed caption filtering for promoting the readability of multimedia or video in mobile devices. In Taiwan, most high school students had learned more than 2000 frequently used English vocabulary. However, their English listen comprehension level cannot match their vocabulary amount. For the purpose of this study, we hide the 2200 most frequently used words from the captions shown in students' mobile phones equipped with small screens to evaluate improvement in readability. This study is not only related to human–computer interactions but also based on information processing theory (IPT). In IPT, memory is classified into three categories: sensory, short-term, and long-term memory [1,2]. The simulation of information processing is shown in Figure 1. When external stimulus is received from the sensory organs, such as vision, hearing, olfactory, tactile sense, and so on, the initial memory is fed from the sensory registers. The majority of temporary memory is instantly forgotten [3]. Meanwhile, only a small proportion of this memory, especially attendant memory, is transmitted to short-term memory, also called working memory [4].

However, the capacity of short-term memory is limited. Its volume ranges from 5 to 9 bits; its length is often regarded as 7 bits on average [5]. Given this limitation, most of the recollections in this memory are also immediately forgotten. Compared with prior knowledge, only a small fraction of short-term memories are elaborated in detail, analyzed, and combined for conversion into long-term memories. To conform to the restrictions for short-term memory in IPT, the largest number of words set for 4-inch, 7-inch, and 10-inch mobile devices are 5, 7, and 9, respectively. This study further evaluated whether the results of caption filtering satisfy the thresholds.

Short-term memory stores information longer than does sensory memory, but the former, which records "at-the-moment" effects, declines easily unless the input information is repeated and coded for integration into long-term memory. Otherwise, short-term memory cannot be retained. Scholars proposed that the language information in short-term memory is coded in the form of hearing, whereas that in long-term memory is coded in the form of language meaning [6]. Accordingly, to enhance the listening proficiency and degree of comprehension for foreign language, we hid the caption of easy words to compel learners to pay attention to aural input. In addition, the more difficult words are shown in the captions to drive learner comprehension of the full content being listened to.

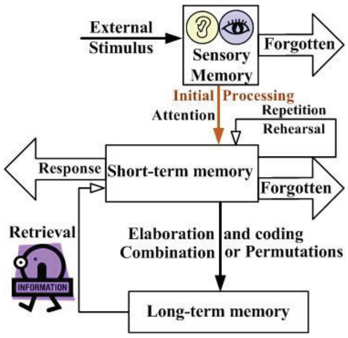

Figure 1. Information processing simulation [1]

The development of mobile devices has brought convenience to learners, providing access to information anytime, anywhere [7]. Researchers reported a tendency toward mobile learning from 2009 to 2014, which shows that mobile learning is associated with mobile devices and that the function of portable information is to carry out the transmission and storage of knowledge [8]. The application of language learning into mobile devices has also been widely studied. For example, Ogata et al. (2008) used mobile devices to help foreign students learn English outside classrooms through the performance of tasks. The result shows that learners adopted a positive learning attitude and exhibited increased interactions with teachers. Kukulska-Hulme (2006) indicated that using mobile devices for language learning results in good learning effectiveness and easy access [9]. Scholars also indicated that mobile assisted language learning (MALL) is helpful for countries with lower education levels [10].

Mobile devices are characterized by diverse sizes and interfaces; these include netbooks, PDAs, smartphones, and so on. Such diverse devices have different screen sizes, as well as distinct operating systems, network explorations, and functions. Studies showed that students can learn more quickly, remember more steadily, and achieve more objectives when they are interested in learning materials [11]. Multimedia and videos are such types of learning materials for foreign language learners. Research indicated that information and computer technology benefits language learning, and multimedia is contributory to vocabulary learning [12]. A player is an essential equipment for language learning [10]. Many different kinds of mobile devices are currently being developed. However, the elucidation of whether different styles or brands of mobile devices have corresponding roles for mobile learning is as important as device development. Examples include media players with readability options, operating systems and application software with compatibility, and so on.

The popularity of information and computer technology enables the constant accessibility of video sharing platforms, such as YouTube and websites for online movies, among others. Although accessing videos is convenient and simple, the small screens of mobile devices pose viewing and readability problems. A previous study indicated that classifying vocabulary to hide easy words by caption filtering and showing difficult words with instant translation in the players of personal computers facilitate good learning effectiveness for English listening training [13]. As for mobile learning, the same mechanism but different settings and research questions can be employed to solve the problem of readability in mobile devices. That is, for learners who are not novices at learning English, the present study solves the display and readability restrictions encountered in small screens by hiding the easy words, such as the 2200 most frequently used words, in the captions. More important, using video to learn not only results in more exciting learning avenues, but also affords learner the freedom to choose according to their learning interests. The use of instructional DVDs in a classroom is convenient typical example. Selecting various languages to be shown in the captions is a simple approach. Previous research compared the effectiveness of captions and scripts and found that most learners used these as a learning auxiliary when they cannot comprehend video content [14]. Therefore, the auxiliary and accessibility of the captions are obvious. In terms of the broadcast functions of players, literature showed that speeding up or slowing down the videos is unhelpful or unnecessary in foreign language listening proficiency training [15].

Accordingly, the aim of this study is not to modulate the functions of the players in mobile devices, but to adjust the quantity of captions displayed in small screens to improve readability. This approach is adopted because of the increasing popularity of mobile phones, which many senior high school or college students possess. We first filtered the most frequently used words, which must be learned before graduation from high school in Taiwan. The top 2200 highest frequently used words were hidden from the caption so that learners are compelled to focus on the aural input of the words. By contrast, the more difficult words were still shown in the caption as aid in the listening comprehension of learners.

To design freeware that adaptively processes the listening materials, we initially set up the top 2200 highest frequently used words in a word bank to filter such primary words for learners graduating from high school. Previous research verified that filtering easy words for advanced learners has a positive learning effect [13]. We expected to evaluate the readability of the filtered captions on different screen sizes. To address the display and readability problem presented by long captions in the listening materials shown in mobile devices, we randomly selected 30 video samples to assess the degrees of readability improvement in different screen sizes after filtering. The research objectives for improving usability and readability in differently sized mobile devices are as follows:

1. For 4-inch mobile devices, to achieve an expected ratio of captions (which are no more than 5 words) of 98% after system processing of the listening material;
2. For 7-inch mobile devices, to achieve an expected ratio of captions (no more than seven words) of 99% after system processing of the listening material.
3. For 10-inch mobile devices, to achieve an expected ratio of captions (with no more than nine words) of 99.99% after system processing of the listening material.

2. Methods

2.1 System design

The font size of the captions is no smaller than 1/25th of the full screen; that is, the captions should correspond to the proportion of the frame, making them easy to read. As for the display of the caption in the player embedded in mobile devices with different screen sizes, however, few studies have explored approaches to improving the readability of the display and fitting the number of words on a given screen size. Consequently, the presence of many multimedia instructional materials restricted by small screen sizes has caused difficulties for learners to engage in mobile learning. Moreover, the large quantity of messages in a video clip may result in overloading of the learners' short-term memory.

To solve the above-mentioned problems, prevent learners from distractions stemming from simultaneous attention to images and captions, and rectify limited comprehension of listening training materials, the present study focused on improving the readability of video captions shown on mobile devices. We achieved these by caption filtering, as well as supporting listening comprehension. Most important, caption filtering must not present learning obstacles but should have positive effects on listening once readability on mobile devices is improved. This is the primary goal of the study. Toward the achievement of the aforementioned goal, more difficult or new words were shown in the caption on mobile devices to aid listening comprehension.

Python programming language was used to develop the caption filtering program. The program is called the caption filtering system of listening materials for adaptive MALL. The system framework is shown in Figure 2. The procedure of the system comprises two parts. The first is the merging of captions that are originally displayed in more than one line in a video clip. The second step is the filtering of the words to hide the most frequently used words and show the more difficult or seldomly seen words. Moreover, two databases are employed. One is the work bank, which stores the 2200 most frequently used words from the corpus. The other database stores the captions after merging and those after filtering. The original caption or subtitle files can be stored as srt files, consisting of time sequence, time interval, and captions. After the caption filtering process, the remaining captions are subjected to statistical computation to determine whether they satisfy the expectation for the adaptation to different mobile device sizes. The results of the merging and filtering processes are also stored in the database. The information on the original captions, such as the number of words in each sentence and total number of words in the video, is saved in the database. The information on the merged captions, such as the times at which merging in a video was conducted is stored in the database whenever the merge mode is run. The information that remains after running the filtering mode, such as the captions filtered, remaining captions, or the number of remaining words in each sentence is also stored. The filtered captions can be embedded into the video for broadcasting on mobile device, enhancement of the readability of multimedia shown in the small screen, and assistance in the listening comprehension of learners.

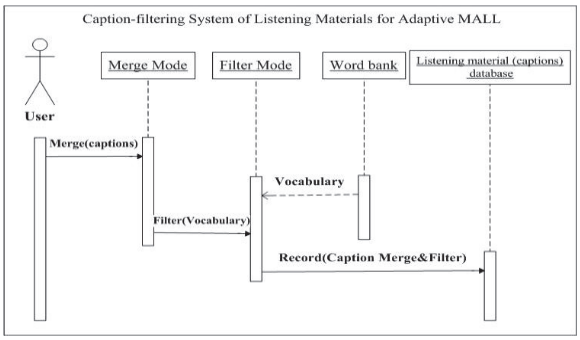

Figure 2. System framework.

2.2 Procedure

The EFL learners who passed the primary level of GEPT certification in Taiwan are considered familiar with the hidden words. Most learners, such as students who graduated from high school, need the support of advanced vocabulary or unfamiliar words. The system leaves advanced or unfamiliar words in the captions to facilitate listening comprehension. In the pilot study, the number of words in the original caption of each video clip was computed. In addition, the percentage of words filtered and hidden from captions and the percentage of sentences that were not adjusted were calculated. The average number of words left in a sentence after filtering was also computed. Finally, whether the captions satisfy the expected value for each size of mobile device was evaluated using the 30 DVD samples.

2.3 Listening materials

Thirty random Discovery DVDs were borrowed from a library in a national university in Taiwan as the samples materials. The system examines the videos to determine the lengths of the video and sentence in the caption, what proportion of captions requires merging into a line or filtering, and how long each filtered sentence in the caption is. The total words, as well as the average number of words in each sentence and in each filtered sentence, were statistically computed. All the related statistical results and the above-mentioned information were calculated. This approach enables further evaluation of whether the modulated results are adaptive to broadcast in mobile devices. The readability of multimedia in mobile devices is promoted as well.

The information on the videos was collected by the system. The results for the first threshold (the five-word standard set for promoting readability in 4-inch mobile devices) show that originally, 78.44% of the captions have longer than five words on average in the 30 videos. After hiding the easiest 2200 words from the captions, only 1.14% of the captions have longer than five words. The results for the second threshold (the seven words set for improving readability in 7-inch mobile devices) show that originally, 55.40% of the captions have longer than seven words on average in the 30 videos. After filtering, only 0.02% of the captions have longer than seven words. The results for the third threshold (the nine-word set for enhancing readability in 10-inch mobile devices) show that originally, 31.39% of the captions have longer than nine words. Furthermore, the filtered sentence approximated that 0% of captions have longer than nine words. Figure 3 shows the example of the captions before and after filtering in the 4-inch mobile phone. The effect on readability after filtering the most frequently used words is remarkable. The visual range also does not exceed the average width of the "hot area" detected by the eye tracking machine. Therefore, the design can be beneficial and adaptive to small screen sizes.

Figure 3. Readability before and after caption filtering in a cell phone (Discovery video)

3. Results

3.1 Analysis of the captions in original listening materials

The mean of the playing times of the 30 videos is 54.53 minutes (SD=13.69). The two longest videos are 80 and 100 minutes. The average number of sentences in the 30 videos are 760.07 (SD=255.16), and the average number of words are 6030.8 (SD=1760.93). The descriptive statistics of each video is shown in Table 1. In the 30 videos, Table 1 shows that the average number of words per sentence is 8. A special video, called the Biggest and Baddest Bugs (the longest video in the 30 samples) contains the most number of sentences and words. The total number of sentences in this video is 1731, and the average number of words per sentence is 6.69, which is the minimum number among the 30 videos. The video introduces insects for around 100 minutes; however, it depicts the sounds of bugs in the captions. Therefore, we suggest that special captions, such as the words that representing the sounds, be processed separately during caption filtering, even though these sounds are not included in the most frequently used words. Table 1 also shows that the most number of words in a sentence on average in the first video is 9.12, which exceeds the limitation of short-term memory on average. This video is called The Ultimate Guide T-Rex, which broadcasts for 50 minutes, and contains a total of 665 sentences. Accordingly, the number of words per sentence in a video is directly related to the introduction of content.

Table 1. Average words per sentence before caption filtering

Rank	Video ID	Video name	Time length of video (Min.)	Avg.words per sentence
1	016	The Ultimate Guide T Rex	50	9.12
2	027	Channel Discovering Ardi	87	8.84
3	023	Understanding Time	51	8.48
⋮	⋮	⋮	⋮	⋮
28	026	Channel Raising the Kursk 2002	51	7.26
29	025	Great Books Galileos Dialogue	50	7.24
30	024	Worlds Biggest and Baddest Bugs	89	6.69
		Mean	**54.53**	**8.00**
		SD	**13.69**	**0.50**

3.2 Results of reducing most frequently used words

The percentage of the words filtered is 71.88% (Table 2). In the 30 videos, the average number of words per sentence decreases from 8 to 5.88 after filtering. The effects of decreasing long captions are remarkable so that showing them clearly on a small-screen device is more easily achieved. That is, most of the captions contain the words that amount to no more than 7 words after filtering. In detail, 99% of the captions contain no more than 7 words, and 98% of the captions contain no more than 5 words. However, 0.94% of the sentences on average remain unchanged after filtering (SD=0.01). Biggest and Baddest Bugs has the longest broadcasting time and the most number of sentences, but also the highest percentage of sentences unchanged. Of these sentences, 7.68% are unchanged. The other videos have approximately 1% unchanged sentences. Table 2 shows that most of the videos have less than 1% unchanged sentences. EFL learners who have graduated from junior high school or passed the primary certification of GEPT in Taiwan can use their mobile devices for English listening training using video instructional materials because the filtering system effectively enhances the readability and usability of multimedia players in small-screen mobile devices.

Table 2. Percentage of sentences filtered.

Rank	Video ID	Video name	Movie length (Min.)	Sentence unfiltered (%)	Words filtered in captions (%)
1	022	Understanding Space Travel	50	0.59%	75.82%
2	006	The Ultimate Guide Elephants	51	0.00%	74.87%
3	023	Understanding Time	51	0.71%	74.58%
⋮	⋮	⋮	⋮	⋮	⋮
28	026	Raising the Kursk 2002	51	0.93%	69.37%
29	027	Discovering Ardi	87	0.73%	68.32%
30	017	The Ultimate Guide Whales	51	0.78%	64.28%
		Mean	**54.53**	**0.94%**	**71.88%**
		SD	**13.69**	**0.01**	**0.02**

3.3 Readability improvement after caption filtering

Before caption filtering, the words in each sentence are normally distributed, showing a distribution of 1 to 15. The statistical bar chart of the distribution is shown in Figure 4. After caption filtering, the number of words in each sentence decreases and is normally distributed so that the peak of the curve in the diagram shifts to the left. Most of the sentences contain no more than 7 words after filtering; thus the objective and expectation of promoting readability are achieved.

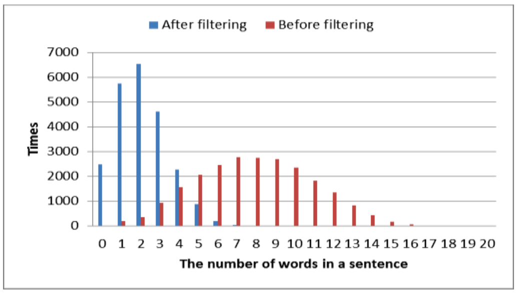

Figure 4. Distribution of words per sentence before and after caption filtering.

The average number of words per sentence in the 30 videos decreases to 2.12; thus the long sentences in the caption are almost shortened. To assess whether the results of caption filtering satisfy the expectations on the 5-, 7-, and 9-word thresholds, we computed the number of sentences that exhibit less than 5, 7, or 9 words before and after caption filtering. The results are shown in Table 3. The degrees of improvement for the different thresholds are all remarkable. For the 4-inch mobile devices, 21.56% of the sentences on average in the 30 videos have no more than 5 words before caption filtering; by contrast, 98.86% of the sentences have no more than 5 words after caption filtering. For the 7-inch mobile devices, 44.46% of the sentences on average have no more than 7 words before caption filtering; 99.98% of the sentences have no more than 7 words after caption filtering. For the 10-inch mobile device, 68.51% of the sentences have no more than 9 words before caption filtering; after caption filtering, 99.99% of the sentences have no more than 9 words. These results indicate that all the expected values for different screen sizes are reached.

Table 3. Readability improvement for mobile devices of different screen sizes.

Thresholds	<=5words(for 4-inch)		<=7words(for 7-inch)		<=9words(for 10-inch)	
Filter or not	After	Before	After	Before	After	Before
Mean	**98.86%**	21.56%	**99.98%**	44.46%	**99.99%**	68.51%

As mentioned above, the results agree with the expectations set in this study. For example, we expected more than 98% of the captions to be less than 5 words after caption filtering. The percentage of captions with less than 5 words is shown in Figure 5 to compare before and after caption filtering values. Almost 100% of the captions agree with the expectations. In summary, the system effectively addresses the problem of readability and facilitates the listening training of EFL learners in the mobile devices by hiding the most frequently used words, which are also usually the easier words. The usability of playing videos in three different sizes of mobile interfaces is promoted, and the readability of caption-assisted learning improves.

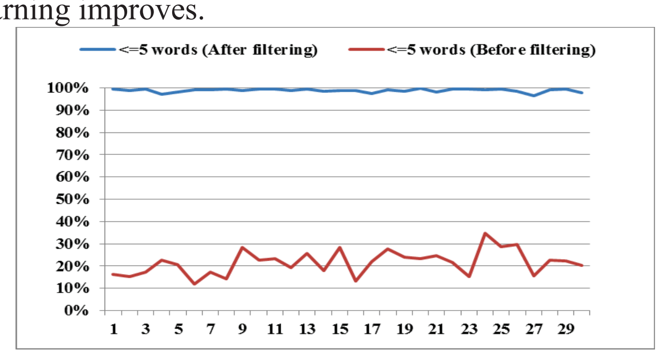

Figure 5. Readability improvement after caption filtering of the listening materials.

4. Conclusions

In this study, the captions fitting more than two lines were merged into one line. We expected all the words to be in a line and within the visual restriction, as well as within the short-term memory limitation; therefore, we set 5-, 7-, and 9-word thresholds for different screen sizes. In addition, future work should consider using the proposed system or its updated version in analyzing more videos or listening materials in diverse domains, such as English news, soap operas, and so on, so that the effects of the system can be more widely evaluated. Finally, we found that more than 70% of the captions are filtered and hidden in the video samples. Whether the development of harder level options for hiding more words is needed should be considered. Given that the percentage of filtering is quite high, we encourage future researchers to develop easier level options first to hide fewer words to support primary learners and provide adaptive support for EFL listening. In the future, this study will be extended to the release of the system as freeware to enable access for English teachers. The availability of the system can facilitate the use of English listening materials for adaptability to the demands of different proficiency levels.

Acknowledgements

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Employability Assessment by Establishing Employment Competence Index System According to Academic Performance

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Abstract: In the society nowadays, the number of highly educated people grows day by day, dramatically impacts the current job market, comparatively the employment problem to be faced by the students also gradually becoming one of the important issues to be discussed. While the students are pursuing their studies in schools, the schools should place emphasis on equipping the students with essential abilities for competency in their future workplaces; design courses that would put these teachings into effect, and thus, develops the employability of these students. This is the core idea of E-Map "Employment Competence Index System" to be discussed in this study. Through establishing E-Map enables the students to understand the effects of self-learning and plan for the directions of abilities for future development, also provides the students referential basis of different dimensions on oneself, schools and business owners. In our study, we are exploring whether the statistical data is consistent with the indices developed by the schools, and to make use of T-test analysis method to summarize the effectiveness of E-Map.

Keywords: Employment Competence, Employability Map, Self-assessment

1. Introduction

Academic results of a normal student are no longer the main criteria for recruitment by the enterprises, these enterprises focus on "Personal Attributes" and "Work Attitude" [3]. For this reason, before entering the job market, every candidate must understand themselves; analyze their own attributes and expertise, so as to develop their abilities for competency accordingly. E-Map (Employability Map, E-Map) is a student employment competence index system with combination of the courses. By splitting solely on the results into various competency indices, to assist the students from the beginning on selecting the courses to the stage of attending these courses, through multi-diversified assessments and revisions of the directions to achieve these indices, and during the process to strengthen personal attributes and further enhance the employability and competitiveness [4].

2. Related Works

2.1 Core Employability

Harvey (2002) suggested that Core Employability consists of the three major items: (1) Personal attributes and work attitude that are beneficial to employability, (2) The ability of self-management and career planning, (3) The willingness of continuous learning, ability to reflect and correct mistakes [1]. Core Employability in terms of techniques can also be segregated into professional information, self-management, problem solving, cooperation and communication, creative thinking, organizational integration, abilities of planning.

2.2 E-Map Framework

There are ten major E-Map Employment Competence Indices as developed by schools, which are further grouped into two categories as "Professional Ability" and "General Ability" [2]. Abilities that belong to professional ability are professional knowledge, practical skills, information capability, integration and innovation, foreign language skills; abilities that belong to general ability are enthusiasm and stress-resistance, presentation and communication, dedication and teamwork, cultural literacy, services and care. The details of school indices are illustrated in Table 1.

Table 1. Descriptions of School Indices

Professional Ability	PA1	Professional Knowledge	Professional knowledge and working ability equipped by the students, having a leading advantage in the field of self-expertise, create self-value.
	PA2	Practical Skills	After building up concepts of multi-dimensional professional knowledge, the ability to combine theories and practices and to master them.
	PA3	Information Ability	Correct and effective use of computer information software, to achieve optimum performance through the aid of information technology tools.
	PA4	Integration and Innovation	With insight that oversees the entirety, assess problems from various dimensions, and straighten out the issues and to conclude after method of prudent study.
	PA5	Foreign Language Skill	Application of multiple foreign languages to demonstrate understanding of international and cultural learning, in response to the earnest demand of globalization trend.
General Ability	GA1	Enthusiasm and Stress-Resistance	To maintain high degree of ambition on new things and new ideas, the ability to effectively adjust one's adaptability, to avoid influencing the working willingness to enable oneself to quickly adapt to the working conditions.
	GA2	Presentation and Communication	To present and communicate in an organized and coherent manner, attentive on listening to the contents of the communicating counterparty, and to give positive feedbacks.
	GA3	Dedication and Teamwork	To maintain good interactions with learning partners, in order to achieve work performance; and to comply with the organizational disciplines and systems, to self-reflect, transcend and continuous improve oneself.
	GA4	Cultural Literacy	With literature and arts virtues and moral characters, understand the significances of cultures and histories, and to exhibit the abilities of humanistic reflection, rational thinking and criticism in living.
	GA5	Services and Care	To build up the habits of respect and care for others, to provide assistance and support for the needed ones, and to care and serve with empathy.

3. Study Methods

3.1 Development process of E-Map

The operating process for developing of E-Map is shown in Figure 1. First of all, collect the general features required by the academic researches and the enterprises, through prudent discussion and assessment of the features of these multi-diversified competencies, and incorporate with the educational philosophy to propose the ten major Employment Competence Indices [5], which are further classified into the two categories of school professional ability and general ability.

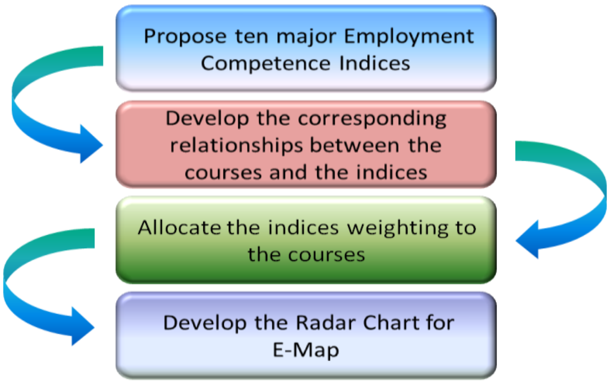

Figure 1. Chart of Operating Process

Once the proposal for the school indices is completed, it is followed by the coordinations by the relevant personnel of each faculties in this research project, incorporate with the professional and general abilities, which are built in accordance with the standards of these school indices. For the allocation of the indices weighting, taking the Computer Science and Information Engineering Department as an example. Table 2 shows the Statistical Table for Courses Weighting. For instance, the overall weighting of "Professional Ability" (PA1) is 24.36% which is also the most remarkable ratio among all the indices. This implies that at the planning stage of the schools, this area is given considerable weighting.

Table 2. Statistical Table for Courses Weighting

School Indices (%)	1	2	3	4	5	6	7	8	9	10
	PA1	PA2	PA3	PA4	PA5	GA1	GA2	GA3	GA4	GA5
	24.36	16.67	16.67	14.1	2.56	7.69	8.97	5.13	1.28	2.56

Table 3 has illustrated and to correspond the allocated ratios to the school indices. Taking Engineering Mathematics Course as an example, such course has three academic credits, "Professional Ability" weighting is 20%, and therefore, the computation for the percentage distribution of competency index as corresponding to such course is shown as below.

$$3(\text{Academic Credits})*\ 20(\%)\ \ = 0.6$$

Therefore, we replicate this approach to sum up the ratios for all the courses of the faculties, which will be the referential basis for the schools indices weighting, and can be retrospective on revising such weightings.

Table 3. Allocation Table of the Courses Competencies Indices Weightings

Courses Name	PA1	PA2	PA3	PA4	PA5	GA1	GA2	GA3	GA4	GA5
Engineering Mathematics	20	10	20	20	10	10	10	0	0	0
Computer Programming	20	10	30	40	0	0	0	0	0	0
Data Structure	20	20	20	20	0	10	10	0	0	0

E-Map is to sum up the weighting distributions of the courses of each faculty, and to combine them with the general ability courses, finally to transform them into Radar Chart [6]. Figure 2 showed several faculties whose differences of the competencies indices are more significant. Apart from the Computer Science and Information Engineering Department, others are Mechanical Engineering Department and Accounting Information Department. From there, it can be seen that there will be different planning for the indices according to the requirements by each department. In respect to the students, by providing a visual referential basis enables them to clearly understand of the stages of development of own abilities; which is also the core cogitation of E-Map. Here we use the E-Map of Computer Science and Information Engineering Department and other relevant information to assess its effectiveness.

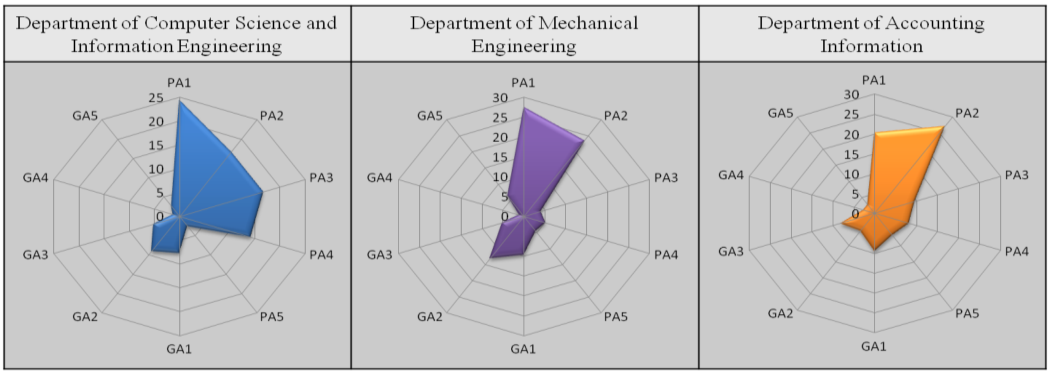

Figure 2. E-Map Radar Chart of Various Faculties

3.2 *Principle of Analysis*

The processes of analysis of this study are divided into three stages of preparation, collation and result. Such research framework is illustrated in Figure 3. First, by the approach of filling in the questionnaires, students are given self-assessments for questions designed to correspond to the ten major competencies indices.

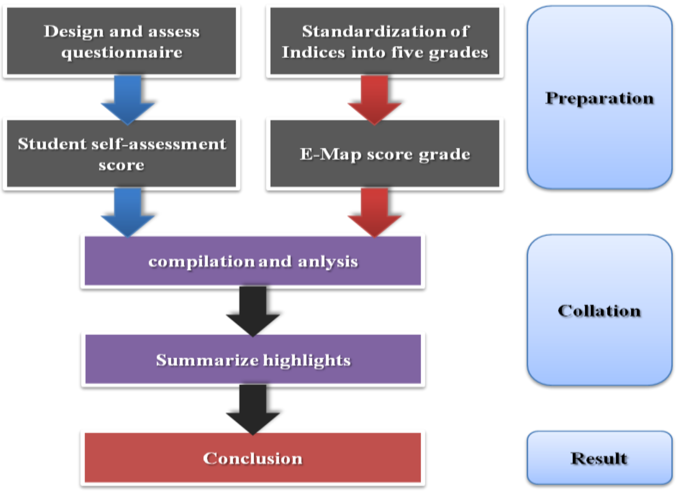

Figure 3. Chart of Research Framework

The assessment responses are designed into five grades: Totally agreed (5 scores), Agreed (4 scores), Acceptable (3 scores), Disagreed (2 scores), Totally disagreed (1 score). Weighted scores are computed by accumulating the scores of each question, then, by deriving the average score of each question to apply them as the basis for assessing this questionnaire [9]. The results obtained from the completed questionnaires by the students. The average scores range from 2 to 4 scores, implies that the results filled in for this questionnaire are rationale. By standardizing the school indices into five grades, identify which grades do the actual scorings of these students fall into. By using the Radar Chart to determine whether the actual scores are consistent with the scores by self-assessments. By using the results obtained from the comparison as the basis for dual perspective analysis of the student as an individual and the faculty as a whole. Make use of T-test to determine whether such differences are significant enough to be summarized as highlights. On the side of the student as an individual, the main observation is to determine whether the competence levels of these students after completing the courses are too high or too low, by corresponding the actual scores of the students to their self-assessments scores; the faculty as a whole through these scores to determine whether they are consistent with the school indices and to exmaine the rationality of the competencies indices planning.

4. Study Results and Analysis

The subjects of this study are 51 students from the Computer Science and Information Engineering Department of some university. From the statistics obtained from the questionnaires provided by the school and the scores derived from the students in every competencies of the E-Map, through analyzing the results of the information collected, examined and elaborated the students and faculty in dual perspectives.

4.1 Perspectives of the Students

By using the E-Map scores and the self-assessment scores of the students to individually study the grading of the students in terms of the competencies indices, by applying the Single sample t-test to derive the results as shown in Table 4.

Table 4. Test Variances of E-Map Scores

Test Value: 5	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
PA1	-17.728	50	.000	-1.72549	-1.9210	-1.5300
PA2	-16.208	50	.000	-1.52941	-1.7189	-1.3399
PA3	-17.609	50	.000	-1.50980	-1.6820	-1.3376
PA4	-1.273	50	.209	-.07843	-.2022	.0454
PA5	-2.368	50	.022	-.23529	-.4349	-.0357
GA1	-14.600	50	.000	-1.43137	-1.6283	-1.2345
GA2	-2.063	50	.044	-.07843	-.1548	-.0021
GA3	-14.220	50	.000	-1.50980	-1.7231	-1.2966
GA4	-1.000	50	.322	-.01961	-.0590	.0198
GA5	-1.000	50	.322	-.01961	-.0590	.0198

The objective of Single sample t-test is to examine whether there is any significant correlation between each test variables and Test Value. The Test Value in the table above is configured as 5, implying that after standardizing of the school indices, we found that of the Professional Abilities field, professional knowledge, practical skills and information ability had indices with variances (Significance or p-value less than .05) which were more profound, meaning that the competency levels of the students in the Professional Abilities field had relatively wider gaps. This might be due to the difficulties on obtaining high scores for difficult courses offered by the faculty, or that the allocated courses weightings need to be revised. In terms of General Abilities field, the competency levels for Enthusiasm and Stress-Resistance and Dedication and Teamwork were slightly inferior, whereas most of the other indices were within the standard range. Figure 4 shows the percentage distribution of the number of people for each index of the entire 51 students. From which the indices falling within the fifth grade (Blue color) whose percentages of over 80% were Integration and Innovation, Foreign Language Skill, Presentation and Communication, Cultural Literacy, and Services and Care. This implied that most of the students had achieved the standards in these five competencies.

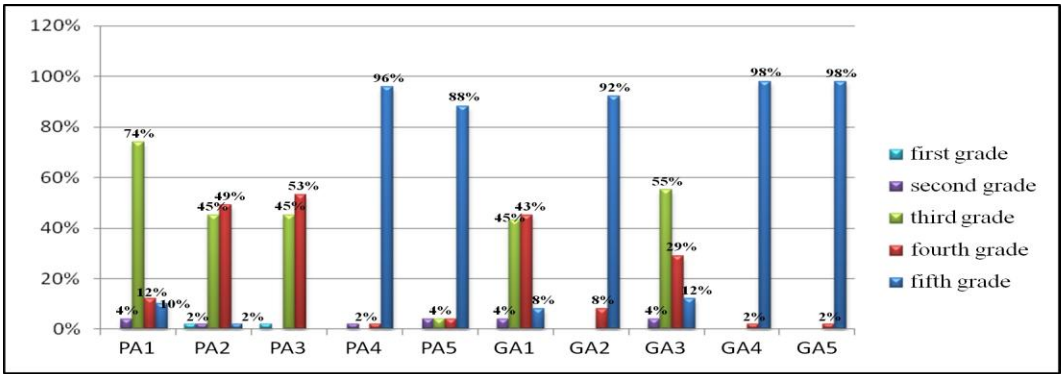

Figure 4. Percentage Distribution of Students E-Map Scores

Similarly, by using the Single sample t-test to determine the degree of variance of the students self-assessments. By corresponding the Test Value configured 5 with E-Map scores, the results are shown in Table 5. There were significant variances in each competency indices for the reason that students by their own have different thinkings, whereby the formation of this situation was reasonably explanable.

Table 5. Test Variances of Self-assessment Scores

Test Value: 5	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
PA1	-14.318	50	.000	-1.60784	-1.8334	-1.3823
PA2	-12.989	50	.000	-1.68627	-1.9470	-1.4255
PA3	-10.341	50	.000	-1.35294	-1.6157	-1.0902
PA4	-11.691	50	.000	-1.39216	-1.6313	-1.1530
PA5	-14.907	50	.000	-2.09804	-2.3807	-1.8154
GA1	-10.473	50	.000	-1.33333	-1.5891	-1.0776
GA2	-11.951	50	.000	-1.60784	-1.8781	-1.3376
GA3	-8.577	50	.000	-1.11765	-1.3794	-.8559
GA4	-10.834	50	.000	-1.43137	-1.6967	-1.1660
GA5	-11.086	50	.000	-1.43137	-1.6907	-1.1720

From Figure 5 results, it was found that most of the students had relatively low confidence level on each competency. Suggest to introduce multi-strategies on the teaching approaches, such as designing certain adaptive tests to record the learning processes of the students; to propose more related topics of the courses for the students to discuss, to improve the level of confidence of the students population through the environment; to conduct remedial teaching for the population of students with lower scores.

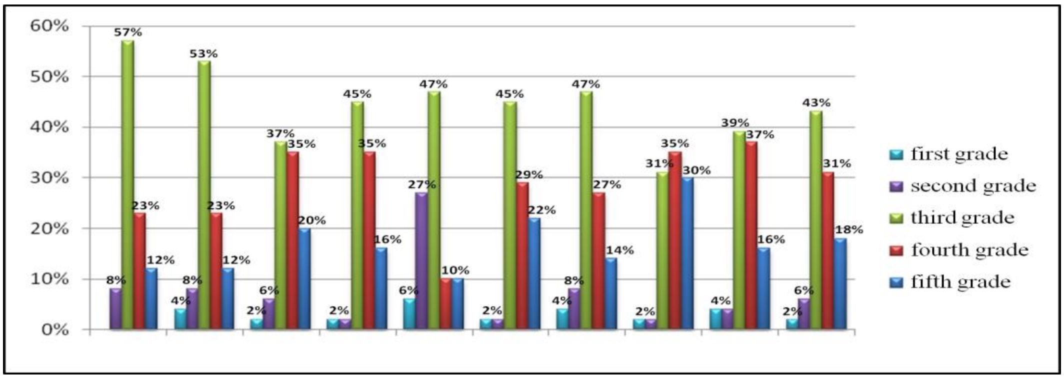

Figure 5. Chart of Percentage Distribution of Students Self-Assessments Scores

4.2 Perspectives of the Faculties

For the school indices, by using the variances between E-Map and self-assessment scores to analyze the competencies levels planned by the faculties. The most ideal situation is not to have any variance, therefore, the standard range was defaulted at 0; or at most a variance of not more than two grades. It is expressed in the formulae below.

$$|\text{Self-Assessment Grade} - \text{Actual Grade}| \leqq 2$$

An absolute value of range exceeding 2, implied that the students had mis-estimated their own competencies grades. Regardless of over-estimation or under-estimation, they were all significant results derived by the test as shown in Table 6. Indices with more profound variances were Integration and Innovation, Foreign Language Skill, Presentation and Communication, Dedication and Teamwork, Cultural Literacy, and Services and Care.

Table 6. Test Variances of Competencies Indices

Test Value: 0	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
PA1	.903	50	.371	.11765	-.1441	.3794
PA2	-1.184	50	.242	-.15686	-.4229	.1092
PA3	1.212	50	.231	.15686	-.1032	.4169
PA4	-10.909	50	.000	-1.31373	-1.5556	-1.0718
PA5	-11.754	50	.000	-1.86275	-2.1810	-1.5444
GA1	.711	50	.481	.09804	-.1790	.3751
GA2	-11.066	50	.000	-1.52941	-1.8070	-1.2518
GA3	2.742	50	.008	.39216	.1049	.6794
GA4	-10.705	50	.000	-1.41176	-1.6767	-1.1469
GA5	-11.512	50	.000	-1.41176	-1.6581	-1.1654

Among the significant indices, by looking at Figure 6, they were mainly under-estimates of the self-assessments. In respect to Professional Abilities field, the variances in Integration and Innovation, and Foreign Language Skill were especially profound, whereas in the General Abilities field, variances in Presentation and Communication, Cultural Literacy, and Services and Care were more profound. As in the case above, we should then study whether the number of the courses offered was insufficient which would lead to lack of confidence in the students' self-assessments. In terms of the Professional Abilities Field, we can complement the students by offering courses relating to Integration and Innovation, and Foreign Language Skill. As for the General Abilities field, the weightings of the courses offered by the faculties were comparatively lower, which constituted the huge gaps of some competencies that could be explained.

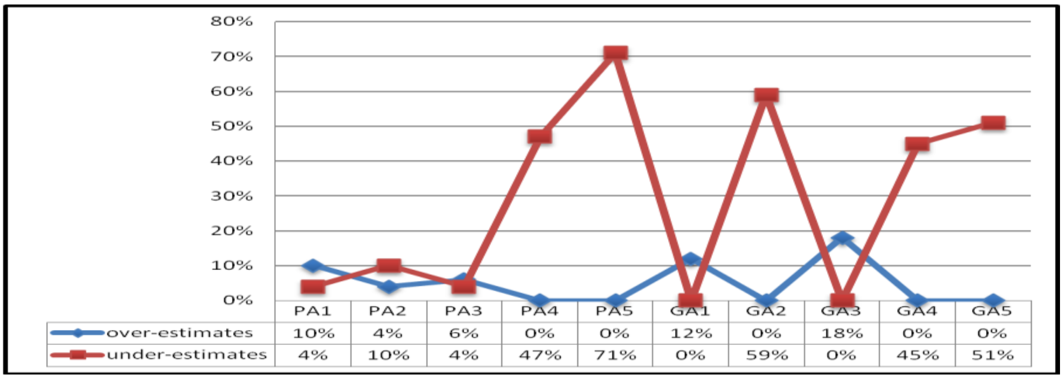

Figure 6. Distribution Chart of Students Ten Major Competencies Assessments

5. Conclusion and Prospects

Our school transformed the E-Map indices into charts, to provide intutitive referential informations for the maintanence of the mutual reinforcing relationships between the students and the courses [8]. In accordance to the results of the study, through generations of various charts and referential values by different analysis approaches, to explore the planning of courses offered by the schools, and the design of the questionnaire [7] for the graduates. From this, the effectiveness of E-Map to the schools is remarkably prominent. The only flaw was the limitation in the data resources, as currently we used only our faculty as our experimental subjects. In the future, we plan to adopt other faculty units, and even the E-Map data for the entire school students, and to include various statistical and analytical approaches, for comprehensive comparisons to enlarge the integrity of the experiment, and to feedback to the school for their referential basis as in the curriculum planning.

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TRIZ Internet Learning Platform Applied to University Factory Practical Training Course

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Abstract: The purpose of this study is to explore the influence of applying the Internet learning platform based on TRIZ to factory practical training instruction at a university in Taiwan. The research subjects in this study were university students in factory practical training courses. The questionnaire method was used to analyze the influence of TRIZ Internet learning platform applied to university factory practical training instruction. The subjects were further divided into the experiment group and the control group, and Internet learning platform strategy was used for experiment processing to carry out experimental instruction. After statistical analysis, the study finds the following conclusions: 1) TRIZ Internet learning platform applied to university factory practical training instruction has significant positive evaluations; 2) Internet learning platform has no significant differences in university student factory practical training course learning effects; 3) TRIZ theory applied to university factory practical training has a significant positive influence on learning effects. Instructional suggestions are given based on results of this study, in order to enhance the innovative thinking ability of university students, in turn making the factory practical training activities more meaningful.

Keywords: TRIZ, Internet learning platform, factory practical training

1. Research Motives and Purposes

The educational objectives of technical education include enhancing related capabilities and cultivating occupational ethics, and it has also received attention for cultivating independent thought and problem-solving ability. However, the most representative part of technical education, factory practical training course instruction is still a teacher-centered instructional model, in which the teacher guides the procession of the entire instructional activity, and the process of knowledge and capability transmission, potential problem-solving ability of students is often overlooked. In 2007, the Ministry of Education promulgated the "Creativity Education White Paper," which mentioned that schools should infinitely expand accommodation and imagination, and create a diverse learning environment that respects differences and appreciates creativity. If creative thinking instruction can be applied to engineering education, it should benefit the creation of engineering knowledge, development of technology, and improvement and innovation of products; the instructional strategies, processes, and effects deserve in-depth exploration and research.

In a context of advanced information, diverse society, and rapid changes, in order to cope with the times and the needs of the current environment, education should be highly sensitive and self-conscious and work hard at reformative and innovative concepts, so instructors cannot maintain traditional instructional methods. Teachers must adapt to people, time, and location to innovate instructional methods to inspire student learning interest. Teachers can use different instructional media to stimulate student learning, realize their creativity, enhance learning motivation, and lower and dispel learning obstacles for students in the process of learning, so that they can achieve the optimal learning effects (Ringwood, Monaghan & Maloco, 2005).

Thus, this study uses TRIZ Internet learning platform to accommodate university factory practical training course instruction, which breaks through the limitations of time and space, effectively realizes the advantages of Internet learning, provides an efficient learning environment, and follows the design of instructional activities and curricular content. Students can use the different instructional strategies and tools to obtain the best learning effects, in order to achieve the educational purpose of insight. This study seeks to achieve the following two points:

(1) to explore the influence of the application of TRIZ Internet learning platform on university factory practical training instruction;

(2) to explore the of TRIZ Internet learning platform on university student learning effects in factory practical training course.

2. Literature Review

Regarding Internet learning platform, TRIZ, and factory practical training, the literature organized and summarized below:

2.1 Internet learning platform

Due to rapid development of computers, communications, and audiovisual technology, learners are no longer isolated when they are learning (Sanchez & Hueros, 2010). Through the assistance of Internet technology, then can cooperatively learn with their peers, or even communicate and interact with other participants. They can engage in real-time or asynchronous discussions that are simultaneous or otherwise, to discuss and supplement each other, so that the Internet has formed rich learning content, diverse learning resources, and personalized learning needs and open learning contexts. Compared to traditional instruction, digital instruction can provide various advantages, including lower learning costs, strengthen response abilities. It is possible to create consistent instructional material content based on needs or customize personal instructional material content, instantly update instructional material content, learn at any time, and construct community knowledge. In the cooperative learning environment with Internet support, when students interact with others, they can also reflect upon themselves. The unceasing process of response and reflection can help promote student integration of their concepts, and this is beneficial for learning (Webb, 1995; Hoadley & Linn, 2000). Many studies have proven that Internet interactive learning method is indeed beneficial to student conceptual learning and problem-solving abilities (Webb, 1995; Hoadley & Linn, 2000).

This study applies the Internet learning platform to university factory practical training course, in hopes of transcending the limitations of time and space, to provide students with diverse learning resources. The learning environment involving student interaction can enhance learning interest to enhance learning effects.

2.2 TRIZ – Theory of Inventive Problem Solving

TRIZ was invented by Soviet Russian inventor Genrich Altshuller in the 1940s; TRIZ is the acronym of the Russian term Teoriya Resheniya Izobretatelskikh Zadatch, and the English translation is Theory of Inventive Problem Solving, which means "the solution theory for inventive problems." After he analyzed over 400,000 patents, he summarized the logic of patent invention commonality, repetition, and innovative inventive thought, forming the theoretical basis for TRIZ (Rantanen & Domb, 2008).
This study uses insight from TRIZ, adopts diverse innovative instruction to elicit active student learning motivation and interest, in hopes of improving the strategy in innovative instruction to elicit student creativity and problem-solving ability.

2.3 Factory practical training course

In order to enable students to be able to practically apply the theoretical courses they have learned after graduation, the purpose of factory practical training is to connect planning of instructional courses with the practical ability in work (Krar & Check, 1997). This allows the practical training process to help students practically understand the basic principles and capabilities of various types of machinery, and at the same time become familiar with the processing and operational procedures, as well as understand correct mechanical operational capabilities and processing methods. With practical work of the work items, students can become familiar with clipping tools, measurement tools, and operation of various tool machineries, cultivating good student industrial safety and hygiene habits at their factory work sites (Krar & Check, 1997).
However, due to advancement of new technological knowledge, if student capabilities can only stay in lower-level learning such as basic processing, it would not conform to needs in the industry. Therefore, this study integrates TRIZ theory into factory practical training course instruction, and would effectively lead students learn higher-level innovative design, so students can engage in practical processing to complete real items to obtain the ability of practical work, allowing them to have deeper impressions on the theories they have learned. The learning method through Internet learning platform is used to help students establish the concept learning they should achieve, and blend into their personal learning contexts for the future, and in turn, make the whole factory practical training course more meaningful.

3. Research Design and Implementation

Based on the research purposes and literature review, the research design and implementation procedures of this study are explained as follows.

3.1 Research framework

Research design in this study is based on research objectives and literature review, applying TRIZ theory to factory practical training course for classes A and B in an engineering department at a Taiwanese university as the focus of the first part of the curriculum, in order to cultivate correct mechanical operation capabilities and processing methods for students. After the midterm exam, classes A and B (the experiment group and the control group) underwent six weeks of experimental instruction via Internet learning platform instruction and traditional classroom instruction, as shown in Figure 1. A context was set so students can express their imaginations. Through TRIZ theory, team students use their creativity to design a conceptual diagram, and apply the capabilities they have learned from factory practical training to realize the product, making students familiar with clipping tools, measurement tools, and the operation of various tool machines, to achieve the purpose of making students fully understand basic processing abilities of machinery and cutting methods and principles.

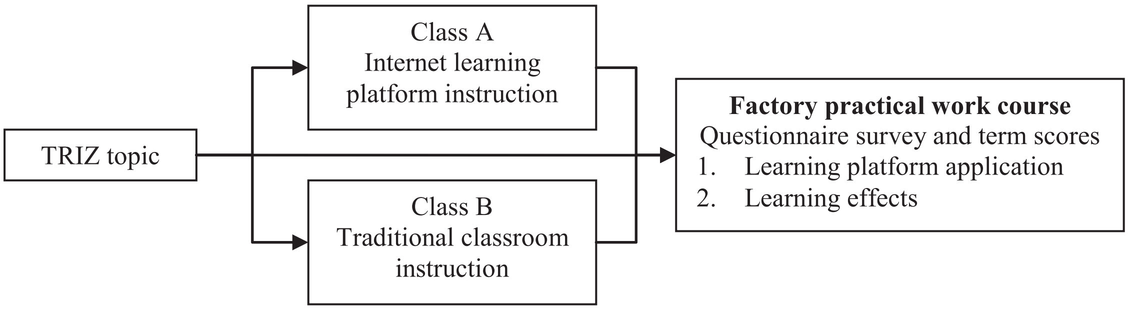

Figure 1 Research framework diagram

3.2 Research Subject and Research Method

Research subjects in this study are 107 freshman students from class A and B (55 students in Class A and 52 students in Class B) at the factory practical training course of the engineering department at the case university. The university uses normal distribution class divisions, and the course is taught by the same teacher, which can enhance the sample heterogeneity. The study uses questionnaires and the 107 students at the case school as the sample. The questionnaire is divided into the two major items of platform usage and learning effects, with a total of 20 questions, and the Likert scale is used to evaluate the extent to which the research subjects agree, in which they select one out of the five choices, which are "highly agree," "agree," "neutral," "disagree," and "highly disagree." Investigation of quantitative data relating to the effect of TRIZ Internet learning platform on university student factory practical training course is conducted through questionnaire data and statistical analysis of student term scores, in order to understand the effect of TRIZ Internet learning platform instructional model on university student factory practical training instruction.

4. Results and Discussion

Based on the research design and implementation of this study, the collected quantitative data undergoes statistical analysis is used to understand "the effect of TRIZ Internet learning platform applied to university factory practical training instruction" and "differences in learning effects caused by TRIZ Internet learning platform to university student factory practical training course learning effects," to serve as the primary basis for follow-up factory practical training course instructional design.

4.1 Analysis of TRIZ Internet learning platform instruction effects

This study uses the results of Class A questionnaires regarding the TRIZ Internet learning platform applied to university factory practical training course in a single sample t-test analysis, in order to understand the effect of integrating TRIZ Internet learning platform into university factory practical training course instruction. The results of analysis on instruction are explained in the following.

4.1.1 Statistical analysis of the effect of TRIZ Internet learning platform on factory practical training instruction

In the application of Internet learning platform, the mean values of the items were all above 3.5214, the standard deviation is under 0.76111, between agree and neutral, and when the test value is 3, it reaches a level of significance, as shown in Table 1. This shows that most students gave positive evaluation to the Internet learning platform. The Internet learning platform can be used to classify and search for knowledge, which can help students accumulate, share, and obtain knowledge. Assistance and consulting from the Internet teaching assistant can help students have in-depth exploration of knowledge relating to the topic. The team members use the discussion area for discussion, so that students can make their knowledge or thoughts more concrete and in the forms of words, and in turn complete the design and production of the topic, which can effectively enhance student learning interests and effects in the factory practical training course.

Table 1 Single sample t-test of TRIZ topic activity Internet learning platform application

NO.	Question	Mean number	Standard deviation	t (test value = 3)
1	The Internet teaching assistant is helpful for me in carrying out the “TRIZ topic activity”	3.5641	.73560	8.295^{***}
2	The work in every task makes me explore knowledge relating to the topic more deeply	3.5385	.76043	7.659^{***}
3	The work in every task is helpful for completing the topic design and production	3.7179	.62761	12.374^{***}
4	Using the discussion area and discussing with team members helps me make knowledge or thoughts more concrete and in the form of words	3.7094	.71991	10.659^{***}
5	The Internet platform helps me to accumulate knowledge	3.6325	.72633	9.419^{***}
6	The Internet platform helps me to share knowledge	3.6667	.62972	11.451^{***}
7	The Internet platform helps me to acquire knowledge	3.6581	.68434	10.402^{***}
8	The various categories on the Internet platform discussion area can help me categorize and search for knowledge	3.5726	.72298	8.568^{***}
9	Participating in the explanation meeting helps me have a quicker grasp of the techniques of operating the Internet platform	3.5214	.76111	7.410^{***}
10	Internet platform usage explanations helps me have a quicker grasp of the techniques of operating the Internet platform	3.5556	.70030	8.581^{***}

$^{***}p < .001$.

4.2 Analysis of Internet learning platform learning effects

This study applies Internet learning platform on factory practical training course for experimental instruction, and the term scores from factory practical training of the students from classes A and B undergo independent sample t-test analysis to understand differences in learning effects of Internet learning platform applied to university student factory practical training course. The analytical results are described as follows.

4.2.1 Statistical analysis of Internet learning platform on university student factory practical training course learning effects

After six weeks of experimental instruction, this study takes the term grades of research subjects in class A and B (the experiment group and the control group) to conduct an independent sample t-test analysis. Results show that the mean value of the control group (M=73.351) is higher than the mean value of the experiment group (M=72.110). The statistical analysis results show that t=-1.032, p=0.305<0.05, and that the Internet learning

platform applied to university student factory practical training course does not show a significant difference in the learning effects aspect, as shown in Table 2.
After the researcher interviewed the teacher and students, the summarized conclusions are as follows. "Factory practical training" is a practical work course, the primary purpose is to help students to work onsite and understand the basic functions and capabilities of the machinery and the processing operational procedures, thus, the semester scoring focus is also on practical operation ability. Online learning in the Internet learning platform designed by this study primarily provides students with diverse learning resources, so that when students interact, discuss, and share with others, they can also reflect on their work, which promotes student integration of self-concept, increases student learning interest, and in turn enhances the efficiency of knowledge acquisition. Thus, according to the traditional term score evaluation points, in the student learning effects in their practical work ability, statistical analysis results show that there are no differences in the practical work ability learning effects of the students in the experiment group and the control group. This shows that teachers should comprehensively plan the orientation of the Internet learning platform in curricular instruction based on course features, and reestablish evaluation standards to correspond to instructional models. This is a research and planning point that should be noted in future experiment design in this study, in order to enhance the completeness of research.

Table 2 Independent sample t-test analysis of Internet learning platform learning effects

	class	N	Mean	Std. Deviation	t	Sig (2-tailed)
Term scores	A	55	72.110	6.5872	-1.032	.305
	B	52	73.351	5.8039		

4.3 Analysis of TRIZ learning effects

This study further processes the questionnaires using single sample t-test analysis in order to understand the effect of TRIZ theory applied to university factory practical training course. The analytical results are explained as follows.

4.3.1 Statistical analysis of learning effects of TRIZ applied to factory practical training instruction

In the aspect of learning effects, the mean values of questions were all above 3.5385, the standard deviation is under 0.79935, between agree and neutral. When the test value is 3, there is a level of significance, as shown in Table 3.This shows that in the aspect of learning effects, most students gave positive evaluations. Through participating in challenging TRIZ topic learning activities, students can learn knowledge relating to the topics, integrate student capabilities in factory practical training, and enhance student ability in knowledge integration, problem-solving, data collection analysis, and practical work, in turn gain important learning experiences to verify theory and practice, which can effectively enhance student learning effects.

Table 3 Single sample t-test analysis chart of TRIZ topic activity learning effects

NO.	Question	Mean number	Standard deviation	t (test value = 3)
1	I learned something I did not know from the someone else's reports	3.6293	0.76363	8.876^{***}
2	Completion of the "TRIZ topic activity" is challenging for me	3.9829	0.73088	14.546^{***}
3	The practical work process can provide an opportunity to verify theory and practice	3.7179	0.65451	11.865^{***}
4	The practical work process is a learning method that integrates knowledge	3.6838	0.67785	10.911^{***}
5	The practical work process can enhance my problem-solving ability	3.6154	0.75254	8.845^{***}
6	The practical work process can enhance my data collection ability	3.6923	0.72471	10.333^{***}
7	The practical work process can enhance my learning of information ability	3.6667	0.73108	9.864^{***}
8	The practical work process can enhance learning of technological ability	3.6325	0.77235	8.858^{***}
9	The practical work process can enhance learning of engineering ability	3.5385	0.82565	7.054^{***}
10	The practical work process has given me very important learning experiences	3.7094	0.79935	9.599^{***}

$^{***}p < .001$.

5. Conclusions and Suggestions

Based on the research purposes, the composite analysis and discussion of this study leads to the conclusions and suggestions as follows:

5.1 Conclusions

After six weeks of applying TRIZ Internet learning platform to the factory practical training course experimental instruction at a Taiwanese university, the tested questionnaire survey data and student term scores undergo statistical analysis. Three conclusions are reached after analysis and discussion in this study:

- TRIZ Internet learning platform has a positive significant influence on the effect of factory practical training instruction

Results of this study show that in the aspect of Internet learning platform application, most students gave positive evaluations. Through Internet learning platform learning, assistance of Internet teaching assistants, and discussion with team members, students can accumulate, share, and obtain knowledge, and in turn have in-depth exploration of knowledge relating to the topics. This can help students make their knowledge or thoughts more concrete and convert them into words. This effectively enhances student learning interest and learning effects in factory practical training course.

- Internet learning platform does not show significant differences on learning effects for university student factory practical training course

This study applies Internet learning platform to factory practical training course for experimental instruction. Analysis of the student term scores shows that there are no significant differences in the learning effects. This shows that the application of Internet learning platform on factory practical training course has no significant difference on the learning effects of student practical work ability.

- TRIZ application to factory practical training course has significant positive learning effects

Results of this study show that in the aspect of learning effects, most students gave positive evaluations. Through participating in TRIZ topic activities, students can integrate the capabilities learned by students in factory practical training, enhance student knowledge integration and abilities in problem-solving and practical work, and in turn gain important learning experiences that verify theory and practice to effectively enhance student learning effects.

5.2 Suggestions

Based on the above research results, the following suggestions are provided as a reference:

- Schools should apply TRIZ Internet learning platform to factory practical training instruction

Results of this study show that there is a significant positive effect of TRIZ Internet learning platform on factory practical training instruction effects, which shows that most students can identify with this instructional model. Since students are happy to accept diverse and lively creative instructional methods and content, so it is suggested that schools should establish a TRIZ Internet learning platform and apply it on factory practical training instruction to elicit intrinsic learning interest of students, and enhance factory practical training learning effects.

- Teachers should adequately plan the orientation of Internet learning platform in course instruction

This study finds that Internet learning platform has no significant difference on university student factory practical training course learning effects. Since factory practical training course is a practical work course, the purpose of which is help students practically understand the basic functions of various types of machinery and become familiar with various processing operational procedures. Thus, teachers should comprehensively plan the orientation of Internet learning platform in course instruction based on course characteristics. For application of factory practical training courses, this study suggests that teachers should stress transmission of knowledge of basic functions and operational method of various types of machinery, and promotion of industrial safety and hygiene. Teachers and students can all use the platform to engage in knowledge exchange and reflection sharing, in order to enhance the efficacy of the instructional activities.

- Teachers should adequately use TRIZ theory to design student-oriented instructional models

Results of this study show that when TRIZ is applied in factory practical training course, most students gave positive evaluations to the aspect of learning effects. Since TRIZ theory can help students to effectively enhance abilities in problem-solving and creative thinking, teachers should adequately use TRIZ theory to provide students with a flexible learning environment, create instructional models that meet personalized needs to incorporate future learning contexts for students, so that they can be more confident in facing their future workplace. Thus, students can learn better and be better able to apply skills to the workplace.

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An Interactive Tool for English Reading Comprehension by Providing Questions and Hints to Student during Reading and Parsing

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Abstract: We developed a tool that helps EFL (English as a foreign language) students to explicitly represent a sentence as a parsing tree. Firstly, the tool generates a sequence of questions from a partial-parsed parsing tree of a sentence, and secondly a software agent provides these questions sequentially to students during the process of reading. By correctly answering to these questions, step-by-step, the students are able to learn how to separate the words, word groups, and phrases of the sentence and organize them into a tree structure.

Keywords: Reading, partial parsing, chink-down, chunk-up, parsing tree, question guided reading

Introduction

Reading a sentence is a process of parsing in which the readers use their linguistic knowledge to transform the linear sequence of words of the sentence into a tree structure of chunks (meaningful group of words) [1], implicitly in their minds or explicitly by representing the tree structure visually. We developed a tool that help students to explicitly represent a sentence as a parsing tree by firstly generating a sequence of questions from a partial-parsed parsing tree of a sentence, and secondly providing these question sequentially to the students during the process of reading and parsing. By correctly answering to these questions, step-by-step, the students will learn how to separate the words, word groups, and phrases of the sentence and organize them into a tree structure.

1. Motivations

1.1 Problem happened in reading for EFL student in Taiwan

Researchers had found that college students in Taiwan who learn English as a Foreign Language (EFL) experienced difficulties in English reading comprehension [2]. Several kinds of knowledge are needed in reading comprehension including vocabulary knowledge and structural knowledge [3]. These knowledge are implicitly learned by comprehensive students, but are sometimes difficult for other students. Thus, an explicit representation of these knowledge is needed to explicitly measure the reading ability of students.

1.2 Reading as a Process of Parsing

Reading a sentence is a process of parsing the sentence into a tree structure of chunks. Previous works on sentence parsing in traditional natural language processing are performing full parsing through prescribed grammars, such as context free grammar (CFG) [4]. However, it is difficult for students to apply these grammars to fully parse sentences. There is a different approach of parsing, called partial parsing [5] [6], which is used to easily and robustly parse sentence into chunks (noun phrase, verb group, preposition phrase, simple clause, etc). There are two paradigms of partial parsing. The first one is called "chunking", which retrieves chunks from a sentence by searching the word sequences that matching the regular expressions of noun phrases, verb groups, and preposition phrases. The second one is called "chinking", which transform a sentence into several segments by eliminating the functional words in the sentence. By applying partial parsing and organizing these chunks into a tree structure, the reading of a sentence is explicitly represented.

1.3 Providing Hints and Questions in the Process of Parsing

The process of parsing a sentence into a tree structure of chunks can be guided step-by-step by providing appropriate questions about (a) which word in the sentence should be separated to rationally divide the sentence into parts and (b) which word in the current part should be separated to rationally divide the current part into more parts. This process can be performed recursively under a depth-first procedure until each part, as a node of the parsing tree, is exactly representing a chunk. By answering to these parsing questions, the students can show that they are able to make correct decisions during the process of reading, and the ability to make a correct decision is measured from recording the sequence that the students answering to these questions.

2. Problem Descriptions

2.1 The Functional Words and the Structure of English Sentences

According to Longman Dictionary of Contemporary English [7], the part-of-speech (POS) of English words are classified into 15 classes, including noun, verb, adjective, adverb, pronoun, modal verb, interjection, preposition, conjunction, pre-determiner, determiner, number, indefinite article, definite article, and auxiliary verb. The first four classes are call "content words" and the others are called "functional words".

The structures of English sentences are classified as four kinds, simple sentence, compound sentence, complex sentence, and compound-complex sentence. A simple sentence is composed of a subject and a verb group, following by a complement, or an object, or an object and a complement, or two objects (indirect and direct objects). Each of these compartments can be modified by adjective phrases or adverb phrases. A compound sentence is composed of two or more simple sentences, as clauses, which are linked by conjunctions. A complex sentence is composed of two simple sentences, the main clause and the subordinating clause, which are linked by a relative pronoun. A compound-complex sentence is composed of both compound and complex sentence. By linking several clauses, the length of a sentence increases. The longer a sentence is, the more difficult for students to read.

2.2 Partial Parsing by Chink-Down and Chunk-Up

2.2.1 Chink-Down

Since a long sentence gains its length by linking clauses and phrases by conjunctions, relative pronouns, and prepositions, which are a subset of the functional words of English. On the contrary, we can decompose a sentence into simple parts by separating it at these functional words, and result in a list of parts which are usually noun phrases, verb groups, adjective or adverb phrases. This partial parsing method is called "chinking", in respect to the other method of "chunking". We call this process as "chink-down". The chink-down rules are shown in Figure 1(a).

(a) Partial parsing by chink-down rules: 1. Cut before and after each punctuation. 2. Cut before and after each conjunction. 3. Cut before and after each relative pronoun. 4. Cut before and after each personal pronoun. 5. Cut before and after each demonstrative pronoun. 6. Cut inside each idiom. 7. Cut before and after verb group. 8. Cut before each preposition. 9. Cut before "a", "an", "the", and other determiners.
(b) Tree Construction by chunk-up rules: 1. Joint preposition + determiner. 2. Joint preposition + noun. 3. Indent before and after subordinating and correlative conjunction. 4. Indent after relative pronoun. 5. Indent the parts governed by the same verb group to the same level.

Figure 1 Rules of chink-down and chunk-up

2.2.2 Chunk-Up

After the process of chink-down, the sentence is decomposed into simple parts, then we apply the chunk-up rules, as shown in Figure 1(b), to joint particular patterns of words as chunks and make indents according to the semantic relationship between corresponding parts to construct the tree structure of the sentence, as shown in Figure 2.

2.3 The Parsing Tree Explicitly Represents the Reading of the Sentence

Through the process of chink-down and chunk-up, the sentence is transformed into its partial parsing tree which explicitly represents the reading of the sentence. Each node of the tree is a chunk, and the nodes under their parent node are also composed to a chunk of higher level of meaning. For example, in Figure 2(c), part 1 to 3 form a chunk as "There is a long-held belief", part 10 to 13 form a chunk as "eye contact we have with the person", and part 9, 10, 14, 15 form a chunk as "the more eye contact, the better". With this

(a) There is a long-held belief that when meeting someone, the more eye contact we have with the person, the better.

(b)		(c)	
[01]	There	[01]	There
[02]	is	[02]	is
[03]	a long-held belief	[03]	a long-held belief
[04]	that	[04]	- that
[05]	when	[05]	- - when
[06]	meeting	[06]	- - - meeting
[07]	someone	[07]	- - - someone
[08]	,	[08]	- - ,
[09]	the more	[09]	- - the more
[10]	eye contact	[10]	- - eye contact
[11]	we	[11]	- - - we
[12]	have	[12]	- - - have
[13]	with	[13]	- - - with the person
[14]	the person	[14]	- - ,
[15]	,	[15]	- - the better
[16]	the better	[16]	.
[17]	.		

Figure 2 Representing a sentence as a tree structure. Number in squared bracket denotes the part number. (a) The original sentence. (b) The list of parts of the sentence after the process of chink-down. (c) The list of parts after the process of chunk-up. Indentation denotes the depth of the node. The example sentence is quoted from the reading comprehension test of English in college entrance examination in 2011, Taiwan.

representation, the results of reading are compared between the tree constructed by a student and the tree constructed by a teacher. If a sentence was correctly read by a student, the resulting tree should be as same as the tree constructed by a teacher.

3. Question Guided Reading and Parsing

3.1 Question Guided Parsing Process

In order to let the parsing process of a sentence for the students to be a question guided one, the sentence is pre-parsed by a teacher. In each node of the parsing tree, we identify one or more functional words which cause the bifurcation of the node from its parent node. We call these words as "parsing pivot", which, in general, are punctuations, conjunctions, relative pronouns, prepositions, verb groups, and determiners. Then we can ask students questions about these pivots like "at which word or words in the sentence should I separate the sentence to best divide the sentence into parts?" or "at which word or words in the part should I separate the current part to best divide the current part into more parts?" We call these questions as "parsing question". By tracing the parsing pivots from the root of the parsing tree through all the descendants, a sequence of parsing pivots is generated, and the corresponding questions about these pivots are generated, too. The generating method is mentioned in 3.2.

When students take a practice or a test of reading, they answer to the sequence of parsing questions from the beginning of the sequence. If the student's answer is correct for the current question, the corresponding bifurcation of the parsing pivot is performed according to the pre-parsed parsing tree, and the current part is updated, and the process continues to next question until all the questions are correctly answered. If the answer is wrong, the student is asked the same question again, until the student has made a correct answer. After all the questions are correctly answered, the result is presented.

A simple example is shown in Figure 3(a). The process begins when the teacher, as an agent, provides a sentence to a student. The first question is to find the punctuation where the sentence ends at. When the student makes a wrong answer, the agent provides a negative feedback message and a hint, and asks again. When the student makes a correct answer, a positive feedback is provided, and the result is shown. The sentence is divided into two parts and the current part is updated to part 1. In Figure 3(b), the question is asking about which conjunction in part 3 is the pivot to best divide the current part into more parts. The correct answer is "that", which divides part 3 into part 3, 4, and 5. Since part 3 and 4 are parsed already, the current part is updated to part 5.

(a)

Teacher: Please read this sentence?

[1] There is a long-held belief that when meeting someone, the more eye contact we have with the person, the better.

Teacher: [Hint] Find the punctuation that ends the sentence.

Q1. Where does the sentence end at?

(1) The "," after "someone"

(2) The "." after "better"

> 1

Teacher: Oh, No! A sentence can not end at a comma! Please find a " . ", " ? ", or " ! ".

Q1. Where does the sentence end at?

(1) The "," after "someone"

(2) The "." after "better"

> 2

Teacher: That is correct! The sentence end at "."

[1] There is a long-held belief that when meeting someone, the more eye contact we have with the person, the better

[2] .

Current part : [1]

(b)

[1] There
[2] is
[3] a long-held belief that when meeting someone, the more eye contact we have with the person, the better
[4] .

Teacher: [Hint] Find the conjunction.

Q3. Which word should be separated to best divide part [3] into more parts?

(1) belief

(2) that

(3) when

> 1

Teacher: Mm... I don't think so. Please try again!

Q3. Which word should be separated to best divide part [3] into more parts?

(1) belief

(2) that

(3) when

> 2

Teacher: Good job!

[1] There
[2] is
[3] a long-held belief
[4] that
[5] when meeting someone, the more eye contact we have with the person, the better
[6] .

Current part : [5]

Figure 3 Question Guided Parsing. (a) Identify the end of the sentence. (b) Separate part [03] at the conjunction "that" into more parts.

3.2 Generating the Sequence of Parsing Questions

The sequence of parsing questions is generated by tracing the pre-parsed parsing tree from the first node through all the descendants, in a depth first search procedure. Each node has a level number. The first node is in level 1. Nodes that are at the same level of the first node are also in level 1. Child nodes of the node in level K are in level K+1. If several nodes of the current part are in the same level, then the algorithm choose the node that contains the parsing pivot of the highest priority as the next pivot to be parsed. The priorities of parsing pivots are shown in Figure 4. The first line shows that punctuation has highest priority. The second line shows the priority of three kinds of conjunctions. The third line shows the priority of different subordinating conjunctions. The fifth line shows the priority of different pronouns.

1. Punctuation : Period, Question mark, Exclamation mark > Semicolon > Colon > Comma
2. Conjunction : Subordinating Conjunction > Correlative Conjunction > Coordinating Conjunction
3. Subordinating Conjunction : That > When, Where
4. Idiom
5. Pronoun : Relative pronoun > Demonstrative pronoun > Personal pronoun
6. Verb
7. Preposition

Figure 4 Priority of the parsing pivots, from high priority (1) to low priority (7). In each line, the detailed priorities of the sub-classes are shown, too.

For example, in Figure 2(c), the nodes of level 3 are "when", comma, "the more", "eye contact", comma, and "the better". The first comma has the highest priority. So, for part 5 "when meeting someone, the more eye contact we have with the person, the better", the next question to ask is to separate part 5 at the first comma to divide it into 3 parts: part 5 as the clause "when meeting someone", part 6 as the comma, and part 7 as the rest "the more eye contact we have with the person, the better". Since part 5 is not completed, the current part is updated to this part. In part 5, the conjunction "when" has highest priority, so the next question to ask is to separate part 5 at "when" to divide part 5 into 2 parts: part 5 as "when" and part 6 as the rest "meeting someone". The part numbers of the following parts are updated sequentially and the current part is updated to part 6.

After part 6 has been parsed as part 6 "meeting" and part 7 "someone", the current part is updated to part 9, because part 8, the comma, is parsed previously. Part 9 is now as "the more eye contact we have with the person, the better". Again the comma has highest priority, so the next question to ask is to separate part 9 at the comma and produces 3 parts: part 9 as "the more eye contact we have with the person", part 10 as the comma, and part 11 as "the better". In part 9, the idiom "the more" has higher priority than "eye contact", so the next question to ask is to separate part 9 as "the more" and "eye contact we have with the person". The process continued until all the questions are generated.

3.2.1 Types of Parsing Questions

There are three types of parsing questions. First, the pivot choosing question is to choose a word that best divides the current part into more parts. Second, the POS identification question is to identify the POS of the parsing pivot. Third, the scope marking question is to mark the beginning word and the end word that are governed by a parsing pivot. The range of words governed by a pivot is the scope of the pivot. There are three types of scope, the scope of an idiom, the scope of a conjunction, and the scope of a verb group.

3.2.2 Generating the Options of the Parsing Question

For questions of type 1 and 2, the options are generated according to three principles. First, the words in the same level and POS of the parsing pivot are options. Second, if there is no word in the same POS of the parsing pivot, then the words in the same level of the parsing pivot are options. Third, if no word is found by principle one and two, then the words before and after the parsing pivot are options. For questions of type 3, the options contain the words of correct answers and some words randomly chosen from words that belong to the current part and are before, within, or after the correct answers.

3.3 Providing Feedback and Hint

After the parsing questions are generated, they are provided to the students, as shown in Figure 3. The agent provides appropriate feedback to the student according to the answer they made. If the answer is wrong, a negative feedback, a hint and a simulated result are presented, and they are asked to answer again. If it is correct, a positive feedback is provided, and the result is presented.

4. System Design

4.1 System Architecture

The system is divided into four major blocks, as shown in Figure 5. First, the sentences of an article are pre-parsed by a teacher to produce the parsing tree of each sentence. Second, a sequence of parsing pivots is generated as the parsing sequence. Third, the sequence of parsing questions is generated from the pre-parsed parsing tree and the parsing sequence to produce a list of parsing questions. Fourth, an agent of teacher is constructed, which takes the pre-parsed parsing trees and the list of parsing questions as input and interacts with the student through a computer GUI (graphic user interface). The performance of the student is recorded for further analysis.

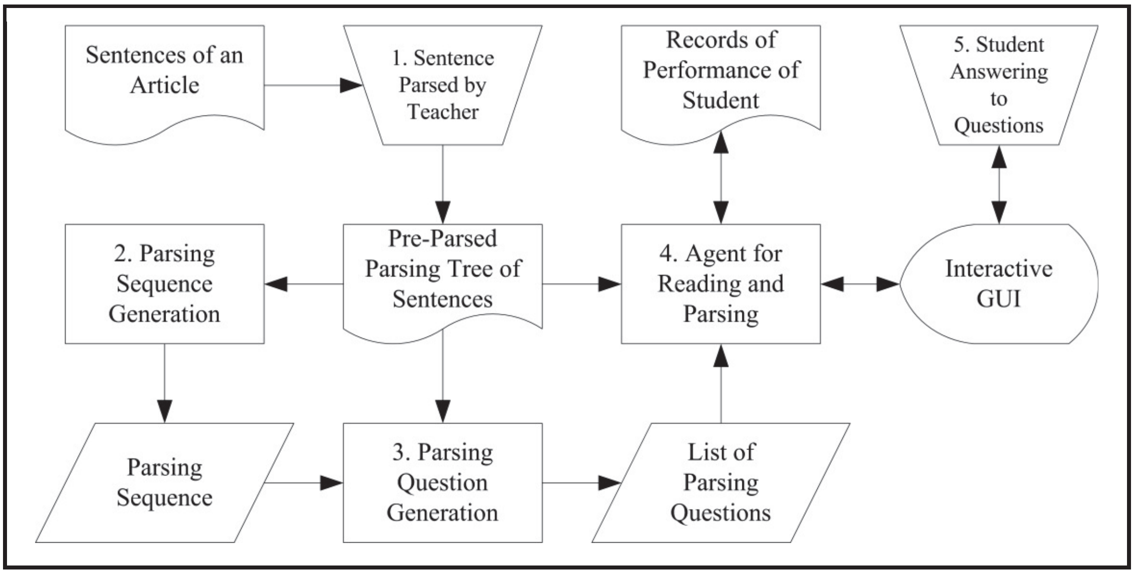

Figure 5 System architecture

4.2 Data Input and Output

The article is in plain text. The pre-parsed parsing tree is represented as four vectors. The first one is a vector of all the tokens of the sentence, including punctuations and words.

The second one is the level of the tokens. If the token is the first word of a part, then the level is encoded as it is, otherwise, the level is encoded as zero to show that the token is a following word. The third one is the POS of the tokens. The last one is the status of the tokens during the reading and parsing process. The parsing sequence is a vector of the index of the parsing pivots in the pre-parsed parsing tree. The parsing questions are represented as a list where each node of the list contains the text of question, options, correct answer, and hint. Students interact with the GUI of the system by keyboard or mouse.

4.3 The Records of Performance of the Students

The records of performance of the students are represented as a vector of an ordered pair of two numbers. The first one is the number of the question. The second one is the answer chosen by the student. These records together with the pre-parsed parsing tree and the list of parsing questions are used for further analysis of the reading ability of the students.

5. Experiments

We use the articles of reading comprehension test of English in the college entrance examination of Taiwan, 2011, as the input texts. There are four articles in this test. The experiment is still in progress.

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Establish the Semiconductor Communication and Control System: An Investigation on System Cognition and Interdisciplinary Curriculum

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Abstract: In the current diversified society of rapid scientific and economic change, the industrial field looks forward in the direction of interdisciplinary integration, since the talent and knowledge of a singular profession will no longer function as industry begins to change. This has seriously become the direction strived for by academic circles, that an engineering education cultivates interdisciplinary talents and knowledge and the ability to integrate them in an effort to balance the talent supply and demand among industrial and academic circles. In this study, we take the equipment of the vacuum coating process, and designs and establishes the semiconductor standard communication and control system (SCCS) with the SECS (Semiconductor Equipment Communication Standard) interface. By doing this, the study attempts to understand how to effectively lead in information, as well as the semiconductor process relevant in the Department of Electrical Engineering (EE) curriculum with the hopes of giving EE students a more diversified interdisciplinary knowledge, more appropriate for the expectations and demands of the industry after graduation.

Keywords: Interdisciplinary, Semiconductor communication and control system (SCCS), engineering education, mechatronics, human machine interface

Introduction

In recent years, the rapid development of advanced technological industries has accelerated a change in higher education, and development between the university and industry has become inseparable [3][6]. On the one hand, university education relies on industrial development. On the other hand, capacity enhancement, new product development and technology development in the field of industry need new knowledge and technology provided by the university and laboratories. Both an interdependent relationship and a contradiction within educational purposes exist between the university and industry because the university is an educational and cultural institute, and its purpose focuses on the application and development of new knowledge. However, industry views new knowledge development as only a means to an end rather than a sole purpose. The industrial field is concerned about the market value of new knowledge and technology. The “educational objective” of the university refers to the career and professional achievement which shall be reached by students after graduation [15]. “Core ability” refers to ability and knowledge of the career, as well as professional achievement which shall be reached by the students before graduation; that is, competitive talent, knowledge and technology which shall be possessed by students when faced with the prospective environment of society or employment [4][11]. Thus, the draft of educational objective and core ability shall make reference to the dimension, e.g. social rhythm and educational development, industrial development and workplace demand, and construct a definite educational objective and core ability pursuant to school orientation and features.

In the current diversified society of rapid scientific and economic change, the industrial field is looking forward in the direction of diversified domain integration. Taiwan' s industrial structure has also made drastic adjustments in recent years on account of the high speed change of global industry, and the demand for talent in the industry field has shown a drastic correction. The academic circle feels the effects of environmental change generated by scientific progress, and although it aggressively aims to make adjustments in the engineering educational structure, the adjustment speed cannot catch up with the demand of industry. Therefore, the mission of school education must be to cultivate the talents used by society and industry to solve the disordered phenomenon of the demand structure of industry and academia. In other words, the abilities which should be possessed cannot be acquired from attention to a single subject but needs the study of many subjects and the integration and application of an interdisciplinary knowledge [13]. The instruction transfers from the past single subject orientation to cultivating a contingent ability and skill set of students to face a diversified society in the future. Outcome-Based Education (OBE) heads toward the curriculum design objectives of knowledge, skills and attitude, all of which should be possessed by students and which focuses on learning methods and self evaluation with students as the main body [12][16].

After the electromechanical engineering subject is mutually integrated by both mechanism and electronics, Mechatronics continuously responds to product demand to adopt more advanced technology. With the rapid development of information technology, the Mechatronics subject also begins to integrate itself with the information technology subject and further encourages the vigorous development of current industrial automation. Production informationization has been applied extensively in many businesses. With every advantage in speed and cost brought by informationization, every business aggressively incorporates relevant information technology in expectation of applying that information technology to acquire accurate decision-making information and thus enhance their company' s competitiveness [9][18]. Therefore, in the current Mechatronics subject, possessing and mastering a single technology has been unable to satisfy the increasing demand for omniscient talents for Mechatronics in the field of industry.

To summarize the aforementioned, the supply and demand drop for talent between the field of academics and that of industry is in need of an urgent solution, and a way to cultivate the more qualified talents to meet the expectations of the industrial circle is currently one of the goals of every college and university in Taiwan. According to the OBE theory, continuous feedback and a corrective can change the academic circle in a way that steadily responds to the demands of industry and society, and feedback provides the opinions of talent needed by the field of industry so that the academic world can refine curriculum design and teaching activities [13][15]. This study expects to take the coating process equipment of the semiconductor process as an example to implement the process equipment information integration system with the SECS interface, to survey the benefit of the system to enhance the competitiveness of their process equipment, to give suggestions about school educational curriculum planning to obtain the talent needed and to make students possess interdisciplinary subject knowledge of electric machines, general information and the semiconductor process, as well as the "core ability" of coordination and integration with different domain personnel.

1. Mechatronics and the system architecture

Mechatronics is the knowledge of integrating machinery and electric machines [2][5]. In the past, machinery and electric machines belonged separately to two different subjects and developed in their own direction with little overlap. Afterwards, the demand for integration emerged on account of the demands of industry. In recent years, with the continuous development of technology, electromechanical products have continuously adopted more advanced technology to maintain its market competitiveness. To date, Mechatronics is not only a combination of the machinery and electric machine subjects, but also incorporates information science and technology. Consequently, Mechatronics is a science combining machinery, electric machines and information science and technology to be applied in the element, module, product and system [5][7].

The current constituents in production and manufacturing of equipment are mainly the mechanism component, sensor component, control component and Human Machine Interface (HMI). In the Mechatronics field, the HMI monitor can clearly show the operator the machinery status, control machinery action and skip the traditional panel control to make mechanical manipulation more automated and user friendly. The HMI is the user interface which allows the manipulator and the automatic equipment to interact and makes the manipulator acquire every piece of automatic equipment information in order to take control of production status and achieve automatic production [8][10]. Although automatic production can enhance production efficiency drastically, on the premise that a business faces globalized market competition, a business not only must enhance production efficiency but also needs to integrate process information from every piece of equipment on the production line to ensure that the products produced possess a high quality and yield rate to effectively reduce production cost.

In the electronic industry, the monitoring system of process equipment is also covered in the Mechatronics field, and its architecture is shown in the figure 1. The system body consists of the mechanism, sensor, driver and I/O control component. I/O communication refers to the communication between the controller and HMI, while the HMI serves as the communication interface between human beings and machinery. Furthermore, in order to establish the SCADA (Supervisory Control and Data Acquisition) [1] on the basis of the computer, the SECS communication protocol needs to be provided to help the IT specialist integrate the information. Thus, how to make the production equipment possess the SECS communication protocol seriously becomes an important topic that electromechanical integrates into its abilities [14][17].

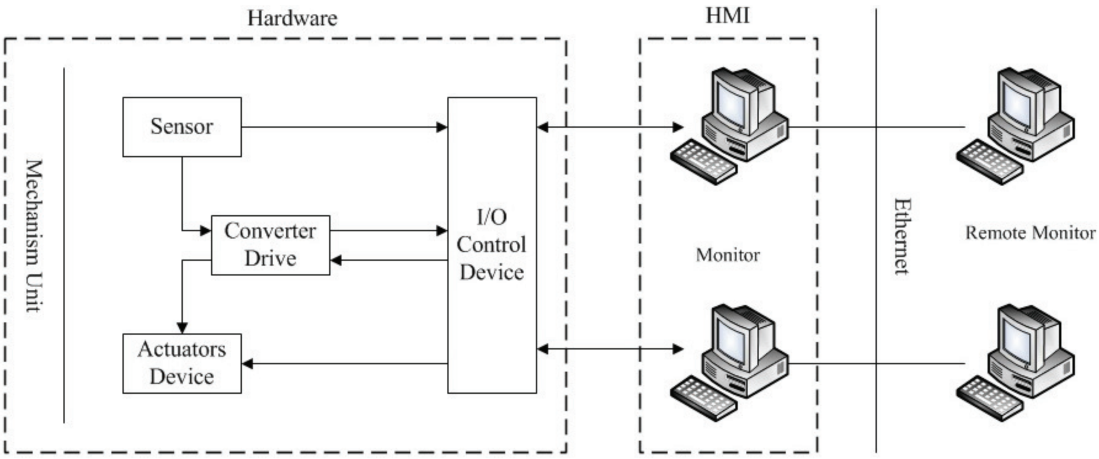

Figure 1. The architecture of the process equipment

2. The SCCS system design

The SCCS is mainly a set of systems which makes the process equipment meet the SECS, and it not only provides the operator on site immediate production information via the HMI of the SCCS, but also allows the production management system to extract the immediate process data of process equipment via the SECS protocol and set and download the parameter or Recipe. SCCS design and development are described in detail as follows.
SCCS design is generally divided into three stages: SECS Interface, IO Server and HMI. The SECS Interface mainly serves as the communication interface with the production management system. The IO Server is responsible for immediate information communication with every instrument of the process equipment and the controller. The HMI shows every piece of information on it so that the manipulator can monitor, design and select the process parameter and Recipe. In the system's design, the process equipment action and communication processes must be understood first to make the system meet the features of the process equipment.

2.1 SECS Interface

SECS Interface mainly serves as the communication bridge between the HMI and the SECS Host, transforms information from the SECS Host to a format accepted by the HMI and relatively transforms information which must be uploaded from the HMI to SECS to be provided to the SECS Host. As for the SCCS and SECS Host transmission, this study accepts the HSMS (High-Speed SECS Message Services) as the form of transmission. The HSMS transmission needs to be set by the SECS Host parameter, while the HMI is identified by Tag. SECS Interface needs to establish the coupling between the SECS Host and the HMI to repay accurate information to the SCES Host.

2.2 Human Machine Interface

The HMI is the communication bridge between human beings and the machine, just as its name implies. Its purpose is to show every piece of immediate information of process equipment on it, to provide the manipulators with the necessary information to monitor, design and select the process parameter and Recipe and to simplify the complicated manipulation interface of the traditional control panel (Figure 2). It selects Wonderware InTouch as the implementation tool of the HMI. InTouch and its communication equipment transmit information mainly via an IO Server, while the communication coupling between InTouch and the IO Server needs to establish an Access Name and set access information with a Tag Name mechanism. In a nutshell, an Access Name is the communication that establishes equipment, while a Tag name accesses its information.

2.3 IO Server

IO Server mainly takes Virtual Studio C++ as the developmental environment and is divided into two parts: a. DDE/SuiteLink Handler, which is responsible for collecting the information requested by the HMI and examining its validity via the DDE/SuiteLink protocol. b. Practical communication part, in which the IO Server delivers a message to equipment and receives the responsive message from the IO Server in light of the

Master/Slave model. The job of the DDE/SuiteLink Handler is to handle the complicated DDE/SuiteLink communication protocols. When the DDE/SuiteLink Handler receives the DDE/SuiteLink message, it will set and examine whether all the messages requested are valid. If the messages are valid, the IO Server will establish information so that it can read information from the equipment terminal.

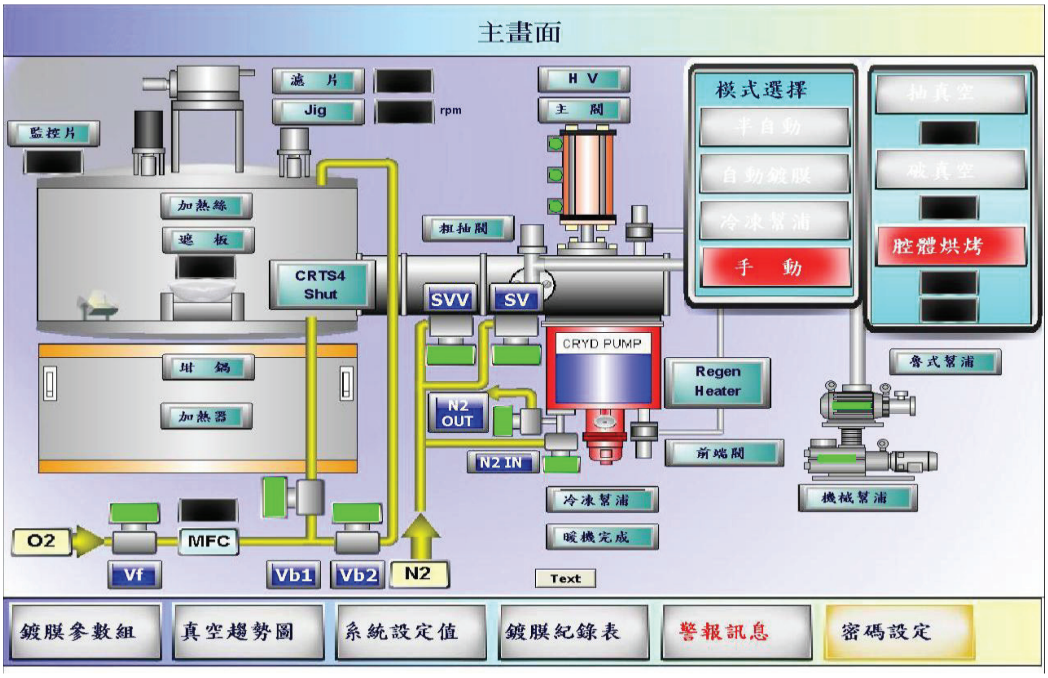

Figure 2. HMI for SCCS

3. Results

Verification of this study is divided into two parts. The first part is to understand the SCCS benefit to the industry, and is further divided into two dimensions (cognition and usability). The second part is to make the industry understand SCCS, to provide the industry with a system able to enhance the competitiveness of the industrial field and to give curriculum arrangement suggestions for relevant EE via industry experience under the educational objective of cultivating interdisciplinary talents.

3.1 Participants

The questionnaire of this study takes the Taiwan's coating process equipment manufacturer as the main participants (n=30) of the questionnaire survey. The participants include the department supervisor of design and R&D, the engineering department, the customer service department, development designers and equipment engineers.

3.2 Verification of the SCCS Cognition Dimension

It can be seen pursuant to the table 1 that the examinees have proven an understanding of the SECS mentioned in the SCCS, as well as an understanding of the SCCS functions and purpose after reading the SCCS introduction in the SCCS cognition. Most of the respondents were shown to believe that developing the SCCS system is something very important (83.3% agree), but the company still does not develop the system of the same SCCS function, and the reason may be that developing the SCCS system is too difficult for the respondents.

Table 1. The responses to the cognitive construct

Item	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Mean
I have been heard the SECS standard communication in SCCS.	40%	46.7%	3.3%	10%	0%	4.167
I can understand the SCCS function and purpose.	23.3%	56.7%	3.3%	3.3%	0%	4.267
Our company has been developed the system of the same SCCS function.	6.7%	26.7%	33.3%	23.3%	10%	2.967
I believe that developing the SCCS is very important for our company.	10%	83.3%	10%	0%	0%	4
I think that developing the SCCS is difficult for me.	6.7%	30%	30%	23.3%	10%	3

3.3 Verification of the SCCS Usability Dimension

It can be seen pursuant to the table 2 that the examinees were shown to agree on several items in the SCCS availability, e.g. increasing the process equipment value of the SCCS, helping the company enhance product competitiveness, meeting the request of customers in data transmission and making customers further increase process equipment reliability. They also were shown to partly agree that the SCCS can drastically enhance both capacity and yield rate.

Table 2. The responses to the usability construct

Item	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Mean
I think SCCS can increase the value of process equipment.	26.7%	70%	3.3%	0%	0%	4.233
I think SCCS can help the company enhance product competitiveness.	33.3%	63.3%	3.3%	0%	0%	4.3
I think SCCS can meet the request of customers in data transmission.	33.3%	60%	3.3%	3.3%	0%	4.233
I think SCCS can drastically enhance both capacity and yield rate.	13.3%	63.3%	23.3%	0%	0%	3.9
I think SCCS can increase process equipment reliability.	26.7%	56.7%	16.7%	0%	0%	4.1

3.4 Interdisciplinary curriculum survey

The industry ranks the feedback opinions of the interdisciplinary curriculum with an average, in order programming language (4.57), object oriented programming (4.47), semiconductor automatic production (4.47), computer network (4.43) and data structure and algorithm (4.2). The results show that in addition to the Electric Machine subject as its basis, the design and development of the SCCS system still need to combine the domain knowledge of information engineering and semiconductor automatic production. However, EE students cannot study much about information engineering and semiconductor automatic production at the confined university stage, so the interdisciplinary integration curriculum is needed to make the students possess the diversified domain knowledge.

Conclusions

The SCCS system presented by this study aims for the process equipment home production of the semiconductor and photoelectric relevant industry to present a refined scheme and suggestions about the necessary subject knowledge that professionals must possess for the relevant EE, via the feedback opinions of the industrial field to make the students cultivated by the school more apt for the expectations of the field of industry. The results of this study are to establish a system which makes process equipment possess SECS communication ability, to verify whether the SCCS is beneficial for the industrial field via the analytical results of the questionnaire survey and to understand that the potential professionals needed by the industry cannot only possess a single professional knowledge but require interdisciplinary knowledge via the feedback of the industry. Thus, university education must move forward in the direction of diverse field integration and cultivate interdisciplinary abilities to enhance the core competitiveness of students

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An Innovative Activity Design for Game-Based Learning on Interactive Whiteboard Space

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Abstract: In a traditional classroom environment, it would not be enough to enhance the interactions between instructors and learners. Many studies argue that multimedia has the potential to create high quality learning which actively engage the learners promoting deep learning. In this paper, the architecture is proposed to integrate hardware devices (Multi-touch screen, handwriting pane, and multiple mice) and software teaching materials for an instructor can decide an interactive learning process easily and simply.

Keywords: Interactive learning, Whiteboard, Multimedia, Multi-touch, Multi cursor

Introduction

In a traditional classroom environment, it would not be enough to enhance the interactions between instructors and learners. Cairncross and Mannion (2001) argue that learning materials with interactive multimedia has the potential to create high quality learning environment which actively engage the learner, thereby promoting deep learning. The key features of interactive multimedia, various media representations, user control over the delivery of information, and interactivity can be used to enhance the learning process through creating integrated learning environment. To realize interactive learning, it must be considered about hardware devices (eg. Interactive whiteboard, Multi-touch screen, handwriting pane) and teaching software. It is too hard for an instructor to decide an interactive teaching process with this technology nowadays. We propose an architecture which integrates with physical devices and software layer. Furthermore, we build an editor which contains an interactive layer above for an instructor to combine interactive activities easily according graphic user interface.

1. Cognitive Benefits and Technologies of Interactive Multimedia

1.1 Interactive Multimedia

The representations presented in the physical environment would not only involve the printed text, spoken text, and pictures (static graphics). In a traditional classroom environment, it would not be enough to enhance the interactions between instructors and learners. Many studies argue that multimedia has the potential to create high quality learning which actively engage the learners promoting deep learning. In general, one of the main cognitive benefits of multimedia information presentations is that contents can be customized according to the cognitive needs of users. Cairncross and Mannion (2001) argue that learning materials with interactive multimedia has the potential to create high quality learning environment which actively engage the learner, thereby promoting deep learning. The key features of interactive multimedia, various media representations, user control over the delivery of information, and interactivity can be used to enhance the learning process through creating integrated learning environment. The interactivity means to give users the opportunity to decide on what and how of the information presentation (Schwan & Riempp, 2004). These can help learners come to a deeper understanding through supporting conceptualization and contextualization of the novel material being presented; actively involving the learner in the learning process; and promoting internal reflection. Therefore, presenting the various representations by improving the interactivity of learning materials has been widely used in the multimedia instruction

1.2 The Benefit of Interactive Whiteboard

Interactive whiteboards (IWBs) are becoming very popular information and communication technologies (ICTs) in computer-supported in-class courses. IWBs provide a range of benefits in terms of increasing interaction with learning activities and increasing student interest, resulting in increased motivation of students (Kennewell et al., 2008; Schmid, 2008; Warwick et al., 2010). The technological capabilities of the IWB and the corresponding software are found to be highly compelling for attracting the attention of students (Kennewell et al., 2008; Torff & Tirotta, 2010). Various recent studies have made use of IWBs in different domains, such as mathematics, science and languages (Miller et al., 2003; Thomas, 2003; Wiggins & Ruthmann, 2003; Gillen et al., 2008). IWBs in these studies have been used to present various multimedia resources on IWB for different learning needs. However, the use of IWBs with a limited display space has potential to confuse students due to the crowding of rich multimedia information on the board (Levy, 2002). IWBs enable new ways of interactions among teachers and students in the classroom. In terms of the benefits for teaching, IWBs allow teachers to teach with flexibility, effectively and interactively, using various presentation media, and multimedia (Smith et al., 2006). In terms of the benefits for learning, IWB can increase learners' motivations and provide them various multimedia and multi-sensory presentations (Smith et al., 2005). IWBs allow students to observe the manipulation of activities, write out procedural instructions, and reduce time spent in repeating explanations (Smith et al., 2005; Smith et al., 2006; Kennewell, et al., 2008).

2. An Innovative Activity Design for Interactive Learning

2.1 Architecture Overview

Our goal is to help an instructor who not master at programming can create various scenario of interactive learning without knowing too much hardware and software knowledge. To implement the goal, there are some key points below:

- What kinds of multiple input devices support?
- How to integration of these different multiple input device
- What kinds of interactive act ivies have?
- How to combine interactive using GUI without any programming?

Firstly, we define an abstract Layer between Physical Devices and Education Layer to integrate different input devices to transfer to the same abstract definition. Almost instructor does not know how to programming. Secondly, we build a combination between Education Layer and Abstract Layer to transfer the programming view to the education view. Finally, we transfer the interactive actives at Education Layer to GUI element for an instructor can create various scenario of interactive learning easily.

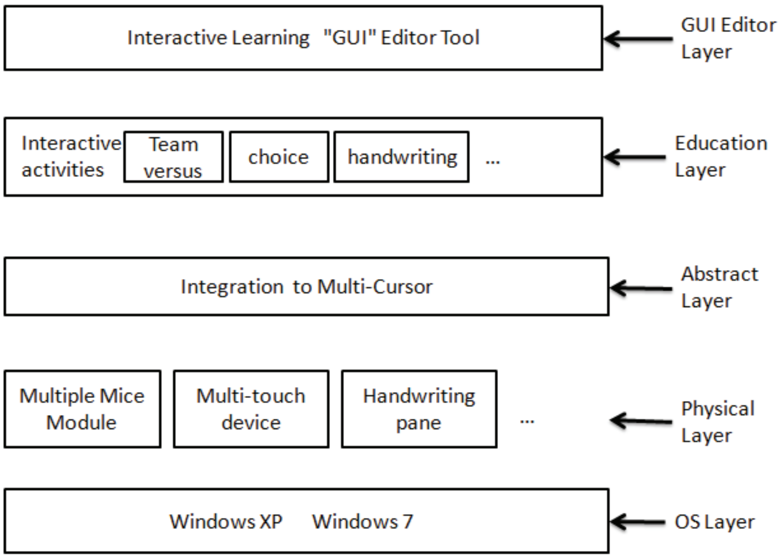

Figure 1: the architecture overview

2.2 Integration with Physical Devices and Software Layer

We integrate three kinds of input devices (multi-touch device, handwriting device and mice). Multi-touch devices can provide multi input at the same time which is useful for competitive learning, but it only support on Windows 7. It can have only one cursor on the screen at the same time even you use multiple mice on Window 7 or Window XP. To Support competitive learning without window 7 or multi-touch derives, we write a Multiple Mice Module to simulate multi cursor on the screen at the same time. A teacher and students can use mice instead of multi-touch devices. We also support some handwriting devices which are useful for painting at art and math. Finally, all different input device are described the same as multi-cursor to prepare integration with Education Layer.

2.3 Education Layer and Interactive Learning Process GUI Editor

After integrating hardware input devices, there are two goal need to be achieved.

- Define interactive activities as general as possible for different domain knowledge.
- Create various scenario of interactive learning without programming

To achieve the goals above we define three kinds of learning materials.

- Static material (text, picture, sound and movie) which are used for general presentation. These are general materials of multimedia learning. For none programming, GUI editor is decided that an instructor to drag a touch area to put the material. The sound and movie materials are played while a teacher click the touch area.
- Interactive activities which are used for interaction between a teacher and students. We devices various kinds of interactive touch areas such as choice, interactive choices, handwriting, score, learning feedback and award. For different domain knowledge and completive learning this material are decide as general as possible. These entire have

some attributes for integrative and can be combination to many kind of interactive activities. All of this element support up to 10 group for completive learning at the same time. For combination example, an instructor can use text or picture material to describe a math question, and use two handwriting area one's attribute set to team1, other attribute set to team2, then a scenario are created that 2 team solve a problem by writing at the same time.

- Flow control units which are use to provide process while creating a scenario. After interaction, some flow control are needed, such as learning feedback, score add, scene reset and so on. We define three kinds flow control link and some action block to achieve this without an instructor to programming. For example, an instructor can set a learning feedback picture and add score automatically after a learning answer correct. The figure of following shows a flow control means if choice 1 answer is correct then score add automatically and then go to choice 2 or if choice 1 answer is wrong then show a "X" picture feedback and then go to choice 3.

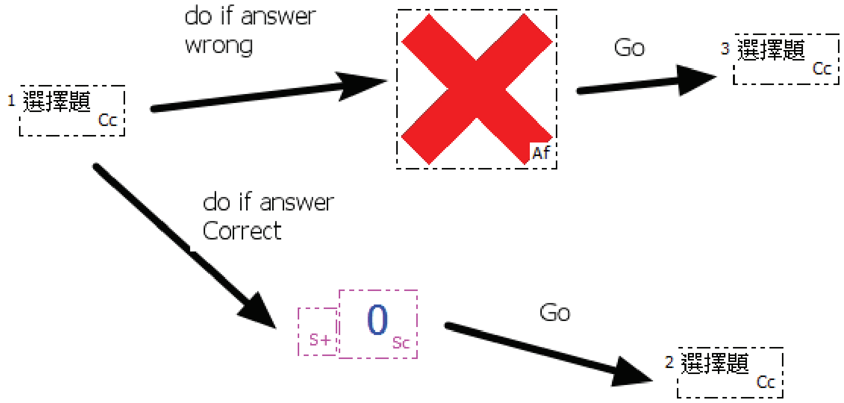

Figure 2: Screenshot of flow control

By the combination of three kinds of learning materials, it can construct various interactive activities at linguistics, mathematic, music, sport and so on, to promote deep learning

3. Example of English Teaching with Competition

An instructor uses the GUI editor to create a scenario of competitive learning with team1 and team2 easily.

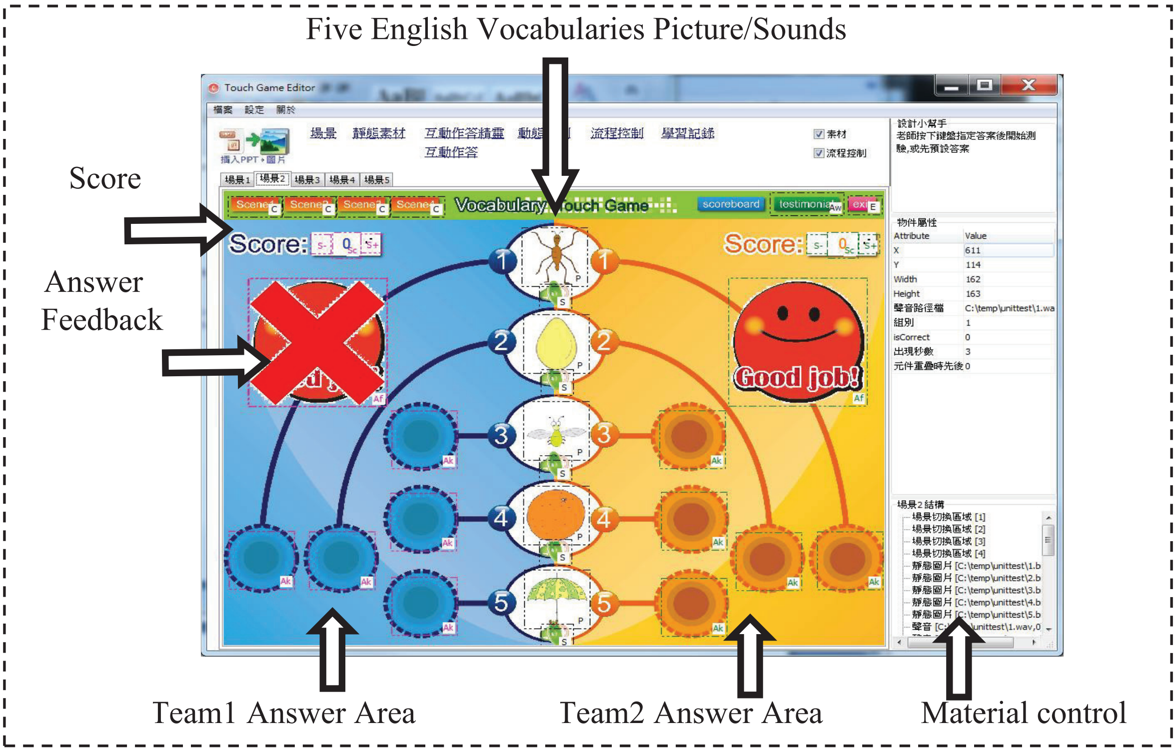

Figure 3: Screenshot of the interactive learning editor

While teaching, a teacher can use keyboard to control which answer is correct. The teacher says “orange” and then learners of team1 and team2 to touch the answer area at interactive whiteboard. Team1 answer is wrong then system shows “X” picture feedback and team2 answer is correct then system shows “Good Job” picture feedback and score add .

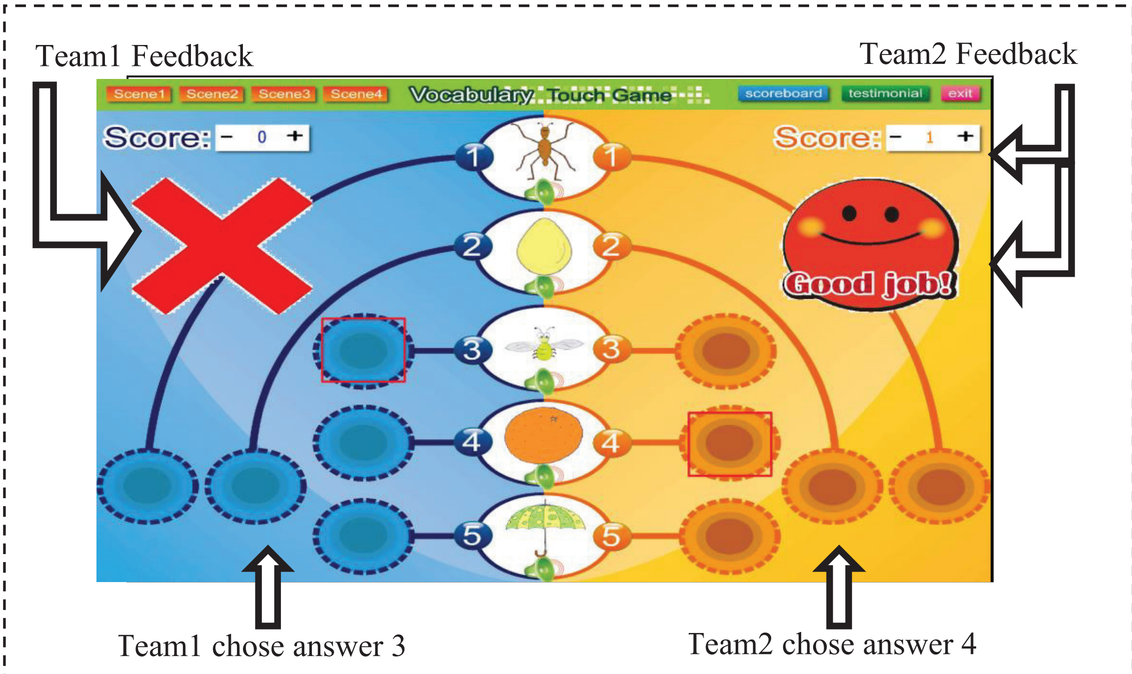

Figure 4: Screenshot of playing, team1 vs. team2 with interactive whiteboard

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Developing an online peer assessment system of digital photography course for college students

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Abstract: The purpose of this study was developing an online peer assessment system of digital photography course for college students. In this study, the researchers reviewed some literatures about peer assessment strategies, and the current situation of digital photography teaching. Moreover, the researchers analyzed the possibility of using the strategy of peer assessment in the digital photography courses of university, and established the system. This system provides multifunction to the learners, such as upload creations, peer review, learning process, and gain feedback from peers, which could help learners enhance the effectiveness of learning digital photography. In other words, the characters of this system have to easy review, anonymity, easy conduct, and quickly evaluate, which support for college students save time of evaluate the photography-related courses creations for peers. However, the proposed assessment system will be verified in the future.

Keywords: Online peer review, digital photography course, college students

1. Introduction

In recent years, photography activities and digital photography courses of school education were growing so fast, and digital photography related courses had become more popular among the public. However, from the assessment point of view, it's not appropriate that assessment methods of different subjects were suitable for photography courses [1]. Gardner [2] indicated that if we want to make a assessment of art subject, we should use assessment methods which were suitable for art subject. Lazear and Dickinson [3] also pointed out that teachers should use proper multi-assessment methods to make assessments, when they conducted on evaluation of different subjects. Besides, Huang [4] reported that if we want to carry on the curriculum and instruction of art subject, we should use multiple assessment methods to assess the learning condition of students instead of using only traditional test methods. Peer assisted learning referred to the people of same group with the equal/similar identity and status learned knowledge and skills via mutual assistance and supporting within group, and thus achieve the learning objectives and promote the efficiency [5]. Linn and Gronlund [6] concluded that we should not just take the whole teaching environment into consideration when we carried on the assessment, we should also gather data from various viewpoints and ways, so that we could help students learn and fully understand the learning status of students. Based on the above descriptions, diversified assessment rise, and peer assessment strategies are one of these [1]. In the future, we can expect that the further investigation on learning efficiency of college students can be done using the optimum peer assessment system for digital photography courses. Thus, the purpose of this study is to develop an online peer assessment system for digital photography course to aid the college students in digital photography learning.

2. Literature Review

2.1 Digital photography course

Photography courses are classified as one category in art education field, and thus the corresponding assessment methods are naturally different from the other subjects due to it unique characteristic. Therefore, it is not appropriate to employ the other subjects' assessment methods directly for photography courses [1]. Yang [7] indicated that the multiple assessment should be recognized, not just focused on traditional and summarized assessment when art subjects (courses) were assessed. Lu [8] also mentioned that multiple assessment strategies should be included in the assessment for art subjects, in addition to the application of formative and summarized assessments methods. Therefore, multiple assessment methods based on the essence of the courses should be employed, and the principles of formative and summarizes assessment methods needed to be taken into account, when photography courses were assessed.

2.2 Online peer assessment

Previous study [9, 10] defined peer assessment as the learners assessed other learners with similar backgrounds, which involved mainly the procedure of learners' assessment of each other and the process of learners becoming assessors. Hsu, Tsai and Chen [11] also indicated that the peer assessment was one of assessment and learning strategy, which was derived from multiple assessments. In order to take multiple, formative and summarized assessments' principles into account, the peer assessment was then chosen in this study for the photography courses.

Jonassen [12] indicated that network peer assessment could make the evaluation without constraint of time or space, and could further promote the efficiencies of both assessment and learning [13]. Furthermore, the network peer assessment is easier than traditional one when anonymous assessment mechanism was used. Both the pressure of peer assessors and probability of unfair grading could be reduced, thus the reliability and validity of assessment results could be improved [13, 14]. However, no online peer assessment systems has been developed and reported so far, although it is recognized as a critical and essential issue for the assessment of photography courses. Therefore, we develop an online peer assessment system for internet usage without borders.

3. System overview

We develop an online peer assessment system of digital photography course. We provide a web server for hardware construction; furthermore, we provide web service (Apache) and database service (MySQL) for the software structure of this system. Figure 1 showed a framework of this system, According to users' identities (login status), the system allows identities of teacher and student. Moreover, we also provide system administrator identity for system administration.

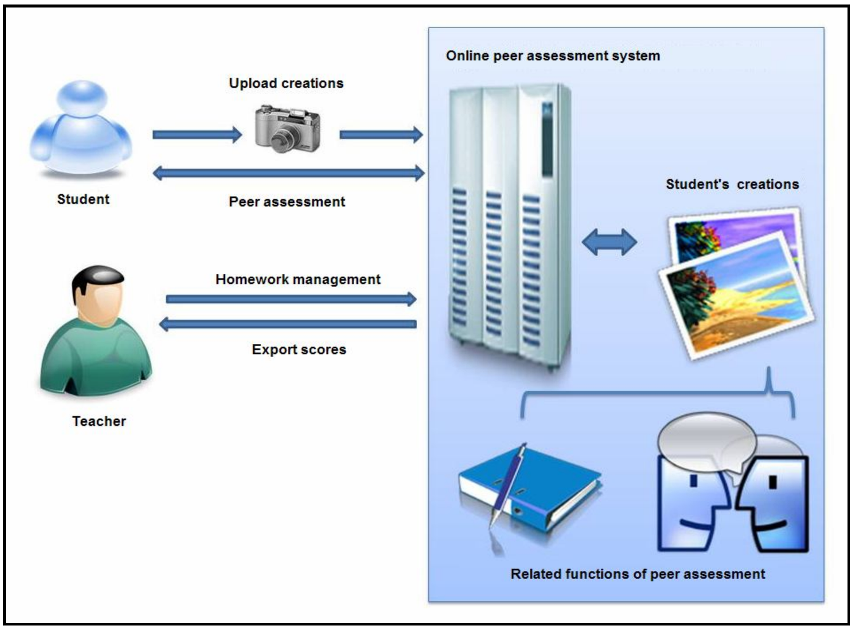
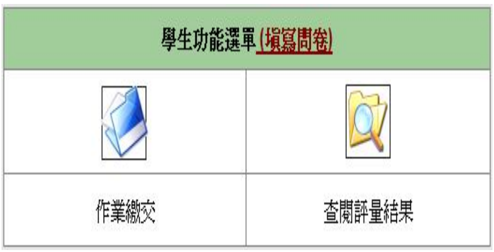


Figure 1. The Framework of online peer assessment system

Figure 2 showed all menus of online peer assessment system. All menus includes: 1. Teacher's main menu; 2. Student's main menu; and 3. Menu of peer assessment. As showed in figure 2a, all users (both teachers and students) can login the system through this page. Figure2b showed teacher's main menu, and this menu includes: 1. homework management; 2. view the students' creations; 3. view the students' feedback; and 4. export scores. Figure 2c and Figure 2d showed the student's menu of peer assessment, relating functions includes 1. Upload creations; 2. View the feedback; 3. Peer assessment; and 4. Reference material.

a. User login page

b. Main menu for teacher



c. Main menu for student

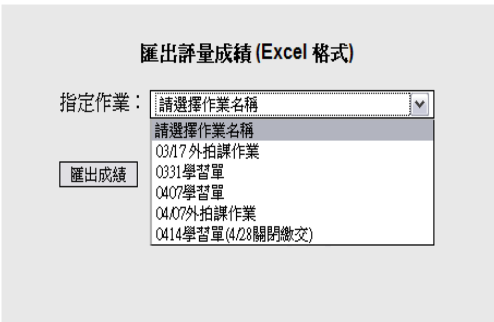
d. Menu of peer assessment

Figure 2. All menus of online peer assessment system

Figure 3 showed that relating functions of management for teacher, it provides homework management (as showed in figure 3a), view the students' creations (as showed in figure 3b), export scores (as showed in figure 3c) and view the students' feedback (as showed in figure 3d). In this system, teachers can use management menu to assign photography homework and provide a platform for student homework uploading. In the function of homework management, teachers can revise homework title, homework requests and assessment standards. Teachers can also open and close the functions of student online peer assessment. After teachers assign homework, they can search for the condition of student homework uploading via the function of view the students' creations. In this way, teachers can decide whether to remind students to upload homework or not. Furthermore, teachers can gain raw data of assessment results (file type: Microsoft office excel) through the function of export scores after students finish online peer assessment activities. After students upload their homework, teachers can look for the condition of online peer assessment via the function of view the students' feedback. After doing so, it's convenient for teachers to register scores or analyze results. Through above functions, teachers can effectively assign homework, administrate system, and seek information of assessment.

a. Homework management

b. view the students' creations



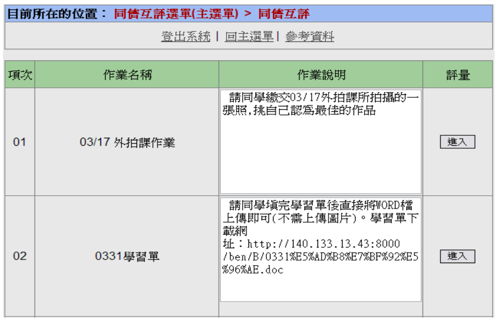
c. Export scores

d. View the students' feedback

Figure 3. Teacher's functions of online peer assessment system

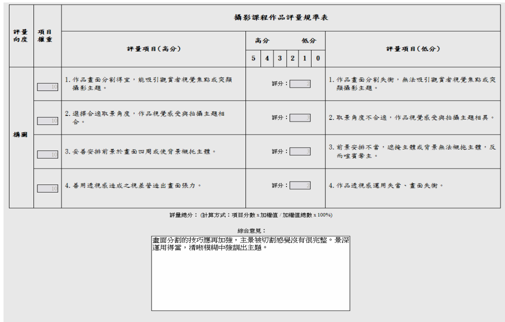
Figure 4 showed relating functions of student. The four functions of students are 1. Upload creations; 2. Peer assessment; 3. View the feedback; and 4. Reference material. In the first function, it is to support the student to upload their creations of digital photography course (as showed in figure 4a). In the second function (peer assessment), related functions are support the student to review and assess creations of peers (as showed in figure 4b and 4c). After students finish online peer assessment activities, all students can view the feedback of their creations through function of view the feedback (as showed in figure 4d).

a. Upload creations



b. Main menu of peer assessment

c. Select menu of creation



d. View the feedback

Figure 4. Student's functions of online peer assessment system

4. Conclusion

In this study, we presented an online peer assessment system of digital photography course for college students. This system could provide an assist learning applied peer assessment strategies for college students. To summarize, the system has advantages, such as easy review and conducting, quick evaluation, as well as anonymity. The suitability of this system will be also verified in the future.

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Trigonica: An Interactive iOS Application for Learning Trigonometry

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Abstract: Fitting a whole lesson in a mobile phone is not easy, especially when we wish to enhance the user's experience to motivate his or her learning. The application has to provide contents and assessments in a way that is attractive to the user and digested enough to be used in a short time frame while waiting for friends or buses but also can be used for a full review of the materials. Trigonica introduces the concepts of trigonometry in three short lessons with hand-on activities. The learner can take a dynamic quiz after each lesson and also a comprehensive quiz. The user can also share their experience with his or her community via Facebook posts after finishing a quiz.

Keywords: trigonometry, m-learning, iOS learning app

1. Introduction

Many students in Thailand found that trigonometry was difficult to interpret. By studying trigonometry, it was likely that individuals had to deal with different kinds of technical elements described under strict contents (Yoshiwara & Yoshiwara, 2007). With various complicated functions provided, those who feel learning was not worth the effort vaguely approached main conception of trigonometry study.

Trigonometry was introduced as one of the fundamental functions in mathematics (Math Academy Online / Platonic Realms, 2011). Trigonometry did not only provide ways to calculate angles and sides of triangles, but its concept of measurement also could be applied in other fields of study and in real life. However, in our informal interview, students tended to believe that the hardest subject of mathematics was still trigonometry.

Therefore, we hypothesized that technology could change their attitude. Nowadays technologies were ubiquitous, and computers were integrated with our everyday's lives (Jones & Jo, 2004). Examples of ubiquitous technology were microprocessors, mobile phones, and many other devices. Such technology had been used in education in various learning activities, such as augmented reality that combined computer generated images with the human visual system to create the augmented display (Azuma, 1997), and e-learning as education that students could access online (Jones & Jo, 2004). The same concept of e-learning could be applied to m-learning (Jones & Jo, 2004). Instead of using cursor pointing on screen, many ubiquitous devices let the user interact with applications by touching directly on screen. In addition, a number of these devices allows multi-touching that could further enhance the user's experience in interacting with the devices.

2. Previous Work

There were not many iOS applications supporting trigonometry learning. Some of them offered only formula sheet while some others were traditional offering readings and quizzes. Some had interactions but offered no assessment.

Feature / Application	iFormulas	Khan Academy: Trigonometry	Triangle Solver	Trigonometry for iPhone	Trigonometry Help	Trigonometry Tutor
Lessons		✓		✓		✓
Formula Sheet	✓					✓
Images/Graphs/Diagrams		✓		✓		✓
Quizzes				✓		
Community Connection						
External Feedback						
Interaction with App			✓		✓	

Figure 1 Some Features of iPhone Applications for Trigonometry in the App Store in May 2011

3. Designs and Features

We would like our app to be a complete learning package. Therefore, we followed the How People Learn framework (Committee on Developments in the Science of Learning, 2000) that suggested four components of an effective learning environment--learner-centered, knowledge-centered, assessment-centered, and community-centered. The learner-centered aspect concentrates on learners being active and constructive in a learning environment. The knowledge-centered specifies that learning is effective when students can acquires knowledge and skills necessary to understanding and transferring of that knowledge. The assessment-centered focuses on giving learners opportunity to evaluate and reflect on their knowledge in both formative and summative forms. Finally, the community aspect enhances the social aspects of learning that involve learning from and working with people in the society. These four aspects are not exclusive, as shown in Figure 2; they have to be designed to interact and integrate with each other to make learning effective.

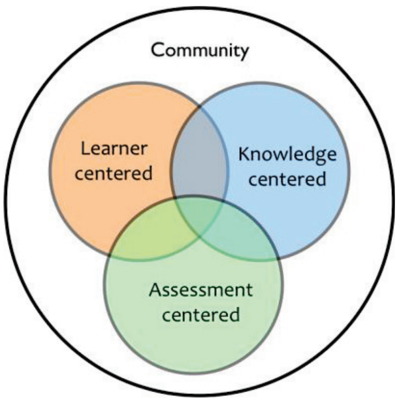

Figure 2 Framework for Effective Learning Environments

To support the HPL framework, Trigonica had three main components, incremental lessons, dynamic quizzes, and interactivities. The community aspect was supported lightly by enabling sharing of the quiz score via Facebook to generate competitiveness. The three incremental lessons were an introduction to trigonometry, functions, and identities, respectively, as shown in Figure 3. Sample contents of each of the three lessons were shown in Figure 4 to Figure 6. The learner could start reading from lesson 1 or skip between lessons in any order. The formulas and interactive illustrations were collected in two separate pages for quick reference, as illustrated in

Figure 7 and Figure 8. The user can switch from one section to another at any time.

Figure 9 to Figure 12 displayed fours of the interactive illustrations. Users interacted with these illustrations by pinch their fingers in and out to explore the graphs, or dragged the corners of right triangle or unit circle to explore the values that were automatically calculated according to the chosen functions.

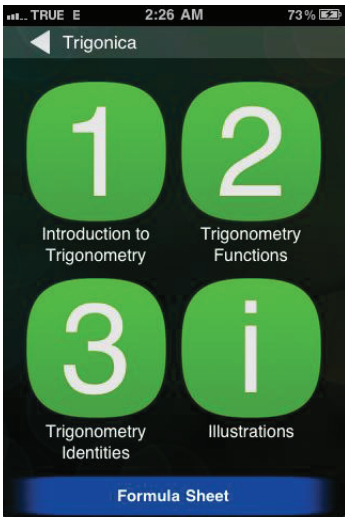

Figure 3 The Main Page of the Study Section

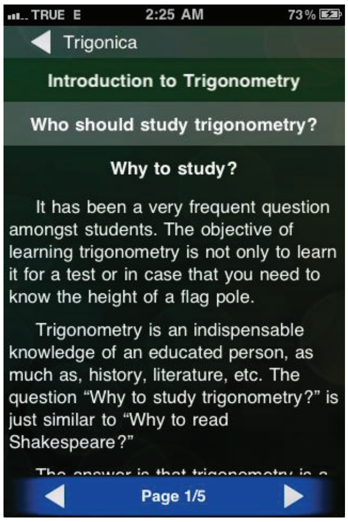

Figure 4 Lesson 1: Introduction to Trigonometry

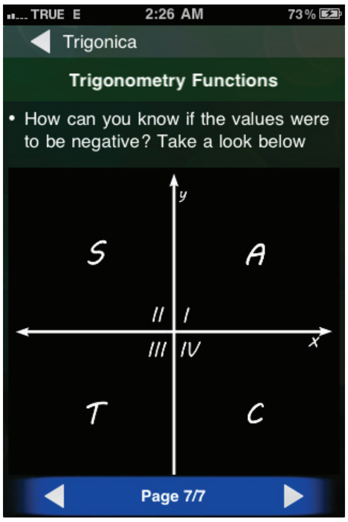

Figure 5 Lesson 2: Trigonometry Function

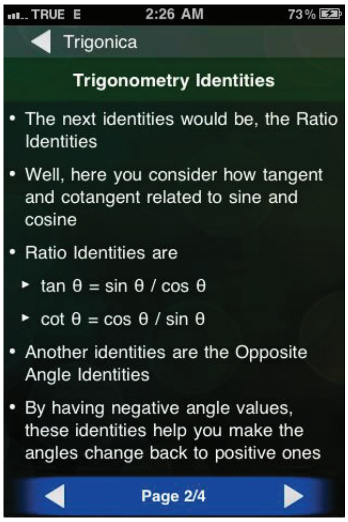

Figure 6 Trigonometry Identities

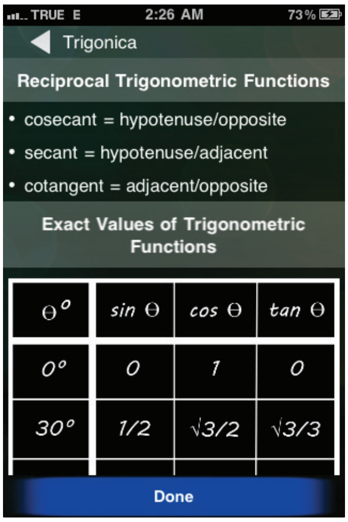

Figure 7 Formula Sheet

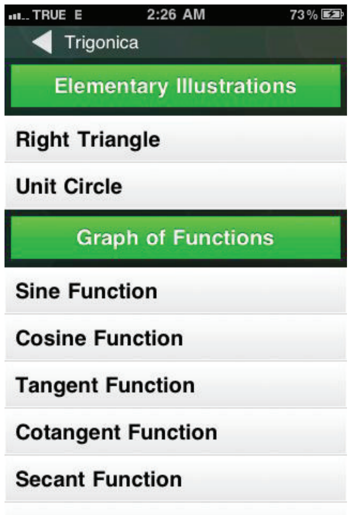

Figure 8 Interactive Illustrations Menu

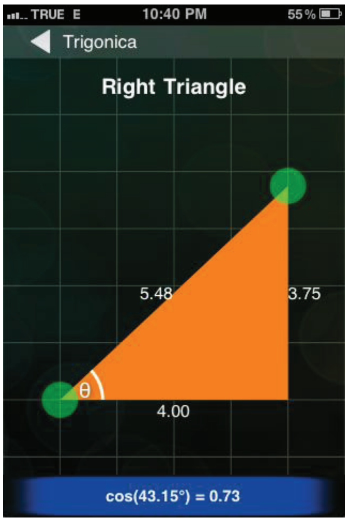

Figure 9 Interactive Right Triangle

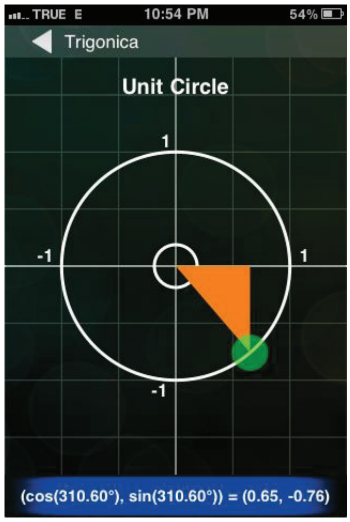

Figure 10 Interactive Unit Circle

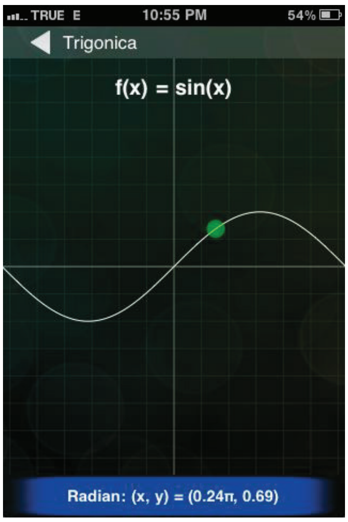

Figure 11 Interactive Sine Function Graph

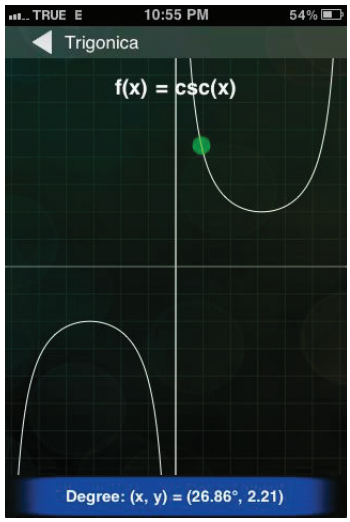

Figure 12 Interactive Secant Function Graph

The main page of the quiz section, shown in Figure 13, was designed to look the same as that of the knowledge section but with a different quiz for each button click. Each quiz started with an instruction as displayed in Figure 14. Instead of fixed multiple-choice questions, each of Trigonica's quiz was a combination of three types of questions, true/false (Figure 15), multiple-choice (Figure 16), and single-word-answer (Figure 17). Questions in each quiz is randomized and, if there is a number, it could also differ from that in the same question appeared in a previous quiz. The number of questions in the comprehensive quiz would be twice more of that in a lesson quiz.

Trigonica gave delayed feedback; it summarized the learner's performance only at the end of a quiz, as illustrated in 錯誤! 找不到參照來源。Figure 18. The score would be recorded if he or she had logged in via his or her Facebook account, and statistics could be recalled later. As mentioned previously, the learner could share this score with friends on their Facebook wall.

Figure 13 Main Quiz Menu

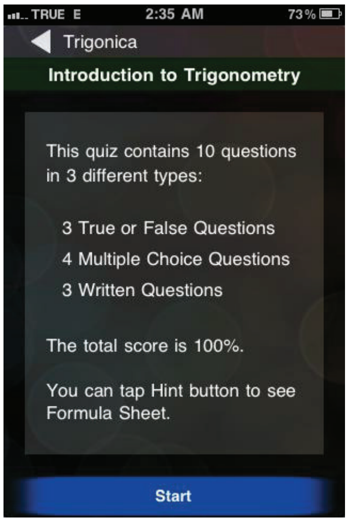

Figure 14 A Quiz's First Page

Figure 15 A True/False Question

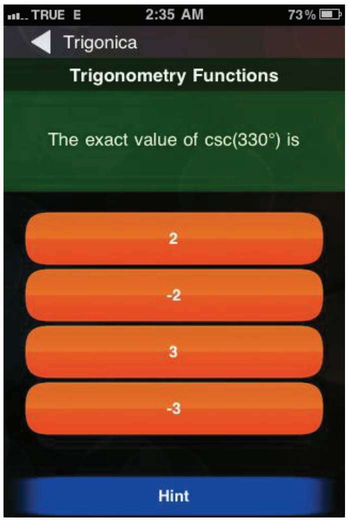

Figure 16 A Multiple-Choice Question

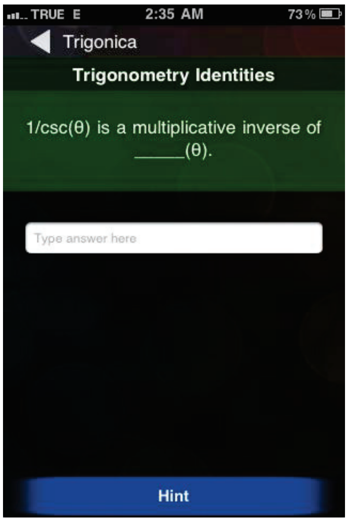

Figure 17 A Single-Word-Answer Question

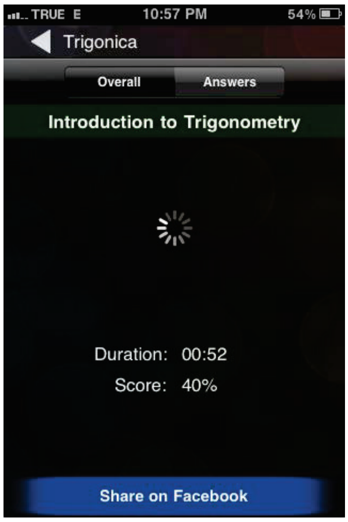

Figure 18 A Quiz's Performance Summary

There were three components to be concerned under the project; Web Server, iOS Device, and Facebook Graph API, as shown in Figure 19. All three components were connected by the availability of the Internet connection. By a user opening an application on the iOS device, the device would automatically send POST or GET method request to web server via Internet. Our Web server would check for matching information with Facebook Graph API in order to confirm the validity of the user's account.

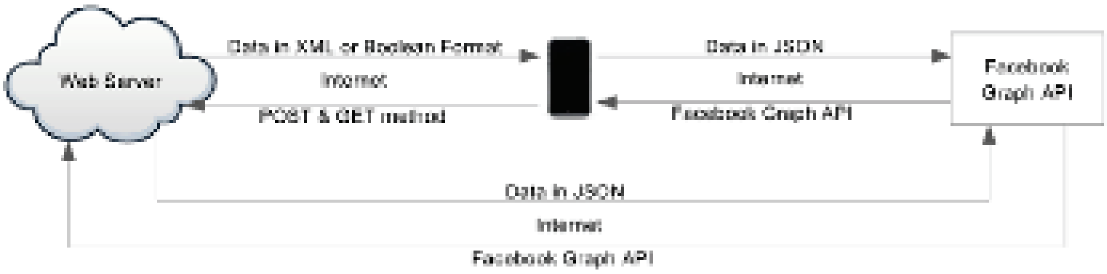

Figure 19 Three components of the project: Web Server, iOS Device, and Facebook Graph API

4. Conclusions

The application had been in the App Store since May 2011, and it was featured in the 2011 MUIC Open House for the Computer Science Program. Feedback from high school students visiting the fair was positive. Many students wished to have the application for their study in trigonometry and also in other subjects. Lately, a small study had been conducted, and the results were being analyzed.

Acknowledgements

We would like to thank Mr. Vichapun Rojcharoenwattana on his help conducting the experiment for this project, many computer science majors who have given feedback on the application and helped test the program again and again, and last but not least, all volunteers who are afraid of mathematics in general but have agreed to help us anyway.

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A Study of E-readers with Multimedia Annotation to Help Elementary School Students Learning with Parental Involvement

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Abstract:
In recent years, E-readers become popular and have potentials to be widely employed to facilitate learning in the future. One advantage that E-reader provides is to facilitate the interaction among students, teachers and parents through what students learned in class and after school. In this study, we attempt to use E-readers to bridge students' learning between school and home and hope to achieve seamless learning. EFL(English as a foreign language) learning activities are designed with the contexts of real daily life at home and school. One multimedia annotation in E-readers recording students' EFL portfolios in class and at home help parents not only to know their children learning at school but also to facilitate children's review or homework accomplishment after school. That will provide parents more opportunity to realize and participate in their children learning.
After experiment, it was found that there was a significant correlation between after-class annotation and students' learning achievement and indicate that learning behavior like using annotation after class needs to be concerned much. Moreover, parental participation was also found to have significant effect to students' learning attitude since E-readers allow students to have opportunity to practice and demonstrate their English skills at home, therefore parents can know their children's learning and help their learning in English. It really helps students using English for their daily life communication.

Keywords: E-readers, Multimedia annotations, Parental Involvement, Social Economic Status.

Introduction

E-readers are concerned recently not only for changing interaction between human and computers but also having potentials to change learning profoundly. From the first-generation Kindle announced by the Amazon online bookstore in 2007 to the iPads and IPhones of Apple become more and more prevailing recently, these trends show e-Readers have a rapid development and will affect significantly the behavior of human beings using computers. Furthermore, more applications for E-readers become available.

And for learning, many factors of learning process influencing students' learning behavior and their achievement, including learning in class, after class and after school. The influence of the family members for learning is the most commonly overlooked, particularly parental involvement after school (Krumm, 1996). Previous research shows that cohesive parent-teacher interaction and parental involvement in students' learning activities will facilitate the development of students' learning behavior and their achievement (Griffith, 1998).

In this study, we attempt to develop one multimedia annotation tool in E-readers to bridge students' learning between school and home and hope to achieve seamless learning because students can take E-readers all day long. For our design of multimedia annotation and learning activities, first, we survey user needs and expert advice to design multimedia annotation functions in E-readers. Meanwhile, we discussed with teachers about learning activities at school and home by using real-life contexts at school and home as well like classroom facilities introduction, dinner description or family members introduction. Ensuring our design can meet the learning curriculum requirements. The experiment course is Basic English in the elementary school. The E-readers record students' EFL process in class and at home. This design not only makes parents know their children learning at school but also help parents to facilitate children's review or homework accomplishment after school. That will provide parents more opportunity to realize and participate their children learning.

Previous studies emphasized students' annotation in class instead of after school and also put less attention on parental participation on students' learning. Therefore, this study try to employ E-readers with multimedia annotation in class and after school as well and hope to bridge students' learning between school and home; Meanwhile, it can facilitate parental understanding of their children learning through E-readers and possibly help parents have more involvements in their children's learning. We use the questionnaire to understand students' perceptions and attitude toward our proposed system after the investigation of students' learning behaviors like amount of annotation in class or at home, parental involvements and their effect to learning achievements by statistic methods.

1. Literature review

1.1 Annotation is necessary in the E-reader

E-readers are mobile devices and easy to carry with a suitable display, which can support learning in different contexts, particularly for exploring real context. Furthermore, the powerful features including multi-touch operation, easy-to-use user interface, data storage and wireless communications make E-readers become more prevailing than laptop computers. Annotation tool is one of important applications to facilitate reading in E-readers, which allow users to highlight, underline, strikethrough, voice recording, and date stamp learning materials. For example, in 2005 McFall designed an annotation to read electronic textbooks and the iPads have a powerful and flexible annotation program, iAnnotate, providing user customizable toolbars by choosing only the functions that users need when reading the PDF files. Previous research also shows annotation function in E-readers is a must (Ajidev, 2011).

1.2 Language learning with real-life situation

In the aspect of language learning, students have to learn four main skills, listening, speaking, reading and writing. Ridley and Walther (2000) believed that good learning curricula can help students and stimulate them to conduct active learning. Learning and dialoging in real situations is benefit for language learning. Giving consideration to language's usability, using the target language in familiar daily life contexts can help students practice what they learned in class and achieve good learning effect. Li (1984) also pointed out language learning should be applied and used in real situations, particularly for the novice students; otherwise most language learning in class become vain and only for exams. Using real life and familiar context for practice or homework are interesting to students; focus on communication and meaningful dialog with providing more listening, speaking and reading exercises is more useful, particularly for the novice students (Rao, 2002; Sun & Cheng, 2002).

1.3 The impact of parental involvement in learning

Parental involvement is a combination of commitment and active participation to help students learning at school and home. Hoover-Dempsey and Sandler (2005) pointed out that the parents actively involved in their children's education can positively influences learning. Parental involvement brings positive effect for students, parents and schools (Bauch, 1988; Hoover-Dempsey et al., 1987; 2005). In deep investigation of parental effect to students learning, educational experts pay close attention to the socioeconomic status of parents and their effect to student's learning achievement. Many studies have explored the factors of parental socioeconomics and their relationship with students' learning, generally in parental education degree, occupation and income as a measure item. It was found that the higher social-economics status parents have, the better achievement students achieve. This is because parents with higher socioeconomic status will have more social resources and greater ability to educate their kids (Chen et al., 1996; Kung, 2002; Ma, 2005, Korat and Shamir, 2008).

Based on the literature review and research motivation, the purpose of this study are: (1) to design and develop one multimedia annotation tool in E-readers and facilitate students' English learning in class and after school, (2) use the e-reader multimedia annotation tool to facilitate parent understanding and involvement of students' learning. (3) and explore the students' learning behaviors and perception using annotation in class and after school and their effect to learning.

2. Method

2.1 Subjects and Materials

The participants of the study are the 20 fourth-grade students in the elementary school, there were four classes for EFL per week and each class was 50 minutes. The experimental period was four weeks. The contents of the text book using by experimental participants were scanned and digitized into E-readers as learning materials, which are not different from the physical textbook. Annotation tool VPEN in E-readers allows students to annotate the text or images of digitized learning materials. For annotation contents, text and voice can also be added and coexist with each annotated learning materials (Figure 1).

Figure 1, the screen of Annotations in E-readers

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2.2 Research Procedure

The experimental procedure was divided into three phases.

- The first phase had two classes in the first week to train students to be familiar with E-readers and use VPEN to make textual and voice annotation correctly.
- Phase II having another two classes of the first week, students can only use E-readers in class and at school like making annotation or recording teacher lecture in English class or replaying lecture voice after class for rehearsal. However, students cannot take E-readers back to home in Phase II for ensuring students know how to use E-readers correctly like charging E-readers' battery properly.
- The third phase was from the second week, students can take E-readers back home, and parents can know their children's English learning at school through E-readers and perhaps they can help their children's review or homework accomplishment after school.

2.3 Activity design

Two learning activities after school were designed for participants to motivate their learning English by using VPEN in E-readers, one is to introduce the family member, the other is to introduce today dinner. Both of them are related to their familiar daily life and participants can practice and apply what they learned in class to describe their real daily life in English. Around one class with four week were dispatched to each learning activity; in the beginning, students were asked to use simple English sentences or phrases in text or voice to introduce their family members; after that, encouraging experimental students to invite their family members like parents to involve in the learning activities like recoding their own voice or text in E-readers for self-introduction. The second activity followed up the first activity and was related to students' dinner at home; beside the introduction of food at dinner, students can explain the favorite food of their family members and the reasons behind. Hence, the two activities looks interesting since they are quite closely related to students' familiar daily life and their family members can easily be engaged if they can.

Figure 2, Activity 1 to introduce the family member.

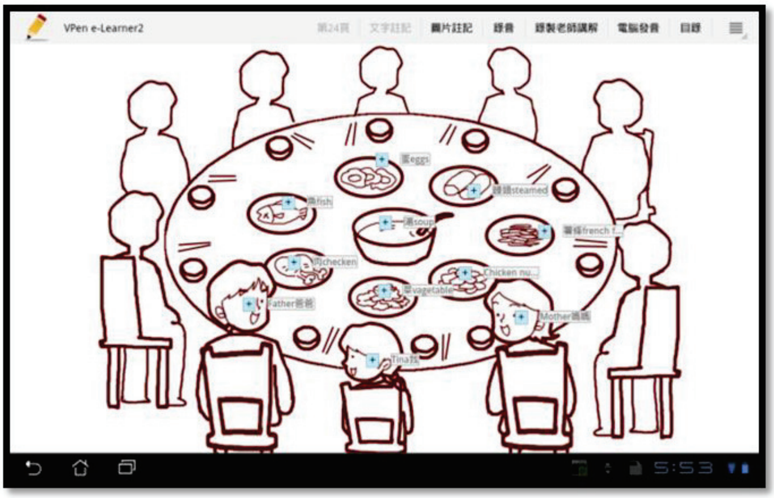

Figure 3, Activity 2 to introduce today dinner.

2.4 Reliability of the questionnaire

The study designed questionnaire based on the TAM (technology Acceptance Model) to understand the perception of students toward the proposed tool and learning activities; we also interview students and parents to know the reasons behind. The questionnaire design has two parts. Part 1 surveyed the students' perception about the proposed system. Part 2 tried to understand the students' perception of after-school usefulness of parental engagement and intention to use and learning activities. The validity of was checked and designed by experts and elementary school teachers. Questionnaire reliability was checked by Cronbach's alpha (α) coefficient, and the values are in the followings. Part 1: Easy to use (α=0.742), Usefulness (α=0.828), Intention to use (α=0.770); Part 2: Usefulness after school(α=0.916), Intention to us after school (α=0.874), Usefulness of parental concern (α=0.801), Usefulness of parental participation (α=0.793), Usefulness of activity 1 (α=0.869), Usefulness of activity 2 (α=0.875)

3. Results and Discussion

3.1 Results of questionnaire analysis

The questionnaires were distributed to 20 students and 17 valid questionnaires returned. As the average value of each dimension is above 3.8, and most of the questionnaire items are more than 4.0. Obviously, students have a positive attitude for our proposed system and activity designs.

3.2 Learning in the class and after class

Table 2 showed the descriptive statistics of learning behavior using multimedia annotation in class and after class like the quantity of text annotation and voice annotation. And the quantity of annotation in class is substantially lower than after class. After interview, the reason was that students had not much opportunity and time to make annotation in class because teacher gave intensive oral lecture and students were occupied in listening. Therefore, In class, students normally employed E-readers only for reading learning material and recording teacher voice lectures, resulting in the quantity of annotation in class is much lower than that after class.

Table 2, Descriptive statistics about quantity of annotation in the class and after class

		Quantity of text annotation	Quantity of voice annotation	Total
In class	Average	10.18	4.82	17.18
	SD	9.268	7.955	24.003
After class	Average	126.47	54.53	132.35
	SD	58.703	43.264	63.353

Regarding learning behaviors using annotation, only the quantity of text annotation after class was significantly related to learning achievement (0.576, p <0.05) (p =0.000). Although previous studies in the literature survey found that the number of annotations would also significantly affect learning, but almost of them in class. However, our result further found that there was significant correlation between annotation after class and learning achievements and showed out the importance of learning behavior after class. It indicated that students' using E-reader at home to facilitate their learning is worth.

3.3 *The impact of parental participation to learning*

In the section, we explored the impact of parental involvement after school using questionnaires, including usefulness of parental care and usefulness of parental participation. We would like to study students' perceived usefulness about parental involvement. The results showed that parental care and participation for learning after school can bring a significantly positive effect to students' intension to use E-reader. The results showed that 'usefulness of parental care" was significantly related to the four variables, Usefulness after school, Intention to use after school, Usefulness of activity 1 and Usefulness of activity 2, the value is (0.402 ,p> 0.05), (0.519, p< 0.05), (0.524, p< 0.05) and (0.501, p< 0.05), and the 'usefulness of parental participation" is also significantly correlated to the above four variables, (0.421 ,p> 0.05), (0.699, p< 0.01) , (0.529, p< 0.05) and (0.586, p< 0.05).The students expressed, "My father and mother read English with me, they like to teach me when I have learning questions"," My parents will help me to find learning information"," parents help me a lot and also care about my learning and grades". However, still a small number of parents cannot help children due to their poor English or no time, "parents told me to do English homework by myself, do not bother them", " they did not help me because they were busy".

Regarding predicting intention to use E-readers after class, the statistic method of stepwise multiple regression was employed and the results were shown that usefulness after class can explain 73.4% of intention to use after class and reach a significant level (F = 45.256, p =. 000). Adding the variable, Usefulness of parental participation, it was found that Usefulness after class and Usefulness of parental participation can explain 87.0% of Intention to use after class and reach a significant level (F = 54.626, p =. 000), indicating parental participation has essential impact on students learning.

3.4 *Conclusions*

In this study, we use E-readers to bridge students' learning between school and home in EFL learning. Learning activities are designed with the contexts of real daily life at home and school for students' practice in English. The E-readers recording students' EFL learning process in class and at home not only make parents know their children learning at school but also help parents to facilitate children's review or homework accomplishment after school. That will provide parents more opportunity to realize and participate in their children learning.

From the results of this study, it was found that students made annotations after class much more than in class and there is a significant correlation between after-class annotation and students' learning achievement This is an important finding, the previous studies mostly focused on the note-taking behaviors in class and some of them showed that when students taking notes in class, they will become distracted in listening lecture, particularly for the low achievement students. More importantly, it was also found that the parental participation did have significant effect to students' learning attitude. E-readers allow students to have opportunity to practice and demonstrate their English skills at home and interact with parents in English. It really helps build students' confidence in using English for their daily life communication.

Acknowledgements

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A Proposal for Educational Reform in Higher Education: an innovative use of e-Portfolio - Showcase at Kansai University -

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Abstract: The purpose of this paper is two-fold: (i) to share the basic concept of what e-Portfolio is from the viewpoints of various stakeholders in education, namely, students as well as their guardians, professors, and the school boards. Here the dissemination of e-Portfolio in education is the key. While introducing various aspects of innovative uses of e-Portfolio, a showcase is given in order for the reader to visualize what e-Portfolio can do in education. (ii) to discuss the potential of e-Portfolio as the drive to cause a paradigm shift in the entire education ranging from K-12 through the graduate school.

Keywords: e-Portfolio, KU e-Portfolio, MUSE Campus, stakeholder.

Introduction

The main goal of this paper is to disseminate among educators the power of e-Portfolio in order to cause a paradigm shift in the entire educational system ranging from K-12 through graduate school. This paper is just a small step forward toward such a goal. It consists of the description of e-Portfolio project at Kansai University and an innovative use of e-Portfolio showcase that demonstrates the potential power of e-Portfolio in education. It is hoped that this paper will shed some light toward the future education.
Due to the advancement of ICT, tt cannot be denied that the wave of e-Learning has brought us to the situation where individual courses must be well-structured and organized with learning objectives as well as the clear evaluation measures described in the syllabi. Indeed, the levels of ICT literacy for students as well as faculty have been improved compared with those of the earlier days. The students now have better command of the computer and better understanding of the purpose and the functions of the e-Learning system and its contents: course objectives, course contents navigation, and the evaluation procedures of the courses. However, it seems that we have been so much focusing on the quality control of individual courses. As a result, individual courses are autonomous of themselves and the students as well as the faculty are lost in the woods of the education system by looking at courses independently rather than looking at the entire curriculum. Now that the quality of courses is of good quality, we need to unite these courses together to map the curriculum with a bigger picture with the entire school curriculum as its center.

1. e-Portfolio Way: Overview

The educational approach that is employed in this paper takes the entire educational region as its domain as shown in Fig. 1 below. By setting the ultimate mission of the school as producing new societal members to fit the needs of the society where the school is based, all stakeholders involving the school will work together to educate the future members.
In this view, the Learning Management System in e-Learning, such as WebCT and Blackboard, is no longer a course-based management system to manage the course contents, the syllabus, course objectives, daily learning activities, and evaluation measures. It is rather a part of a curriculum mapping or management system, which steers the future direction of the education of the entire school.

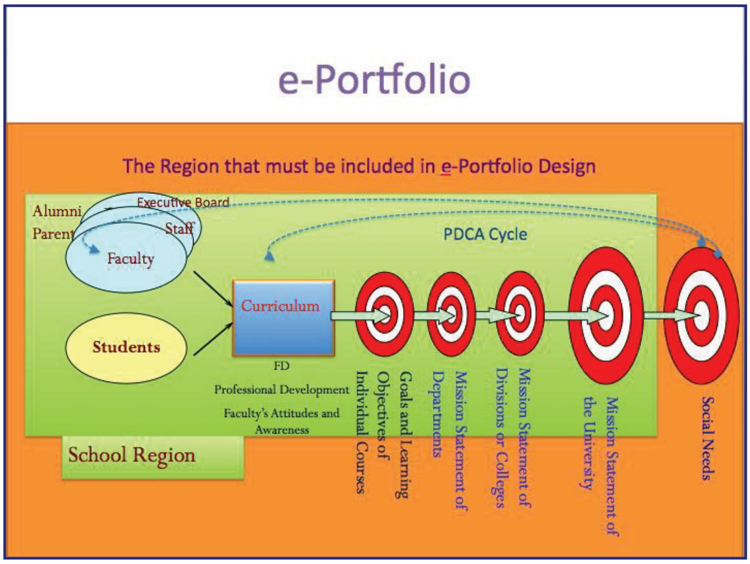

Fig. 1. The region of e-Portfolio: University must develop the curriculum to meet the needs of the society, where all stakeholders are involved. Thus, the ultimate goal of the university is to give birth to the future members of the society through education in order to make the society a better place to live.

The design of the education with e-Portfolio as its center begins by setting up the mission for the school. The needs of the society must be observed and analyzed so that the school can decide how to make the young generation ready for the society through education. In order to set the mission of the school, the school must have clear educational goals to produce new members of the society, based on the profound idea of producing ideal people for the democratic nation. Thus, the school must provide students with interactivity in learning to promote human growth in a constructive way. As the students learn, the records of growth of individual students as well as the evaluation of learning are archived in e-Portfolio in order for all stakeholders to share and support the academic growth of the students.
In realizing the vision reflected in the mission statement, the evaluation system for e-Portfolio must clearly assess the learning activities and the records of the human growth in academia from multiple dimensions. For example, at the lower level, the records are archived of learning processes in the activities described in the list of learning objectives for the courses laid out in the curriculum. In addition, the results of the evaluations are archived.

And at a higher level, the records of the growth in a school year, the psychological and societal growth, and evaluation records are archived.
Furthermore, even at a higher level, e-Portfolio archives all records of students from the admission to the graduation, or even the students' entire life. In other words, all the students' life-long records are archived in the e-Portfolio. The e-Portfolio must bear the responsibility of sharing the students' records of growth with their guardians and other stakeholders. The life-long records of the processes of growth for all students as well as the records of evaluation are analyzed even at a higher level to offer predicted "life-to-be" for the currently enrolled students. This type of e-Portfolio will show the students how the life will be with a similar life design in 10 years later, 20 years later, 30 years later, or even 40 years later, making reference to their predecessors' footprints in life.

2. Kansai University e-Portfolio System

Kansai University was established in 1886 and has a history of over 120 years. It consists of 13 colleges and the graduate school with the student population of over 300,000. Kansai University includes five campuses, three senior high schools, three junior high schools, one elementary school, and one kindergarten.

The ultimate goal of the Kansai University e-Portfolio is to archive all students' information including the learning results, the evaluation records, and the meta data scattered in various servers on campus into one integrated e-Portfolio database server. See Fig. 2.

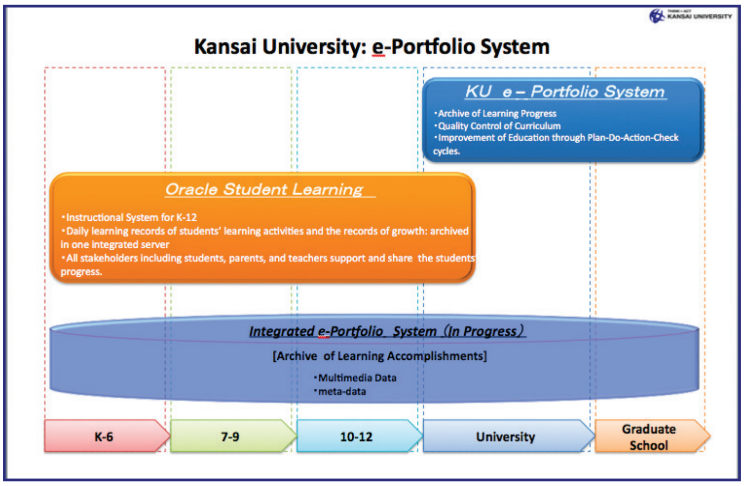

Fig. 2. The current situation of Kansai University e-Portfolio System.

KU e-Portfolio System archives and manages students' learning activities and their records through the Plan-Do-Check-Action cycle (henceforth, the P-D-C-A cycle). See Fig. 3. Each student first enters his/her learning goals for enrolled courses and lays out the learning plan. Based on them, the instructor gives advise as well as feedback for improvement. For the illustration of the P-D-C-A cycle in the KU e-Portfolio, see Fig. 4, Fig. 5, and Fig. 6.
This process continues until both agree with the intended level of achievement. Throughout the course, the student enters logs for learning activities and accomplishments, to which the instructor returns feedback and advice for encouragement. At the end of the semester, the student self-assesses his/her progress, compared with the goal that was set at the beginning of the semester. The results of the self-assessment are again turned in for comments for improvement. In this way, the student's level of motivation for improvement is maintained throughout the semester with the constant care and attention by the instructor. In here all information is kept in the e-Portfolio system as the record for intellectual growth.

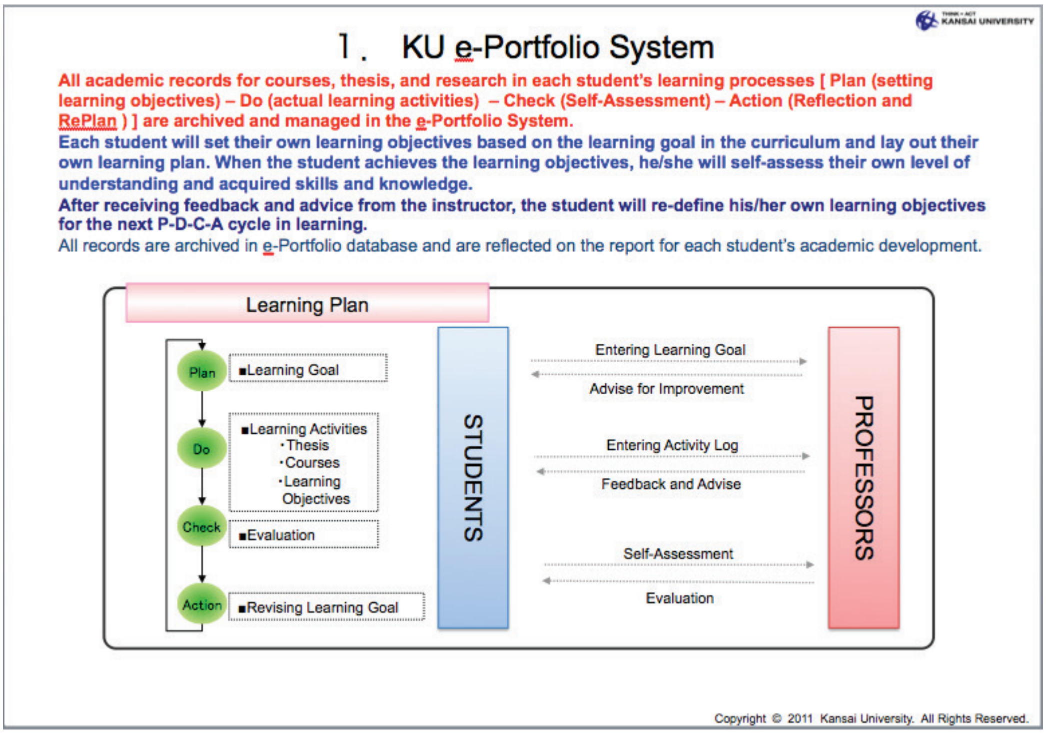

Fig. 3. The Learning Cycle of Kansai University e-Portfolio System

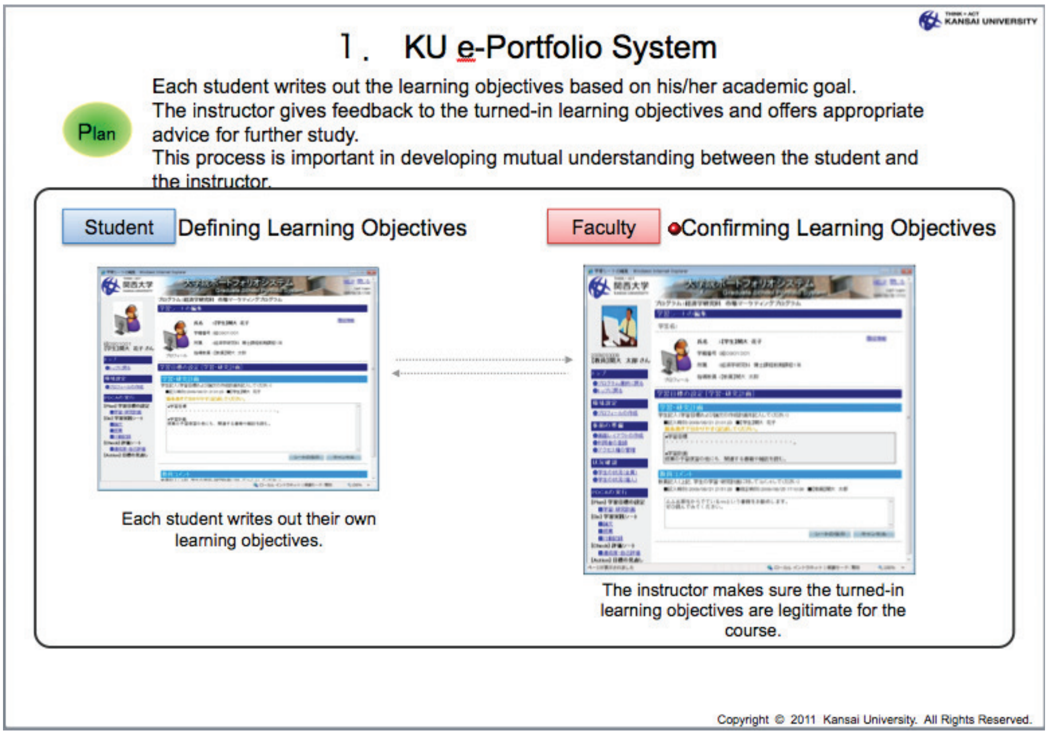

Fig. 4. The Learning Cycle of Kansai University e-Portfolio System: Plan

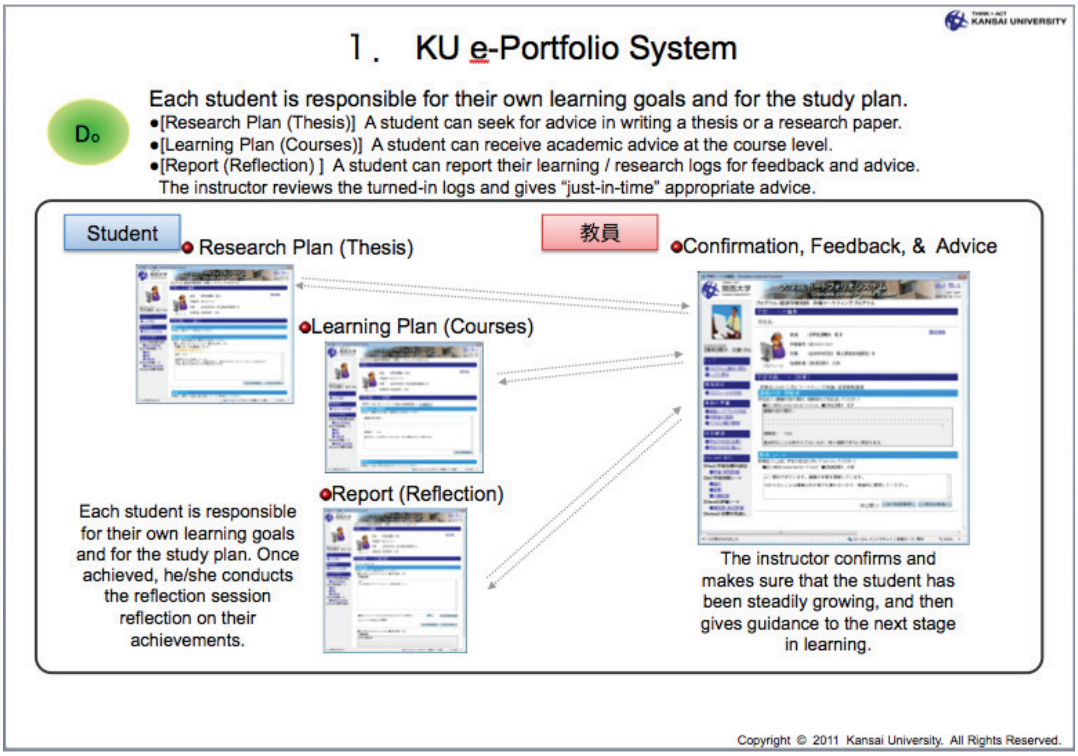

Fig. 5. The Learning Cycle of Kansai University e-Portfolio System: Do

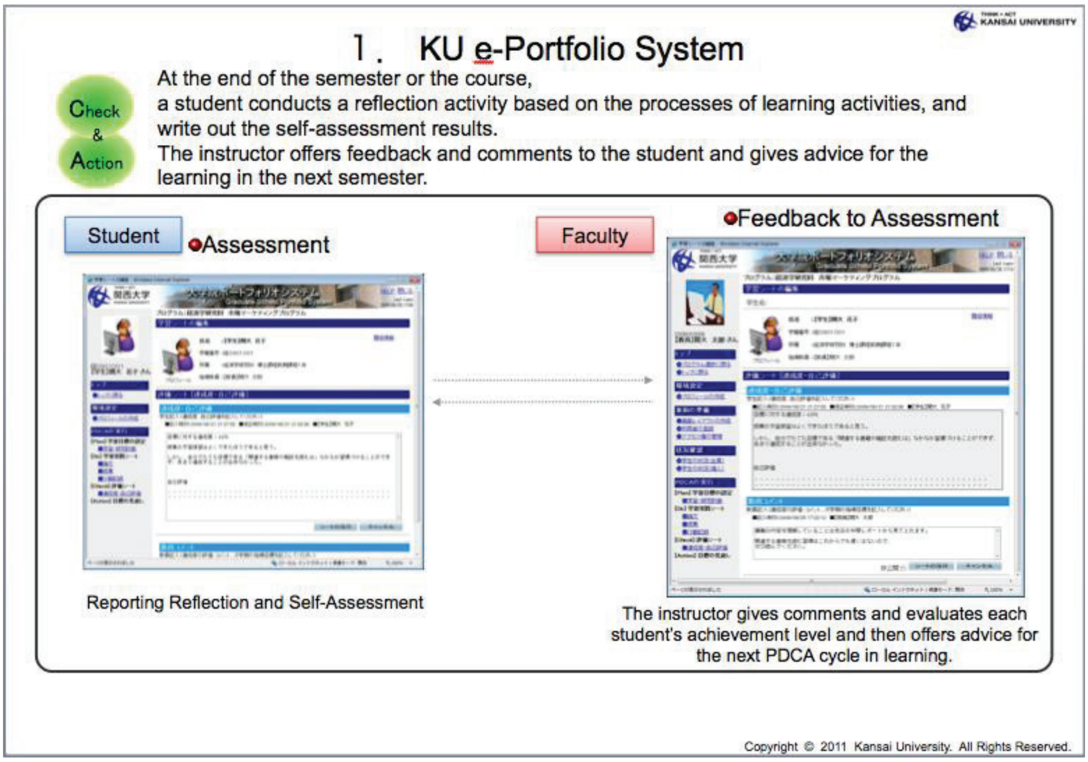

Fig. 6. The Learning Cycle of Kansai University e-Portfolio System: Check & Action

In this way, the 24/7 learning environment with consistent quality level of academic advising is guaranteed to all students. As the results, all the students are not just evaluated by the accumulative grades of the courses, but by the records of the learning processes and reflections that are documented by themselves and their academic advisers.

3. Conclusion

The four years of the university life is the most important period for the life of a student. Although the student enters the university as a child or a teenager after graduating from a high school, he/she will become an adult in four years and will be a member of a society upon graduation. Thus, the mission and its vision of the university play the most important role in education. This educational plan is best realized in a unified way with the use of KU e-Portfolio, as demonstrated above.

This paper dealt with an introduction of e-Portfolio. It was discussed possibility of causing a paradigm shift in education with the use of e-Portfolio. A showcase of the KU e-Portfolio was presented as an innovative use of ICT in education.

It is highly recommended to visit another case of the innovative use of e-Portfolio at Kanazawa Institute of Technology.

Acknowledgements

The authors of this paper are very much indebted to Dr. Ray Huang for providing them with an opportunity to share their experience as well as view of e-Portfolio.

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A Proposal for Educational Reform in Higher Education: A innovative use of e-portfolio - Show case at Kanazawa Inst. of Tech.

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Abstract: Education in graduate school is expected to catch up rapid changes of social needs and to assure educational opportunities for various carrier goals of students. At KIT(Kanazawa Institute of Technology), we started a new program based on portfolio system of course management for strengthening our graduate course in 2004. In this program we built system for 'KIT Portfolio Intelligence' which makes possible systematic procedures to evaluate whole course activities step by step using competency modeling and PDCA circles. Closely collaborations among students, teachers and staffs are essential to obtain successful results. System for KIT Portfolio Intelligence, originally created by KIT, is an educational system which evaluates skills and knowledge obtained during courses as well as thesis accomplishment. Portfolio approaches are also introduced in the system, which work for clarifying skill development and achievement objectively. Several years practice of the system at our graduate program show effectiveness in developing professional skills in short term.

Keywords: Process oriented Education, Portfolio Intelligence, Action Learning, Human Power, Carrier Development

1. Introduction

In KIT (Kanazawa Institute of Technology), we have been working on the reform and the operation of the educational program to clarify the quality for the upgrade of the graduate education since 2004. Concretely, we have enabled the graduate student to accumulate the result of the lecture and extracurricular activities. In addition, a systematic mechanism that the improvement of mutual verification and the education of the learning process and the result could be attempted from student's viewpoint is progressed by the individual interview result with the graduate student. We have been proposing the mechanism showing in the above-mentioned as "KIT portfolio intelligence". This mechanism has been the Trinity the graduate student, the teacher, and the staff, and has based of the graduate education at the improvement cycle (PDCA).

The KIT portfolio intelligence has been different from the education of the before done when the individual is evaluated by outcome of research and grade of subjects. It's a new educational technique for doing a quality evaluation in the lecture course corresponding to the educational target that KIT sets by valuing the process how to understand knowledge and the technology and what to master. Additionally, the education by the portfolio intelligence is an effective educational technique in the following points.

- Graduate Student
  - Objective evaluation of integrated human power improvement

    - Important factor for reconfirmation and recognition of content of study and knowledge
- Educational institution
    - Grasp of graduate students study understanding level
    - Clarification of coverage to educational target as graduate program

In this paper, Section 2 describes competency model on demand in portfolio intelligence. Section 3 describes the portfolio intelligence file. Section 4 describes the action learning process.

2. Competency model on demand

Figure 1 shows the basic plan of HRD of this graduate program (Program in intellectual creation system).

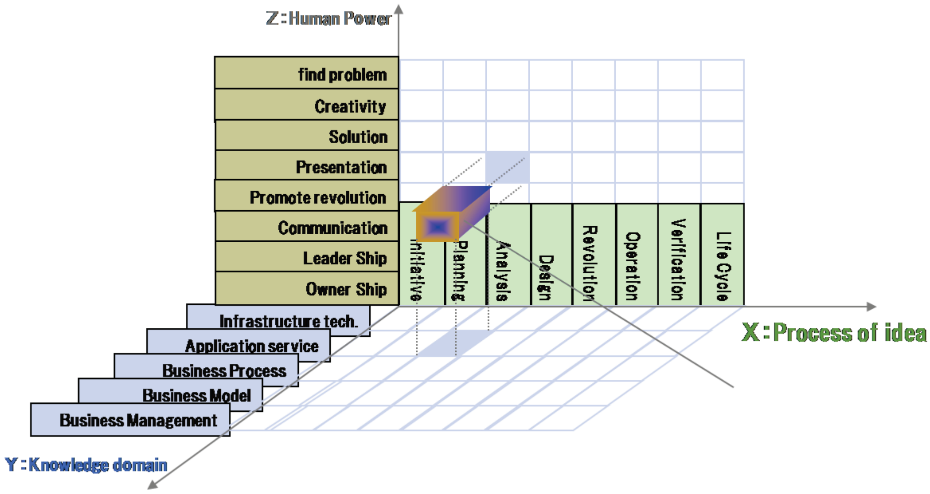

Figure 1. Competency model on demand

First of all, the graduate student executes the self-evaluation for the present capability using EQ (Emotional Intelligence Quotient) examination. Next, the subset of the combination of the area competencies that they want to acquire in the graduate school is set from "Human power", "Knowledge domain", and "Process of idea". As a result, their targets are clarified, and the competency registration model construction has been achieved. Subsets shown in each axis of Figure 1 are not the one that exists individually, and have been integrated. An own strong point and weak point is understood by using the combination of subsets in the self-analysis, and it helps to the target setting of study.

3. Portfolio Intelligence File

In this section, we explain the composition of the portfolio intelligence file. The graduate students attend a learning Master's seminar, research activities, and electives in the flow named MPDC at the Grow Up cycle (Figure 2).

The graduate students have made the summary that expresses the knowledge domain, the process of idea, and the human power.

Moreover, power to be able to do the reflection by study has been valued because it has aimed to assume that it is possible to evolve at any time. For instance, the reflection in the wide range has been enabled as the practice of elective becomes the motivation of research activities. The summary has been created as a result at this Grow Up cycle, and the research paper also has made. About the portfolio intelligence file, it has become the evidence of study in the postgraduate course at the same time though it has been graduate student individual's artifact.

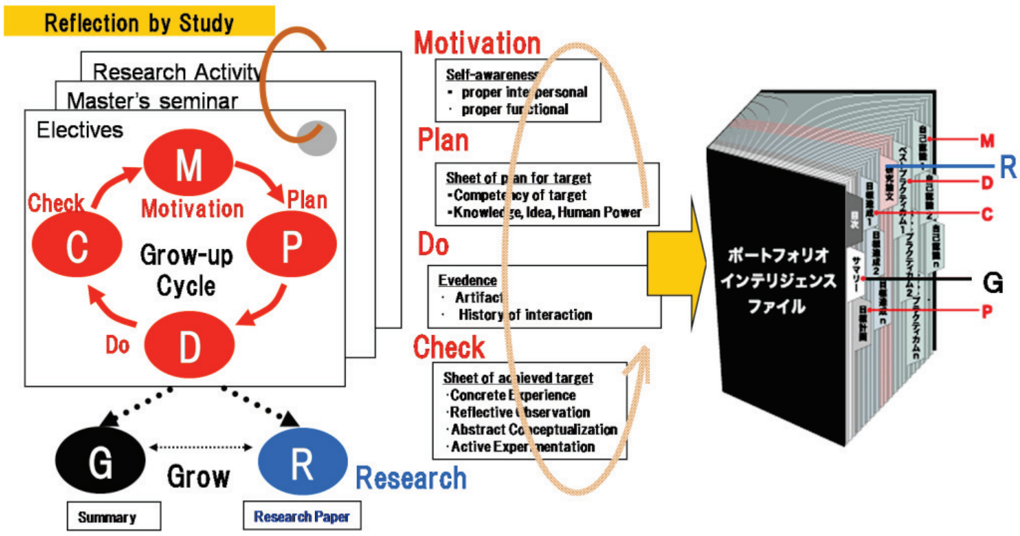

Figure 2. Portfolio Intelligence File

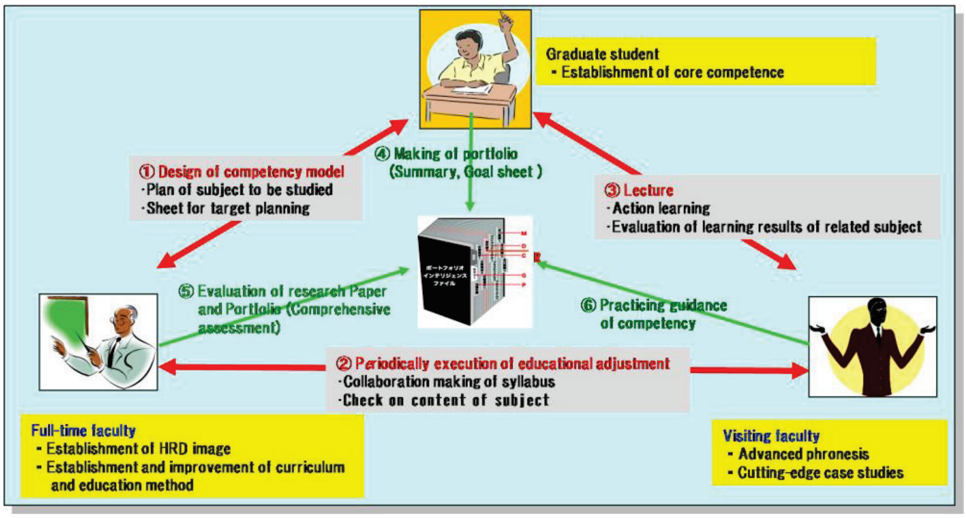

Figure 3. Relation between Portfolio and Learning

Figure 3 shows the study flow using the portfolio intelligence file mentioned above.

1. Design of competency model
   To develop the competency model, the registration planning and the target planning sheet are constructed through the interview among the graduate student and full-time professors.
2. Periodically execution of educational adjustment
   Periodically execution of educational adjustment of the collaboration making of the syllabus and the check on the content of the subject is done among the full-time professors and the visiting professors.
3. Lecture
   The lecture that uses the action learning is executed, and the evaluation of learning results of the electives and required are performed among the graduate student and the visiting professors.
4. Making of the portfolio intelligence file
   The summary and the accomplishment of a goal sheet that becomes material as a result of these subjects in the portfolio intelligence file have been made.
5. Evaluation of research paper and portfolio intelligence file

The professor executes guidance and the evaluation of the summary and the accomplishment of a goal sheet at any time, and is tying to the comprehensive assessment of the research paper and the portfolio intelligence at the end.

6. Practical guidance of competency

   An academic, practicing guidance by the professor based on the case study is executed to the graduate student.

4. Action Learning Process

Figure 4 has explained the action learning process. In the lecture, the education of modularity has been taken. In addition, the information service to the graduate student has been done by describing "Educational technique", "Material", and "Environment" clearly on the syllabus. The process of the experimental learning that refers to Kolb model is executed with the experience and the report in the lecture. We explain about the model of the process in this system.

1. CE (Concrete Experience)

   The competency model that the graduate student was able to acquire the content of the experience learning is described clearly, and those evidences are shown.
2. RO(Reflective Observation)

   The content of the experience learning (CE) has been considered and understood from other people's views, and it's described to have reconsidered again based on it.
3. AC(Abstract Conceptualization)

   The reconsideration result (RO) has been proven through an academic article and the research. An objective idea, the abstraction idea, and the generalized idea have been supported, and the grasp of essence has been tried.
4. AE(Active Experimentation)

   The plan applied to other problems is made based on the abstraction idea (AC).

   The report that describes the above-mentioned process becomes the sheet about achieved goal.

In addition, the material that becomes these evidences is stored in the portfolio intelligence file.

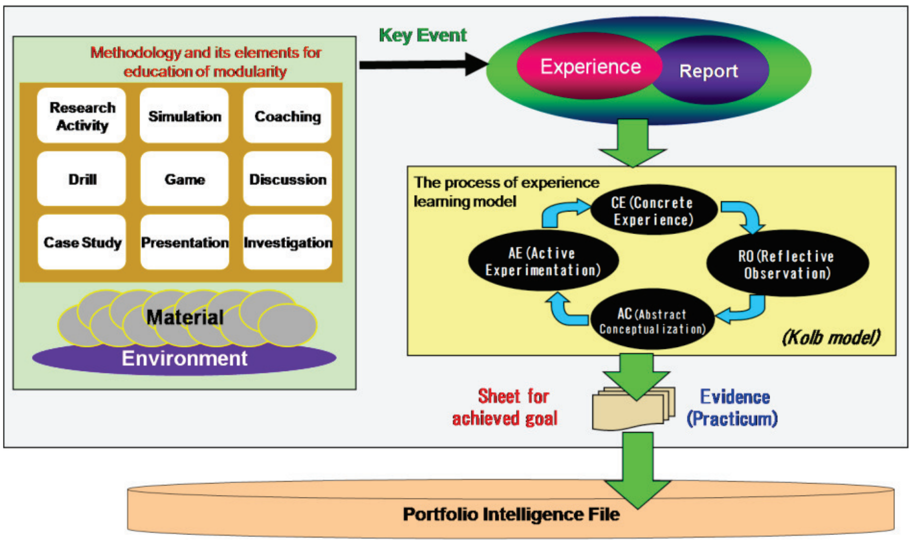

Figure 4 Action Learning Process

5. Evaluation

In order to evaluate how the system works effectively in our graduate program, we conducted a survey in the form of a questionnaire to our graduate students. There are thirty nine respondents to the questionnaire. The data is not enough to make statistical assessment, but we can see the student reactions to some extent. One of the results is shown in Fig. 5.

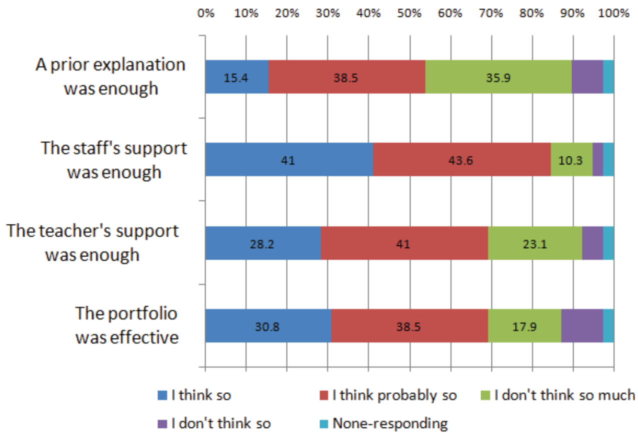

Figure 5 Evaluation of Portfolio Intelligence

- To the question, "A prior explanation was enough", 15.4% of students answered "I think so". Positive response totaled 53.9%.
- About effectiveness of portfolio intelligence, the response, "I think so", totaled 30.8%. Including 38.5% of the response, "I think probably so", then 69.3% of students satisfied.

There are some comments from the student as follows;

- Advantage:
  - The experience was easily arranged.
  - The purpose and the current state became clear.
  - Looking back easily during study.
- Disadvantage:
  - Need careful security consideration
  - Need to unify guidance methods among teachers and staffs

6. Conclusion

In this paper, we introduced an educational portfolio system (KIT Portfolio Intelligence) of course management developed by KIT for KIT graduate course in 2004. This mechanism has been successful under close collaboration among graduate student, professor and staff, and has based on the graduate education at the improvement cycle. In addition, it has been able to get objective evaluation with the point of making of the education substance. At present, we made the prototype as IT system, and started a test run since April, 2008. In future work, we will consider to cooperate with other universities and to expand the portfolio education mechanism.

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A Study on Positioning Issues in u-Learning Environments

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Abstract: The applications of ubiquitous learning is still considered to be very limited theses days, which has to do with many of the issues that have yet to be compromised involving some of the key technologies required; among which would be "positioning issues". Complications involving positioning issues can be divided into three categories: In the first category would be those of the global positioning system (GPS), since it consumes much of manpower in obtaining environmental parameters needed in order to ensure its functioning to be free of problems. The second category has its roots in the sensitivity of signals received by the wireless network equipment; units or systems would be greatly affected by whether or not the signals are being received on a reliable basis. Finally, there stills exists considerable inaccuracy in the practical usage of positioning methods, which has prevented them from being applied in reality. By integrating the Exponentially Weighted Moving Average (EWMA) and the concepts of the Sequential Positioning Method, this study has outlined the "Integrated Positioning Method" ("IPM") which, through segmentation and comparing of signal strengths, not only would decrease the degree of complexity in computing performed but would also reduce the positioning error rates. The results of this experiment shows that besides its capacity to have the environmental parameters figured out automatically so that the instability of signals received get to be improved, the IMP also simultaneously provides a location error rate of 1.3m on average, whish is of a great precision. As the effects of the impacts of the parameters used get to be more closely observed in details, even greater improvements could be achieved in the accuracy of positioning. Since the IPM that has been developed out of this research has a positioning function that is automatic in its operations, it is more of a system that is going to meet practical applications.

1. Introduction

The positioning objects in applications of indoor positioning systems are usually humans, for instance, the management of patients in a hospital; ensuring the safety of the miners working in a mine; monitoring of prisoners at a prison, etc If holding mobile devices, instead of humans, accountable as the objects of positioning, the network base stations will be able to provide superior quality of networks connections. The applications of such technology can be best illustrated when it is used in location-oriented guiding tours at a museum, when it is used to position items in management of inventory at a warehouse, or when it is used to track the production objects at a factory. Such advancements developed in the sphere of wireless network transmission technology actually spur on the developments of the indoor positioning systems that take full advantage of all sorts of wireless technology [1-7]; it explains how it is that one such application appears after yet another one.

2. Indoor Positioning System

The global positioning systems in general deliver reliable performance when utilized in the outdoors setting set in open spaces, though when used in such indoors settings as in factories, offices, or conference rooms, since the signals often times are blocked by buildings or other units of complex, they become relatively weak and unreliable for receiving. The positioning of such weak signals would usually acquire additional applications being employed, and this holds true in cases where more detailed information or other services are needed. This section will thus be focusing mainly on indoor positioning systems in particular by illustrating the indoor radio wave positioning systems that have been proposed in the past and the alternatives that might replace them.

The wireless positioning systems nowadays rely on radio frequency (RF), or, the transmitter and the receiver of radio waves as the chief means of transmission. The transmission of the infrared -- though not as popular as it once used to be -- has been the most widely-used method before the emergence of the "transmission-by-radio frequency market. In addition, because "ultrasound" has often been used as a way of assisting radio wave positioning systems it has long been considered as one of wireless means of transmission. The following would be an introduction of the radio wave positioning systems which take radio frequency as their basic structures.
Adopting radio frequency as a positioning system has become a trend. As [7] has illustrated, the outcome would turn out to be more desirable when a positioning system has integrated numerous kinds of positioning technologies. With the range measurement technique, it uses geometric figures to form conjectures on positioning of objects, which requires that information on relative distancing be obtained prior to any calculations can be performed. This techniques can be further divided into the two sub-categories of the "late ration technique" and the "angulations' technique". Still then, the late ration technique is either time-based -- basing calculations on time of arrival (TOA) or time difference of arrival (TDOA) -- or Really Simple Syndication-based (RSS-based). With the environmental analysis technique, there is the off-line stage and the on-line stage. This technique is commonly used in indoor positioning systems. RSS information displayed in the off-line stage, along with reference point signal strengths displayed in the on-line stage, are collected for establishing a radio map of the positioning environment to save into and be compared against each other in a central computer, which would have the coordinates computed after putting matching algorithms into the equation.

What radio map is is a RSS database that can determine the connectivity from being centralized or distributed. Generally speaking, the greatest of the population that composes the data the higher in accuracy of the data. When the connectivity is centralized, the antenna situated in the certain spots detects the likelihood of the locating point approaching, in this way; the centralized computer would then be able to pinpoint the specific coordinates. In case where more than one locating points are received, the one with the strongest in reference point signal strength would be determined as the defining coordinates amongst the many others. When the connectivity is distributed, meaning with a layout of a large number of locating points with coordinates, the locating point that is detected to be the nearest determines the defining coordinates.

3. Integrated positioning method

We integrated the concepts of the maximum-likelihood estimation (MLE) and the sequence-based localization (SBL) in designing of the "integrated positioning method". The areas in which the locating points are located depend upon the received signal strength indicator being great or small in values. If the maximum RSSI value received on the latest is identical to the previous one received, it would be fair to make the judgment that it is going to be the first area that is where the location point is going to locate, as so demonstrated in Section 1 in Figure 3.1

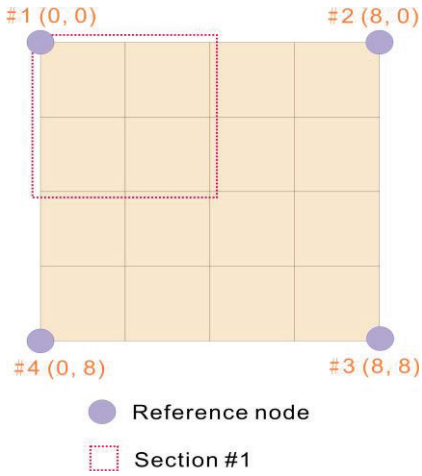

Figure 3.1 Determining of the major section

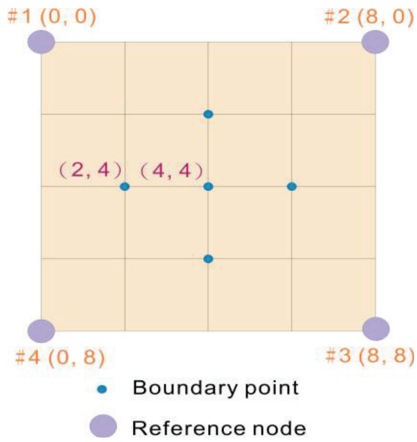

Figure 3.2 Determining of the boundary point

If the maximum RSSI value received on the latest is different from the previous one received, then it could be judged as the boundary point in different areas where locating points may sit, as illustrated in Figure 3.3. For example, if taking the maximum value of "1" received in the first instance as the reference point and compare it to a maximum value of "2" received in the second instance, then it can be judged that the locating point is moving from the first coordinate plane towards the second coordinate plane, making the coordinates of (2, 4). If the maximum value received in the first instance was "1" and "3" in the second instance, then the locating point would be coordinated at (4, 4). The boundary points are taken into considerations for that with those locating points that are really of short distance to the positioning regional center, the RSSI values are usually not far off.

After the major section has been determined, having the minor section determined breaks down into a two-fold process. The four centers of sections as shown in Figure 3.4 amplify the more specific coordinates and by using MLE, the nearest coordinates can be located. Provided that it would simply take four centers of sections as such for referral, it would be the reference points that need be determined in the beginning of the process.

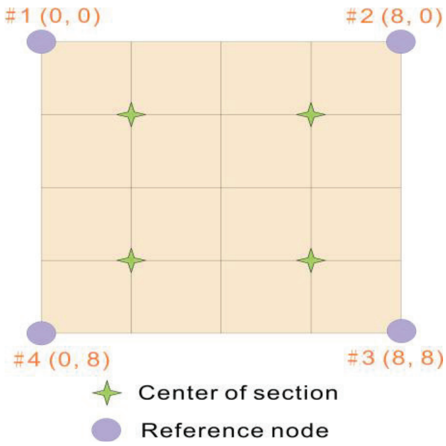

Figure 3.3 The reference nodes

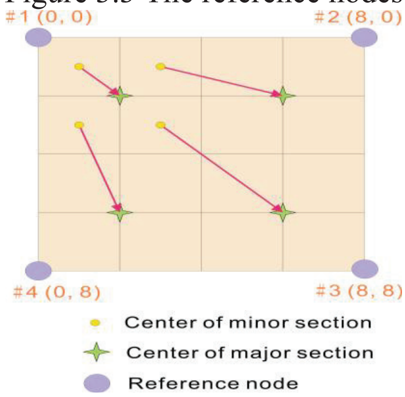

Figure 3.4 The relationship between the reference nodes and center of minor section

Provided that there are only four reference nodes taken into considerations for the present study, there are relatively fewer sort restrictions need be considered in regards to the sequences concerned. Only sequence other than the maximum value received because the locating point has been determined to locate in the minor section. When the sequences received are (1, 4, 2, 3), for instance, the second sequence being four, it is indicative of the possibilities for the coordinates to be either (1, 2) or (2, 3). If the sequences received are (1, 3, 2, 4) or (1, 3, 4, 2), with the second sequence being three, the sequences may be deemed problematic and the locating point would then be set on default, or at (2, 2), which is approximately the center point of the section concerned. In the case scenarios of the sequence being either a "2" or a "4", chances are there would be two sets of coordinates located. The actual coordinates can be specified after determining whether the maximum RSSI value is close to the reference point. See Figure 3.5.

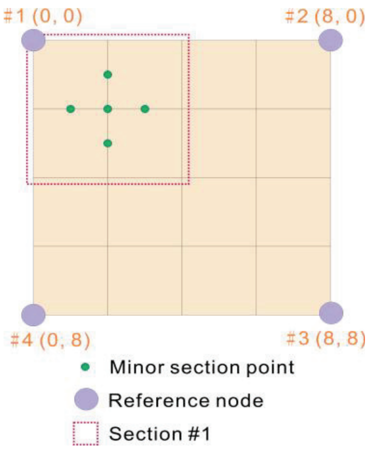

Figure 3.5 Determining of reference point by sequence

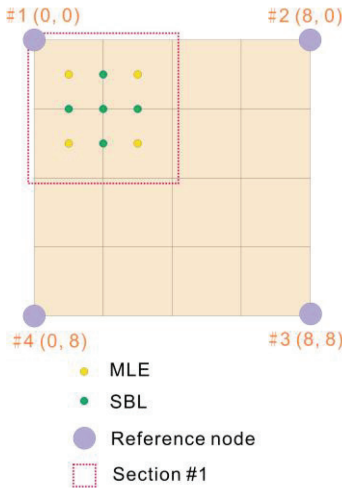

Figure 3.6 Illustration of integrated positioning determinants

After both the MLE (yellow spots shown in Figure 3.6) and the SBL (green spots shown in Figure 3.6) have been applied, the values are taken and averaged to determine the coordinates in the minor section. This way, it would not be necessary to convert the RSSI into a distance value and the coordinates are also be prevented from deviating from the positioning range. Also, the section in which the location point is detected can still be identified correctly even when erroneous RSSI values are received.

4. Conclusion & Analysis

After the Exponentially Weighted Moving Average of the RSSI values are treated with flip-flop filter, it is compared against the original RSSI value. In the experiment, the location point is adjusted from being ten meters away from the reference point to one meter away instead and back to the starting point, while the nodes are situated 60 centimeters above the ground, with the speed of travel of 60 seconds being the constant.
In positioning the amount of environment used in this study takes 1 to 10 meters as the interval in the path loss index

4.1 **The Dynamic adjustment path loss index test**

In positioning the amount of environment, the intervals was set at ten meters in the path loss index. The path loss index is calculated by taking into considerations of the minimum mean square error; a locating point is paired up with a reference point to form a data set by the unit of one meter that will allow the RSSI value of each point to be obtained. The index figure obtained from using the minimum root mean square error method is 2.769, which is a common value applicable to such indoor setting as offices. The path loss index can be automatically calculated when the distance is used along with the RSSI value.
In simulation, the reference points were arranged in a manner that was identical to the actual positioning, as illustrated in Figure 4.1. The RSSI values of the four reference points picked were recorded, and then also recorded were those of the four locating points. There were thus sixteen pairs of RSSI values. Figure 4.2 is a diagram displaying node #03 collecting the RSSI values of the four reference points. The RSSI values of the four location points were then used to substitute the variables in the integrated positioning method that has been developed in this study to see if the area where the node was located could be identified correctly. The outcome of the inspection (that was done in reverse) has further reflected the method to be reliable in being accurate even when there were discrepancies' making the RSSI values collected unreliable.

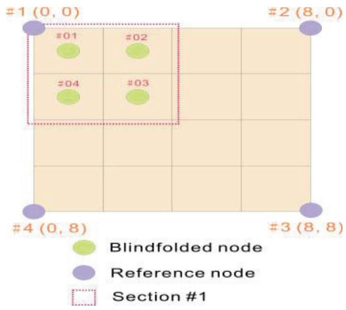

Figure 4.1 The reference points were arranged in a manner that was identical to the actual positioning

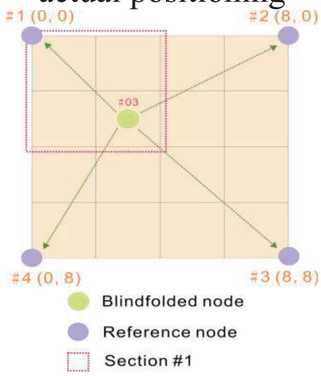

Figure 4.2 diagram displaying node #03 collecting the RSSI values of the four reference points.

4.2 The positioning test

A demonstration was carried out to put the integrated positioning method to the test. Four locating points located 1.2 meter above the ground were motioned at the constant speed of one meter per second, alternating with 5-minute intervals in between. Ten pairs of statistics were recorded and taken the average of to make an illustration of the error comparison, where spots plotted on the horizontal axis represent where motioning took place. The coordinates of (2, 0) would represent the starting point of "1", while the coordinates of (4, 0) would represent the finish point of "12" and so on and so forth.

The average location error rate produced by the demonstration ultimately indicated surpassing efficiency delivered by the method than if only MLE was applied (Figure 4.3), or than if only SBL was applied (Figure 4.4), or still, than if only CC2431 was applied (Figure 4.5). In Figure 4.6, the different comparisons made against the integrated positioning method were combined.

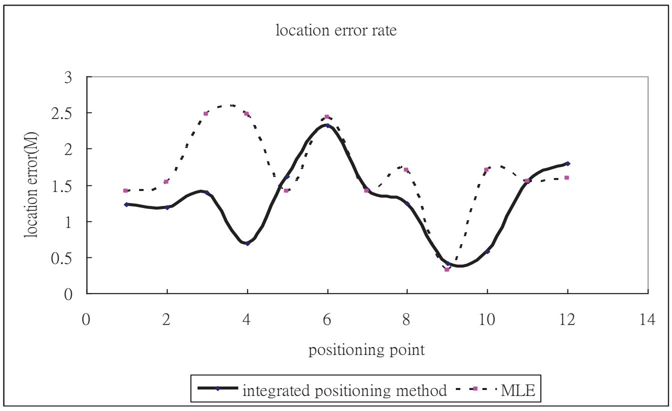

Figure 4.3 Comparing the IPM and the MLE

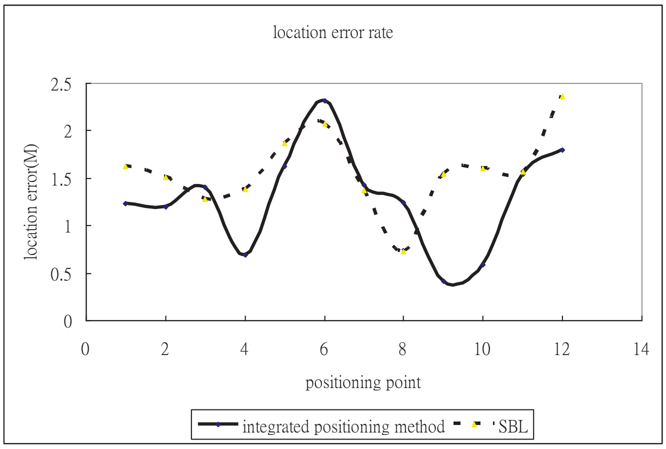

Figure 4.4 Comparing the IPM and the SBL

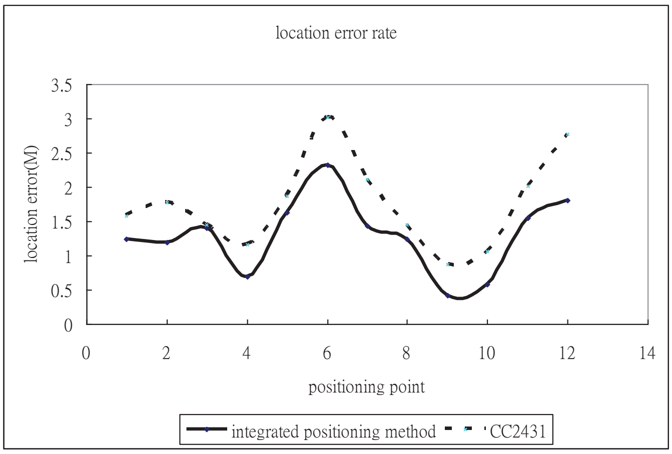

Figure 4.5 Comparing the IPM and the CC2431 (positioning engine)

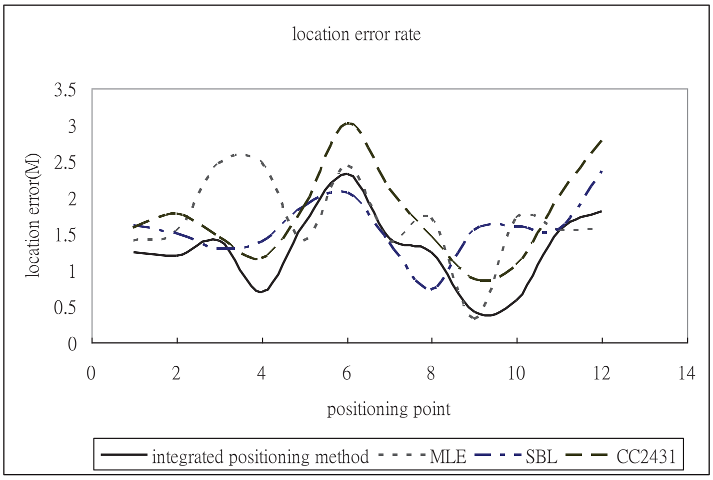

Figure 4.6 Comparing the IPM and the various methods combined

5. Conclusion

This study has proposed the adequate solution of solving positioning issues in particular by suggesting the use of the "integrated positioning method", which can be characterized as follows:

1). By referring to the path loss index the reference points used were determined by the sensibility of the RSSI values collected to be legitimate, which is then followed by the application of the EWMA flip-flop filter for smoothing.

2). The pass loss index need not be calculated beforehand, since such information is automatically obtained with ongoing communication being carried out throughout the reference points.

3). Because the integrated positioning method determines the section in which the reference point is located through the collection of the RSSI values, the signal strength values need not be converted into units in distance, and this avoids erroneous information from being produced in second operations.

The results of the research has indicated of a productive outcome that was delivered by the utilization of the integrated positioning method, which achieved a positioning error range of 1.3 meter that is sufficient for practical applications inside indoors settings that are enormous, such as classrooms or offices. The concept of zoning helped to limit other possibilities in the positioning ranges.

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Chapter 9

Skill Analysis, Learning or Teaching of Skills, Learning Environments or Training Environments for Skills

Preface

In this workshop, skill means special techniques to do something by interacting with objects, other persons or environments. Creating arts and playing sports are examples of the category of skill. Skill consists of recognition of objects or environments, Selection of appropriate action, and execution of action. A learner repeats these processes when he/she learns skills and trains skills. In this workshop, analyses of such skills are important issues. In addition how to learn skills or how to train skills are also important issues. Moreover, designs or developments of learning environments or training environments for skills are also important topics.

In this workshop, seven interesting papers were accepted and will be presented. Two papers of them are related to sports skill learning support environment. Other two papers are related to nursing skill learning support. Another paper is related to acupuncture. Another paper is related to pronunciation skill training environment, and the other paper is related to presentation skill learning environment. Therefore, the papers are coming from various domains.

The methods how to support skill learning also show wide variety. Some papers use 2D or 3D animations with CG. Another paper uses electroencephalogram for sports training. Another paper uses web technology for presentation skill learning. Another paper shows ontological approach. Other papers use motion capture system for sensing learners' or experts' body motions, and the other paper uses force feedback device.

In this way, participants in this workshop will be able to know various aspects of skills and also various approaches for skill learning research. Fruitful discussions on skill learning and training are expected in this workshop. Hopefully, this workshop will contribute to develop new skill learning studies.

Organizer

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Development of Motion Visualization System with The Center of Gravity for Novice Learners

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Abstract: To control the center of gravity of the body is one of the most important issues in motor skill learning, however, it is difficult for us to imagine the center of gravity, because he/she cannot see it. Furthermore, when he/she learns motor skill by coach or reference book, the center of gravity is often described with ambiguous expression, therefore, he/she find it difficult to know the center of gravity. In this background, we developed a motion visualization system with the center of gravity for novice learners The learner's motion data is got by wearable motion capture system with gyroscope. By using this system, a learner would be able to visually understand the relationship between his/her body movement and the center of gravity.

Keywords: motor learning, body's center of gravity, motion capture, skill, badminton

1. Introduction

To move a body is to move the center of gravity. Therefore, it is clear that the center of gravity is important in motor skill learning. Thus reference book or coach often gives advice about the center of gravity. However, learners cannot understand the center of gravity very well, because the advice about it is implicit or described with ambiguous expression. Furthermore, it is difficult for us to imagine it, because we cannot see it. Accordingly, invisibility of the center of gravity prevents learners from the mastering motor skill.
In this background, Kubo et al estimated the center of gravity visually [1]. The fitness software :Wii Fit or Wii Fit Plus shows the shift of the center of gravity by the projection on the ground. These researches show the center of gravity from one viewpoint.
For in related research on motor skill learning, Soga, A. et al developed application system[2][3]. This research shows the learning support by using 3D models.
The goal of this study is to design and develop a skill learning support environment for novice learners to improve his/ her arbitrary motion in motor skill learning. We developed a motion visualization system with the center of gravity. This system displays the physical center of gravity and movement with learner's 3DCG born model. The 3DCG models are made by OpenGL. We made the animation from the motion data which we acquired by a motion capture system. By using this system a learner can see his/her movement and the center of gravity from the any view point. Moreover, the learner can easily understand the relationship between body movement and the movement of the center of gravity. Therefore, we think that learning performance would increase.
In addition, we performed an evaluation experiment which decided whether a learner was able to improve his/her motor skill by the visualization of the center of gravity. Moreover, we performed a questionnaire survey after the experiment.

2. The Calculation Method of The Center of Gravity

The position of the center of gravity of human body is calculated as follows.
(1)Divide human body into 15 parts.
(2)Calculate the position of the center of the gravity of each part.
(3)Calculate the integrated center of gravity.
We need to know the length and mass of each part of the body for calculating the partial center of gravity. We can get the length of part of the body by a motion capture system. Ae et al intended for youth athlete for the wide area for build and divided a body into 15 parts: the head, upper trunk, lower trunk, left upper arm, right upper arm, left forearm, right forearm, left hand, right hand, left thigh, right thigh, left leg, right leg, left foot, and right foot. They estimated those mass and a centroid position and the centroid ratio by use of a mathematical model[4]. We used this mathematical model in this study.
For example, when we demand a x value of the head, the partial center of gravity can be calculated by math formula (1). Figure 1 shows endpoints of physical parts. Endpoint a and endpoint b represented each endpoint of each physical part. The position of the endpoint is calculated by the data which we acquired by the motion capture system.

$$\begin{bmatrix} X' \\ Y' \\ Z' \end{bmatrix} = \begin{bmatrix} a_x \\ a_y \\ a_z \end{bmatrix} + r \begin{bmatrix} b_x - a_x \\ b_y - a_y \\ b_z - a_z \end{bmatrix} \quad \cdots (1)$$

X': x value of the partial center of gravity
Y': y value of the partial center of gravity
Z': z value of the partial center of gravity
a_x: x value of the endpoint a
a_y: y value of the endpoint a
a_z: z value of the endpoint a
r: the centroid ratio
b_x: x value of the endpoint b
b_y: y value of the endpoint b
b_z: z value of the endpoint b

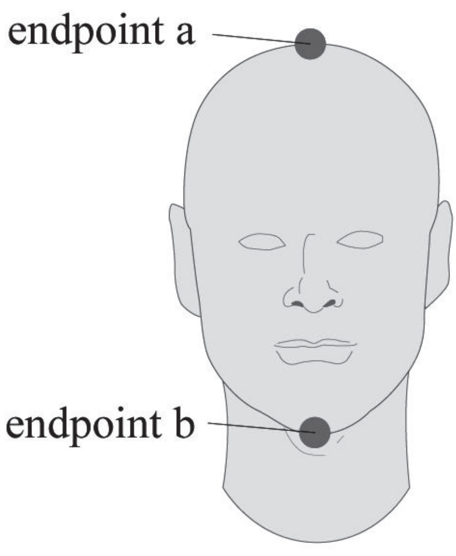

Figure 1 The example of the physical part (The head)

When I demand a x value of the center of gravity, it can be calculated by math formula (2)

$$\begin{cases} X = \sum_{i=1}^{15}(m_i x_i) \ / \ \sum_{i=1}^{15} m_i \\ Y = \sum_{i=1}^{15}(m_i y_i) \ / \ \sum_{i=1}^{15} m_i \\ Z = \sum_{i=1}^{15}(m_i z_i) \ / \ \sum_{i=1}^{15} m_i \end{cases} \quad \cdots (2)$$

X: x value of the center of gravity
Y: x value of the center of gravity
Z: x value of the center of gravity
m: the mass of each part of the body
x: x value of the partial center of gravity
y: y value of the partial center of gravity
z: z value of the partial center of gravity

3. Motion Visualization System with Center of Gravity

3.1 System Summary

It is easy for the learner to understand the relationship between movement of his/her body and movement of the center of gravity by making it visible. Therefore, we developed the motion visualization system with the center of gravity for novice learners. We think that it might be helpful for the motor skill learning. This system displays learner's 3D bone animation and the learner's center of gravity. An Expert's motion data is captured by wearable motion capture system(IGS-190) in advance. IGS-190 has directional sensor. In addition, it sends and receives data by wireless thus the learner is able to move wide area.

3.2 The Procedure for Use of The System

Procedure to use the system is as follows.
1. An expert's motion data is measured by the wearable motion capture system in advance, and store the data is stored in the system.
2. The learner measures his/her motion by the wearable motion capture system, and store the data in the system.
3. The system opens two windows. One window shows the expert's motion by bone animation with the center of gravity. The other window shows learner's motion by bone animation with the center of gravity.
4. The learner can find the difference between expert's motion and learner's motion.
5. The learner trains himself/herself to minimize the difference.
6. The learner repeats 2 - 5.

This system displays the bone animation in the three-dimensional space, therefore, the learner can check his/her movement from any viewpoint. The learner can zoom in, zoom out, replay the motion, and change the viewpoint by using a mouse and the keyboard. In addition, the learner can see movement of the center of gravity by displaying trajectory of the center of gravity. Moreover, the learner can know the passage of time intuitively, because the trajectory varies from blue to red as time passages. Figure 2 shows an example of bone animation of learner's movement and trajectory of the center of gravity.

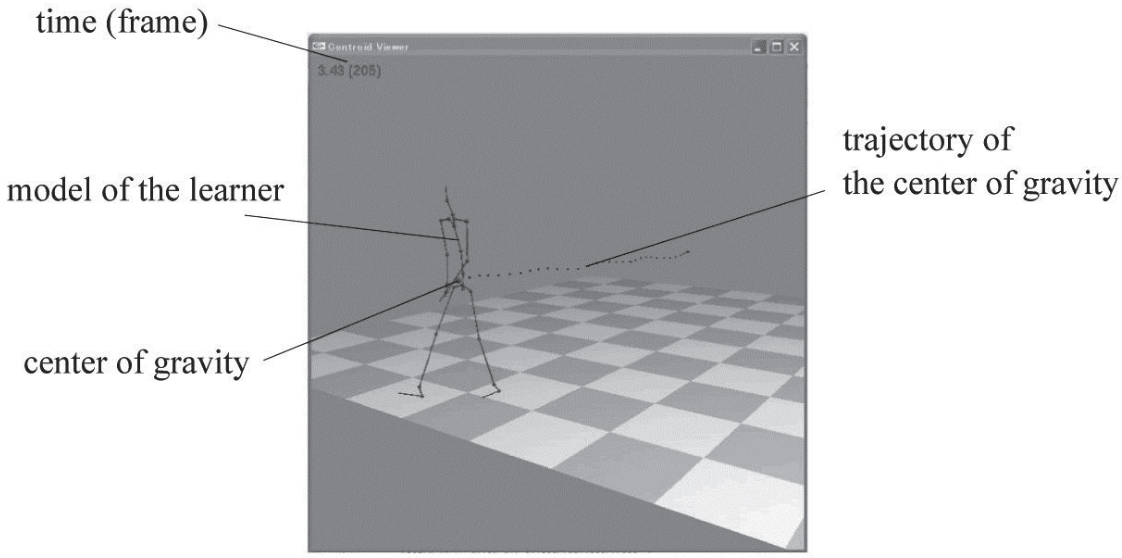

Figure 2 Bone animation of learner's movement and trajectory of the center of gravity

4. Evaluation

4.1 Experimental Methodology

We performed an evaluation experiment to verify effects and the utility of the system. We chose two kinds of forms which are basic shots of badminton: long high serve and high clear as a test domain in this experiment. The reason why I choose these shots are because a learner moves feet a little but moves body much, therefore I think the center of gravity is important in motion of long high serve. In addition, I make sure of the effectiveness of the system by the movement in a wide area in the motion of high clear. This is because there is a reason that movement with a whole body without moving a foot can utilize the characteristic of the system. Subjects are six male students in their 20's. We divided them into two groups. One group is experimental group in which subjects use the system with seeing the center of gravity. The other group is control group in which use the system without seeing the center of gravity. Long-high serve is the shot in badminton by which a player shots a shuttle as highly and far back in the court as possible from the service line to the opponent's court with underhand stroke. High clear is the shot in badminton by which a player shots a shuttle as highly and far back as possible from back in his/her own court to the opponent's court with overhand stroke. In addition, we performed a questionnaire survey after an experiment to evaluate a usability and effectiveness of the system.

4.2 The Flow of Experimentation

The flow of the experiment is as follows.
(1)We told the target point in the opponent's court, and then, we explained how to swing in basic long serve, the trajectory of the shuttle.
(2)Subjects in both group hit five shuttles without any practice by wearing a motion capture system. We measured subjects' motion and flying distances of the shuttles. These data represents subjects' ability before learning. We measured flying distance by measuring the perpendicular lines from the fall spot of the shuttle to a service line. If the shuttle did not go

over the net or a subject hit a wood shot, we didn't count them in the trial. A wood shot is a legal shot in which the frame hits the shuttle of the racket.
(3)After subjects finish hitting five shuttles, they compare their own motion data with expert's motion data by using the system. Subjects in experimental group use the system with seeing the center of gravity. On the other hand, subjects in control group use the system without seeing the center of gravity.
(4) Subjects in both group hit five shuttles by wearing a motion capture system. We measured subjects' motion and flying distances of the shuttles. These data represents subjects' ability after learning.

After finishing the experiment for long high serve, we performed the experiment for high clear by the same procedure as the long high serve. A flying distance by the high clear is length of a perpendicular when hitter dismantled the vector that bound the spot of the hind leg heel when he hits the shuttle and the fall spot of the shuttle together to a horizontal ingredient and a perpendicular ingredient in a net.

4.3 Result of Experimentation

Table 1 and table 2 show pre-learning and post-learning results of flying distance of the shuttle by long high serve. We rounded off flying distances to 10-digit.

Table 1 Pre-learning result by long high serve (cm)

		1	2	3	4	5	average
experimental group	A	760	700	800	800	700	752
	B	780	730	870	770	810	792
	C	580	580	650	680	510	600
control group	D	760	710	740	680	760	730
	E	330	500	590	460	490	474
	F	750	530	600	580	500	592

Table 2 Post-learning result by long high serve (cm)

		1	2	3	4	5	average
experimental group	A	830	800	780	770	820	800
	B	850	950	910	830	780	864
	C	680	820	520	530	730	656
control group	D	730	730	700	720	750	726
	E	590	490	660	380	600	544
	F	690	660	640	650	750	678

We found that the average of flying distance of all the subjects in the experimental group increased by comparing the averages in table1 and table2. We also found that the average of flying distance of all the subjects in the control group also increased except subject D by comparing the averages in table1 and table2. Therefore, it is difficult to show a learning effect by visualization of the center of gravity by the results.
We define maximum difference as the difference between maximum flying distance of pre-learning result and that of post-learning result. Similarly, we define minimum difference as the difference between minimum flying distance of pre-learning result and that of post-learning result. The maximum difference becomes larger in experimental group than control group. In other words, as for the experimental group, the maximum flying distance comparatively increased. On the other hand, we could not find difference for minimum

difference between experimental group and control group. From this result, we understood that the maximum flying distance tended to be easy to come to increase by learning with visualization of the center of gravity indication.
Table 3 and table 4 show pre-learning and post-learning results of flying distance of the shuttle of high clear. We rounded off flying distances to 10-digit

Table 3 Pre-learning result of high clear (cm)

		1	2	3	4	5	average
experimental group	A	910	1020	990	1050	1100	1014
	B	640	560	710	640	680	646
	C	960	970	830	1040	920	944
control group	D	960	1100	960	1170	1140	1066
	E	1010	920	1070	1100	930	1006
	F	860	900	800	850	670	816

Table 4 Post-learning result of high clear (cm)

		1	2	3	4	5	average
experimental group	A	1050	1070	1160	1130	990	1080
	B	670	830	800	850	640	758
	C	920	920	860	1000	1030	946
control group	D	1100	1160	890	1100	1040	1058
	E	920	670	1000	1030	940	912
	F	960	880	830	1000	840	902

By table 3 and table4, subject A and B of experimental group largely increased. Subject C in experimental group and subject D in control group did not show learning effect. Subject E in control group largely decreased. Therefore, there seems to be a tendency to increase flying distance a little in experimental group, however, we didn't find clear conclusion.

4.4 Result of Questionnaire Survey

We performed questionnaire survey about a feeling of use or the effectiveness of the system with six subjects. Subjects answered each question by five point scale. Score 5.0 means most positive score and score 1.0 is most negative score. In addition, subjects described their opinion by free description. Table5 shows questionary sentence
Table 5 shows questionary and the answer result of the questionnaire. The number in the right column indicates each is average each of rating. Questionnaire number 2 and 3 are questions only to experimental group, and questionnaire number 4 is a question only to control group.

Table 5 Questionnaire results

	question	average
1	Was the operation of the system comfortable?	3.0
2	Do you think it is effective to learn skill by seeing movement of the center of gravity?	3.7
3	Did you know a center of gravity position?	4.0
4	Did you understand how to move your bodies correctly?	3.8
5	Do you want to use a system in the future? (experimental group)	4.0
5	Do you want to use a system in the future? (control group)	3.7

We show some opinions by free description as follows.
Positive opinions:

- I was able to discover defects of my movement.
- I understood well the difference of the center of the gravity between expert's movement and my movement.
- I am glad that I can watch my movement from any view point.

Negative opinions:

- It is difficult for novice learners to improve their form even if they noticed differences.
- An unnecessary trajectory of the center of gravity was displayed and was obstructive.
- It is difficult for me to relate the center of gravity to physical movement

We verified effect of visualization of the center of gravity by positive opinions, because subjects told that they understood deeply their movements and movements of the center of gravity. On the other hand, we also found some disadvantages by negative opinions, because subjects told that they understood the difference between their own movements and expert's movement, however, they also told that they didn't understand how to improve their movements.

5. Conclusions

We developed the system which visualizes body motion with center of gravity in this study. We expected that a learner understood his/her body motion and a relationship between his/her body movement and the movement of center of gravity. To evaluate the system, we chose two kinds of forms in badminton as a test domain. We found that the flying distance of the shuttles tended to increase a little; however, we didn't get a clear conclusion by the experiment results. Since there is an opinion that there may be more important factors than the factor of the center of gravity in badminton, we would like to verify the learning effect of this system by the other sports.
This system was effective for learner to understand his/her movement and movement of the center of the gravity. The learner was able to notice the difference between expert's movement and his/her movement and also difference between expert's trajectory and learner's trajectory of center of gravity. However, the problem is that the learners cannot find the method how to improve his/her movement. To solve this problem, we have to develop a new function which advises the difference between learner's movement and expert's movement and also advises how to improve learner's movement.

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Integrating Electroencephalogram Analysis for Improving Mental Condition in Physical Skill Learning

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Abstract: In this paper, we propose a supporting system for a learner to develop a motor-skill. This study focuses on an electroencephalograph during physical skill performance. There are close relations between brain wave and psychological condition. It is our beliefs that identifying the strong relation between brain waves and the physical motion leads new approach to support learning motor-skill. The purpose of this study is to make the ideal psychological condition by the mental support according to runner's psychological condition

Keywords: Motor skill, skill development, running support, mental support, brain wave.

1. Introduction

1.1 Background

We focus on running as a primary target of developing motor-skill by this study. A lot of people currently pay attention to running because it is an easy exercise that can be carried out alone [1]. The population of both regularly and temporal runners are increasing. It is because the advantage of running are eliminating lack of exercise and avoiding metabolic syndrome. Further, it is easy, low cost and having a lot of race-events. However, many runners sometimes tend to dropout. The expected reasons why to dropout are injury, seasonal estrangement and decreased motivation.

The people who are civil runners seldom take professional lectures on running. Therefore, educational support for such runners is important. In considering the approach, we take into account of the different approaches of supporting type. There are two major types; physical support and mental support. Both supports are important for runners [2]. Many previous studies are based on the physical support for sports at real time. However, real-time mental support is rarely seen. We believe the mental training in sports is important. Running performance and mental state are closely related. In other words, running of high performance is created ideal mental state [3].

1.2 Purpose

The purpose of this study is to support runners who want to improve their running conditions efficiency and continuousness. One of the methods for detecting mental state is to monitor brain wave. Several tools to capture the brain wave are published. We adopt "*BrainAthlete*" to measure the brain state. With this device, the system is able to monitor the information of brain at real-time. The brain state of a runner is estimated for 15 seconds in every 5 minutes. With psychological design of a runner after the measurement, the system provides the feedback of the mental information. The feedback can cause with early-expression, maintain, re-expression of the runner's-high that is favorable psychological state.

2. Integrating Brain Wave

2.1 Brain wave

Brain wave shows potential change from electrode on the scalp. Those data are shown by line-chart. Horizontal-axis of the chart is time line. Vertical-axis indicates the potential change. Brain wave is detected potential change from cortex to extensive cortex. Brain wave takes the integral from cortex and distant point (e.g. Ear)
Brain wave is classified into Alpha wave, Beta wave, Theta wave, and so on (see Table 1). These waves can be divided and captured at the same time because of the different frequency. Cerebrum is always processing much information intricately. When the brain is working normally, potential of neuron is scattering. Thus, the brain shows beta wave. The potential of neuron is synchronized with other one in rough when the brain is non-active. Thus, the brain shows Alpha wave [4]. Activity of brain is understood by watching brain wave. Additionally, psychological state is estimated from activities of the brain.

Table1 The brain wave states

Brain wave	Frequency	Feature
Delta	0.5~4Hz	Deep sleep
Theta	4~8Hz	Shallow sleep
Alpha	8~13Hz	Memory, Learning, Stress reduction
Beta	13~40Hz	Focus, Concentration, Energy, Excitement, Attention
Gamma	30Hz	Angry State

2.2 The relationship between sports and psychology

To keep high state in mental condition is important for high performance of running. As mentioned before, the physical state and psychological one in sports are closely related [5][6]. The types of mental training for athlete are attention and meditation.
There are many kinds of mental training that is reported and regarded as an effective method for performance. However, most of the evaluation of effect of mental training is subjectivity. The problem is that evaluation always performed with less objectivity [4]. Therefore, it is important to integrate brain wave for the detection so as to evaluate the mental state objectively.

2.3 Runner's High

Repetitive motion like running will cause pleasant emotional states when a runner runs more than a certain time. A publicized effect of endorphin production is so-called "runner's high". This phenomenon is occurred by excreting a lot of endorphin in the brain. The endorphin cause analgesic effect and enhanced mood. Hence, a runner can train without emotional distress. If a runner can control the condition, it may lead to the better performance.

3. Tool

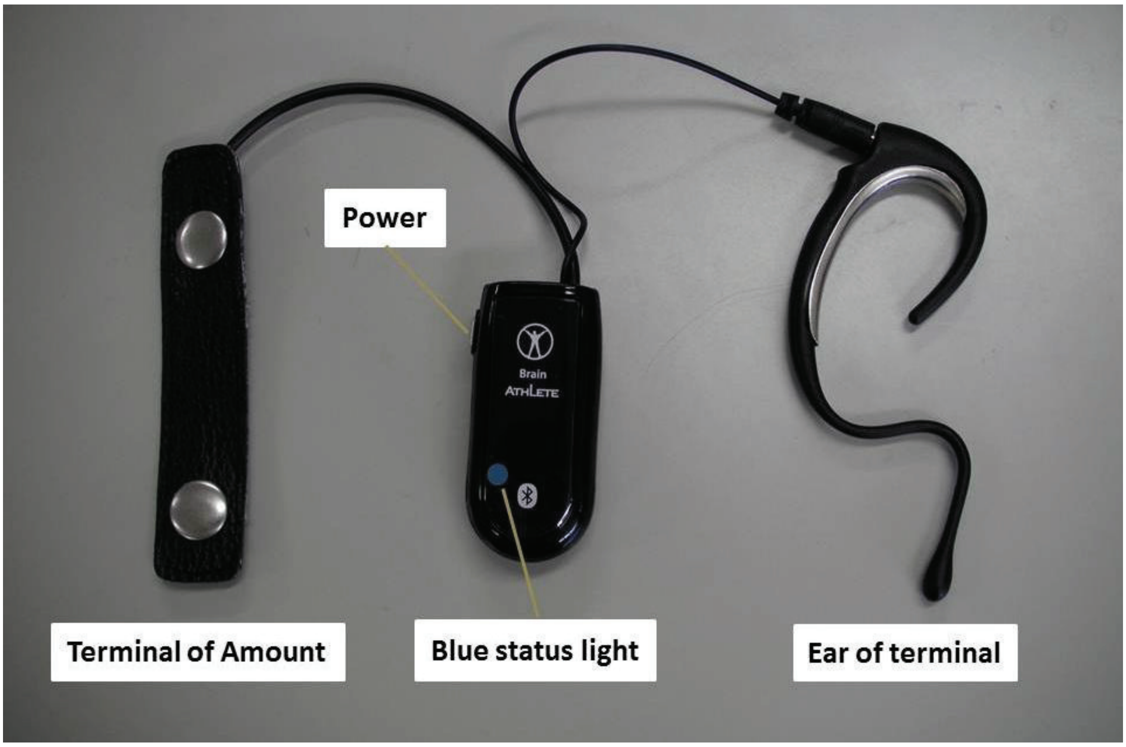

Figure 1 Sensing device in BrainAthlete

3.1 Module

3.1.1 BrainAthlete

BrainAthlete is the device that measures the brain wave (see Figure 1). This computes and determine attention and mediation from the brain wave based on the unique algorithm (this is called eSence). These values show the psychological state. It can be measured without obstruction of running. We can wear at a sun visor because this device is very small and lightweight.

3.1.2 Noise Filtering

Brain wave is very faint signal that is normally microvolt. Therefore, measurement result is sometimes affected by noise. Electroencephalogram is needed noise filtering to eliminate the interfere noise.

BrainAthlete eliminates the noise by using hardware and software filtering. The system removes bio-signal that is non-brain wave. The software on the device is able to output the wave in graphic representation at real-time during these process.
The device sends data on Bluetooth communication. If the distance between the sender and the receiver is less than guaranteed distance, Bluetooth can send data without being affected by angle. Therefore, it is easily measured in indoors and outdoors.

3.1.3 Conversion

BrainAthlete analyzes the brain wave by using unique algorithm called eSense. The brain wave is a complex data that is understood by only specialist. Therefore, eSense can convert from the raw data into two aspects as attention and mediation in order to be understood by non-specialist. These data is given from 0 to 100 of relative values. It shows relax and concentrating status that are important index values for sports. Besides, these values can be monitored without regarding the scene. Accordingly, this device is fitted one for our system. The device consists of smart shape because the process and analysis of the brain wave is mounted on only one module.

3.1.4 Appearance

The body of the sensing device is set on a sun visor and the relative-grand position is located at ear. The measurement of the brain wave and the sending of the data are realized by only these devices. Therefore, the runner does not mind deeply about wearing it. It is a basic advantage of this device.

3.2 Output Attention and Meditation

The device outputs the attention and meditation from measurement data. These data are output from 0 to 100 in real-time. Figure 1, 2 show the experimental result of output pattern. Red line shows attention, green line shows mediation. The horizontal line shows time. The vertical line shows the score of each data.

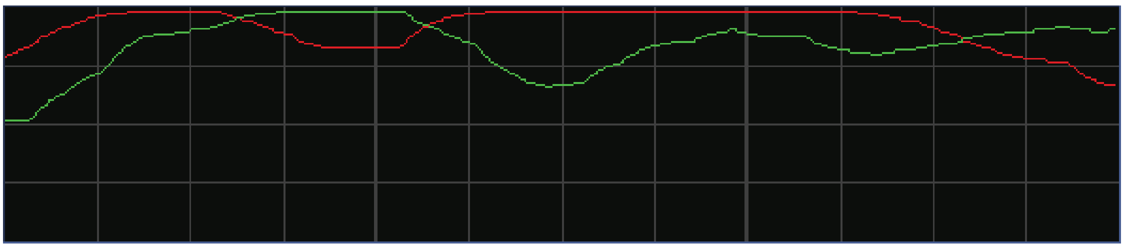

Figure 2 Sample of concentration

When the examinee is concentrating, the attention always shows high values such as from 70 to 90. The mediation also shows high value. Judging from the data, it can be confirmed that the examinee is concentrating (See Figure 2).

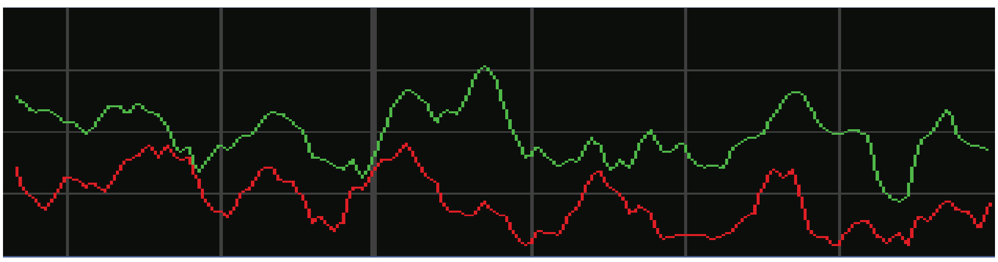

Figure 3 Sample in reading a book

When the examinee is reading (See Figure 3), the attention and the mediation oscillate in a chaotic pattern for instance. The average of the mediation is about 50. It is monitored that the attention is lowered at the same time as flipping the page. It is assumed that the examinee have a lapse of concentration when one flip the page.

3.3 Usefulness

Electroencephalogram measurement experiment uses flash mental arithmetic. Because, we want to demonstrate the usefulness as an index of BrainAthlete. From this experiment, measured characteristic data were similar between subjects in flash mental arithmetic. Thus, we demonstrated the usefulness as an index of BrainAthlete.

3.3.1 Flow

The number of subjects is four at this time. Subjects solve flash mental arithmetic on PC during measuring the brain waves. Subjects wait 5 seconds until the next issue after the answer. The flash mental arithmetic is going up difficulty according to solving the question. Subjects will end the measurement, when they mistake.

3.3.2 Experimental result

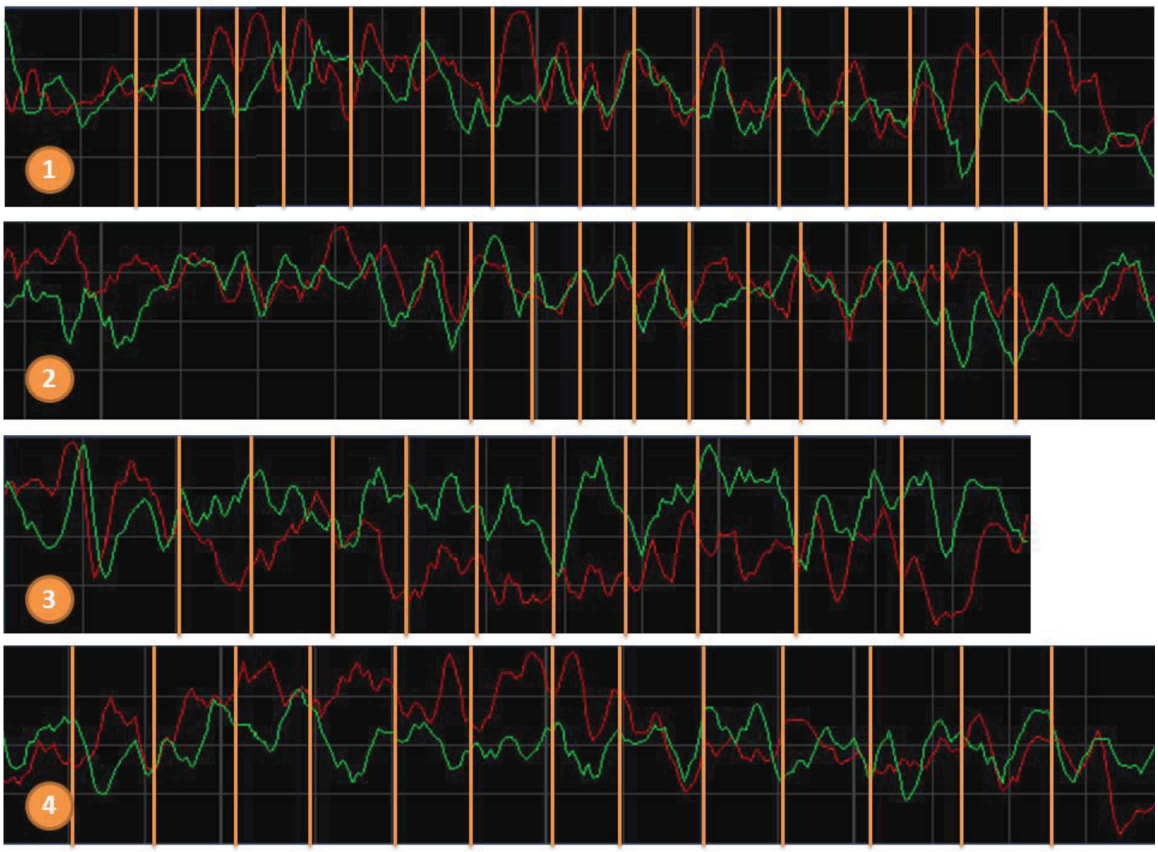

Figure 4 An experimental graph

The red line indicates *Attention*. The green line is for *Meditation*. Both lines are represented in a same graph (Figure 4). The vertical bar is the time that started to solve the question. When subjects start to solve the question, Attention raises sharply, then descent after the answer. This pattern appeared frequently. At first, Attention had to rise from begin the question. However, when the difficulty in question goes up, just before beginning the question, the rise of Attention appears notably.

4. Implementation

4.1 Flow

In this study, our purpose is to support to the runner by using electroencephalogram and feedback on time. At first, the runner runs 30 minutes by using treadmill. The runner using BrainAthelete for electroencephalogram. Next, the runner slows down speed of running equally walking speed when after the 5 minutes. The runner kept shaking head as much as possible. The measurer measure the electroencephalogram while 15 seconds. If the measurer finishes measurement, the runner begins running. The measurer feed back to the runner by using electroencephalogram. These repeat every 5 minutes that are running, slowdown, measurement, acceleration, feedback.

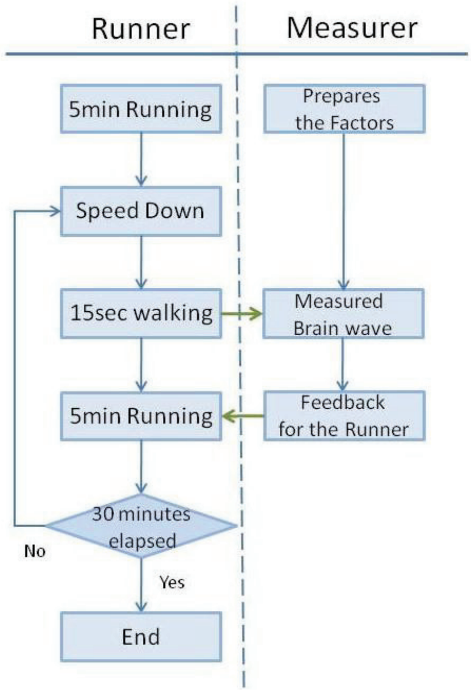

Figure 5 The process of supporting skill-development

To measure brain waves may then runner is stop. But, it is difficult, the runner stops to take brain wave like the running. Because, runner was calm heartbeat and respiration. If the measurer measure the electroencephalogram, the runner walk while keep shaking head as much as possible. There by, measurer can get low-noise electroencephalogram and similar to the electroencephalogram during running.

The measurer provides feedback for the runner by using electroencephalogram that was measured. The runner can get continue and re-emergence of runner's high. Thereby, the runner was sported of mental.

4.2 3×3 Thresholding

The measured brain waves are output as attention and meditation. These are represented by the value from 0 to 100. In this study, we define the 3 scope of attention and meditation.

Thereby, psychology is estimated of runner. Attention and meditation done in this area divided. Then, psychological state of the runner is divided into 9 states. The measurer provides feedback for the runner by using them.

4.3 Feedback

The measurer provides feedback for the runner by using the measured brain wave. Thereby, the runner was inspired to appear, continue and re-emergence of runner's high. The feedback approach is to encourage 5 sensory. There, the measurer prepares the factors to encourage for 5 sensory in advance (Table 2). These are factors that runner can relax or exit. Therefore, the runner is changed to ideal psychology by using them.

Table 2 Sensory organ and approach

Sensory organ	Approach
Vision	Projector, Monitor, etc...
Hearing	BGM, Natural sound, etc...
Smell	Perfume, Aroma, Incense, etc...
Taste	Candy, Drinking water, Cigarette, etc...
Touch	Temperature adjustment, Air Conditioning, etc...

5. Summary

This paper provided problems in running and the importance of mental support. we proposed solution of them.
Section 2 explained the relationship between brain wave and mental status. It explained the suitability of the brain wave in mental support.
Section 3 explained BrainATHLETE that is electroencephalogram measurement.
Section 4 explained this support system's flow, threshold value and feedback.

Acknowledgements

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Evaluation of An E-learning System to Support Self-Learning of Nursing Skills

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Abstract: Learning-support using video teaching materials is known to be effective in nursing education. In recent years, as video equipment or computer technology have advanced, learning systems providing nursing skill video images on the web have been investigated. However, because they are only shown the teaching materials, students cannot review their own skills using such materials. Therefore, we verify the effectiveness of reflective learning by comparison between the video of a nursing student's skill recorded while training and the video of skilled nurse's skill model, using the self-learning support system. We report the analysis of the nursing students' skill acquisition process was phased in their self-learning situation.

Keywords: Nursing Skill Learning, Learning Model, Self-learning Support System, Nursing Student, Reflective Learning

Introduction

In nursing education, it is necessary to acquire not only specialized knowledge but also appropriate nursing skills. Furthermore, because nursing evaluation is often judged by whether the nursing skill is good or not, learning support necessary for a nurse to become familiar with nursing skills is required. In recent years, although the study of learning support of the specialized knowledge using ICT in the field of education is well practiced, the study of the learning support system requiring skills (series of techniques related to physicality) has been underway.
Intravenous injection, which draws much attention among nursing skills, is a skill that is related to body invasiveness by inserting a needle and infusing medicine into a blood vessel. In recent years, after the change of new administrative interpretation to "intravenous injection conducted by a nurse is treated as the category of auxiliary action of medical treatment" in Japan (Health, Labour and Welfare Ministry, 2003), it has been noted that education related to intravenous injection must be improved (Japanese Nursing Association, 2003). Consequently, nursing students are now required to master the skills to administer intravenous injection safely. Nevertheless it has been found that "self-learning of intravenous injection" and "technical training in college" are less useful for skill acquisition of intravenous interjection of new nurses, presumably because many students do not feel that learning at college is useful in a field or because new nurses tend to be passive in skill acquisition. Moreover, "reviewing one's own failure" and "knowing one's own tendency by personal experience" are described as highly valued for skill acquisition. Therefore, it is regarded as important to encourage the support system to allow a nurse to review their own failures and know their own tendencies.

Consequently, the author holds that it is necessary to encourage students to think subjectively and find important points for themselves to improve the circumstances described above, including self-learning in skill education at college. Moreover, it is necessary to support their effective nursing skill acquisition. In this study, for supporting nursing skill acquisition for nursing students, we put forward the three-level skill-learning-support models of (1) practice, (2) comparison, and (3) reflection. Then we verified the models using intravenous injection skill as one example. Focusing attention on the difference in the thinking mode of "knack" of intravenous injection skill between nurses and nursing students, we developed a learning support system to allow nursing students, as beginners, to self-learn nursing skills. In this study, we verified that capability.

1. Present situation of nursing skill education

In conventional classes designed to teach nursing skills, first instructors explain the purpose, necessity, and procedures of nursing skills in lectures and then demonstrate them in technical seminars. Thereafter, nursing students gain skill training individually or in a group in a series of learning processes. In skill training, even if the students sometimes teach each other in a group, they often put questions directly to the instructor. In other words, they tend not to think well about their questions by themselves in many cases. There are not many teachers who can answer their questions sufficiently on the scene. Therefore, students might be unable to gain nursing skills sufficiently within college classes, given present conditions. Although some skills can be learned with knowledge that is prescribed in a manual, it is difficult to learn nursing skills, which include implicit knowledge, as physical knowledge, according to a manual. Knowledge acquired from experience or practice could be called experiential knowledge, or deep knowledge (meaning the expertise or special skills which proficient engineers or managers accumulate from their various experiences). For learners to obtain that kind of knowledge, they must acquire experience and reinforce that knowledge through additional learning including practice, observation, problem resolution, and experiments, especially under the guidance of instructors [1].

In the field of nursing education, the chances for learners to gain skills through on-the-job training (OJT) in the clinical training are offered. In the field of college education under the pressures of number of instructors or time, however, it is not easy to use the form of OJT for learning various skills. In addition, because nursing students have many skills to learn, it is difficult for them to take much time to master any one of them. Consequently, to support them in acquiring nursing skills, we shed light on what is an effective learning-support method and examine the skill-learning support model.

To produce a learning-support model, it is noteworthy that we must consider two kinds of cognition that are used by human beings: experimental cognition and reflective cognition [2]. The former includes reactive understanding of an overall situation without deep thinking and acting just then. The latter involves making decisions through consideration and comparison. Furthermore, it is noteworthy that learning with reflective cognition should be required at an early stage, suggesting that it is important for a learner to learn by careful independent reflection to promote more effective skill learning.

Moreover, new nurses learn practicing intravenous injections through first "following the instructors' model," "benefiting by their experience," and "repetitive practice" [3].

Additionally, in a traditional learning method, at first, it is common that the nursing student imitates the technique of the expert nurse [4]. In the another point of our previous study, we found that linguistic expressions differed among nurses in terms of the sensation of fingers that nurses recognize at perceiving blood vessels by touch or inserting an injection needle.

This suggests that formal knowledge by visualization would be better than that by verbalization to share and use know-how of nursing skills which cannot be verbalized [5].
For that reason, seeing video images from the viewpoint of skilled persons (nurses) and learning by following their model or by comparing one's own skills to theirs, a new nurse can promote reflective thinking, leading to the acquisition of effective skills.
Consequently, in this study, using the learning-support system [6] developed for comparison between the video of a nursing student's nursing skill recorded while training and the video of skilled nurse's skill model, we first verify the effectiveness of reflective learning of nursing students' skill acquisition by making a comparison between both video images.

2. General outline of the learning-support system

Learning-support using video teaching materials is known to be effective in nursing education. In recent years, as video equipment or computer technology have advanced, learning systems providing nursing skill video images on the web have been investigated. However, because they are only shown the teaching materials, students cannot review their own skills using such materials. Therefore, we verify the effectiveness of reflective learning by comparison of how nursing students acquire their skills, using the following learning-support system [6].
The developed e-learning system described assigns importance to handling images to enable visual learning. In addition, because many nursing students consider precise implementation of procedures as technical "knacks", the instructional design consists of the following four phases:
1) Identification of one's own technical procedures;
2) Comparison of model images with one's own technical images;
3) Comparison of each image in one's own practice progressions; and
4) Output and identification of learning results.
The system comprises four functions. In the following, we explain the functions sequentially.

2.1 Procedure-learning function

It enables nursing students to learn technical procedures. Nursing students understand that the knack of skills should be to conduct the procedures precisely, suggesting that learning methods allowing learners to remember the procedures among others are good for them. The illustration of Figure 1 below shows that this function is a type by which a user can confirm procedures by checking a radio button.

2.2 Image-comparing function

This is a function by which a user can play two video images simultaneously or alternately to compare them (Figure 2). If the learners use this function, then they are helped by comparison to experience and think about the difference of time between that required by a skilled nurse and by themselves.

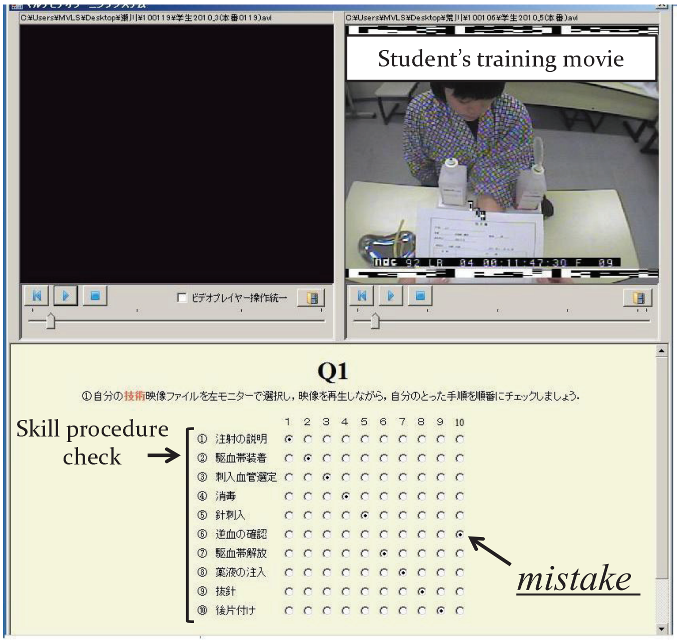

Figure 1. The screen of technical procedures check

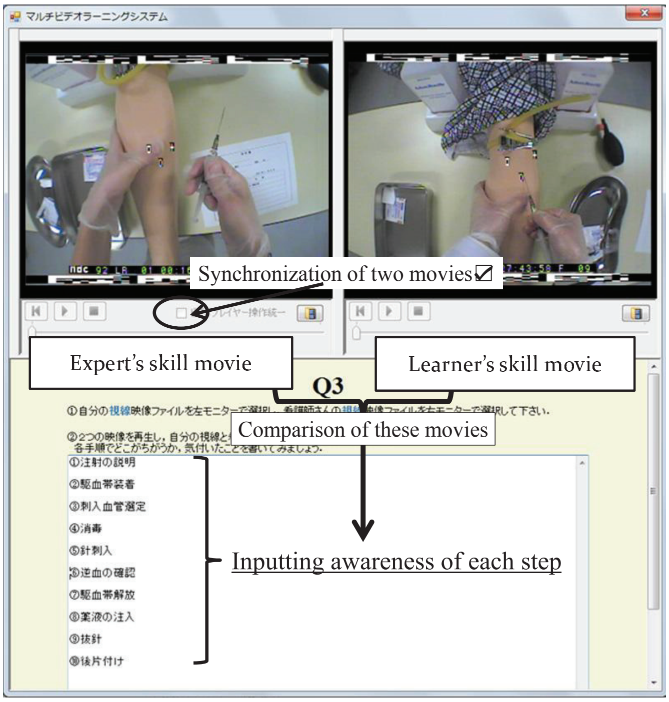

Figure 2. The screen of comparing images and inputting awareness

2.3 Text-entry function

With this function, nursing students can enter text through answering questions (see the lower illustration in Figure 2). Learners can think by themselves through comparison and freely describe what they have found. It helps learners to promote their reflection and think by writing using the system. The questions are set so that learners can make a comparison in every procedure of intravenous injection.

2.4 Text-output function

With it, users output the procedures that they have input by themselves or describe what they have found. It is also used as a portfolio of the process of skill acquisition, by which the learners can be conscious of their own findings and advance their own learning.

3. Research method

3.1 Experimental method

To verify reflective learning by video comparison on nursing students' skill acquisition, the experiment was conducted using the system described above. The experimental procedures are shown as follows. The experiment was conducted in January 2010.

1) A student wears a camera and conducts intravenous injection according to the simulation model of intravenous injection (Fig. 3), shooting a video (video A before training) from his perspective. The video images are portrayed in Figure 4.
2) After the student conducts training, the student shoots a video (video B after training).
3) Using the system, the student confirms the procedure and then describes findings after comparing video A (taken personally before training) with a skilled nurse's model.
4) Using each function of the system, the students confirm the procedure, comparing their own video images before and after training (video A and B) and theirs after training (video B) with the skilled nurse's video. Then they input their own findings.
5) Finally, they conduct intravenous injection again to shoot a video (video C after learning by the learning-support system).

Figure 3. An experimental picture

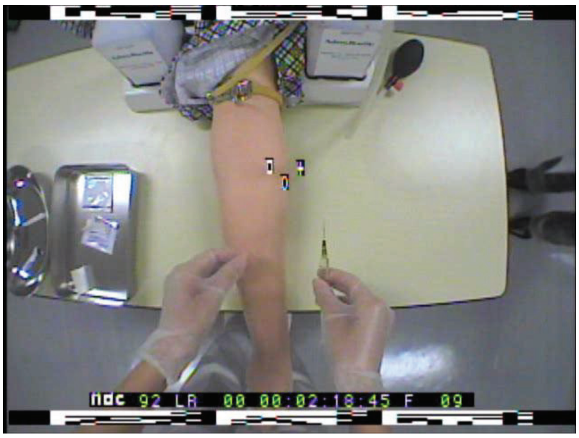

Figure 4. A nursing skill image

3.2 Subjects

The experimental subjects are five senior students who received credit in nursing technique training, including intravenous injection skills, and whose consent to participate in this experiment has been obtained.

4. Results

We analyzed (1) the procedure video shot by the nursing students, (2) the confirmation of whether they succeeded in inserting the needle into a vein precisely, and (3) the content of the interview which we conducted with them. The obtained results are presented as follows.

4.1 Procedures conducted by the nursing students

The numbers of students who made mistakes in the intravenous injection skills are shown in Table 1. The column of items in Table 1 represents the precise procedures used to conduct intravenous injection. The numbers in Table 1 presents the numbers of students who made mistakes while conducting respective procedures (say, skipped it or conducted in reverse order). The result of each situation is explained step-by-step in the following:

1) Before self-training
   Before the students conducted self-training, many procedural mistakes were found overall.
2) After self-training
   Taken altogether, the numbers of mistakes even after training were not so different from those before training.
3) After experiencing the self-learning support system developed
   After comparing video images and learning by the self-learning support system that we have developed, no students exhibited mistakes overall from explanation of injection in procedure (1) to cleanup in procedure (10).

Table 1: Number of nursing students who made mistakes during procedures

proc.	items	before skill training	after skill training	after learning support system
(1)	explanation of injection	1	1	0
(2)	wearing tourniquet	0	1	0
(3)	selection of a vein to insert a needle	1	2	0
(4)	sterilization	1	1	0
(5)	insert of a needle	0	0	0
(6)	check of reversed blood	0	0	0
(7)	undoing tourniquet	3	2	0
(8)	infusion of medical solution	3	2	0
(9)	removal of a needle	2	1	0
(10)	cleanup	0	0	0

4.2 Check whether the needle is precisely inserted into a vein

The students who were confirmed to have succeeded in inserting a needle into a vein precisely were 0 before training, 4 after training, and 5 after comparing video images using the learning-support system.

4.3 Content of the interview which we conducted on the subjects

Regarding the question of what were the key points of intravenous injection skills or what they were careful of while conducting it, all five participants answered, "to confirm the procedure" before training. In contrast, after the video comparison, all participants described not only the procedure but also the content about "selection of blood vessel and support to a patient." Regarding the question as to what they found when comparing their own video and a skilled nurse's, we obtained the comment "I was able to find my mistake clearly. I understood the process of procedures. I was able to see my video objectively." Regarding the comparison between self-videos before and after training, a student answered, "There was almost no change. I know well on what points I failed, even if I tried after self-training. I can understand what I did not do well."
Asked whether they feel their skill was improved through comparing video images, all five participants answered that they think so. In addition to the question about whether they want to learn in the future, we obtained the request "I'd like to use the system that I used this time. After practicing the intravenous injection skill, I'd like to learn from listening to the opinions of the professor and my friends; I want concrete advice from them."

5. Discussion

Regarding procedures, results show almost no improvement after self-training. In contrast, after learning by comparison of the self-video and the model video produced by a skilled nurse, improvement was shown by all participants. They became able to do intravenous injection precisely according to the procedure. It might be that seeing the self-video and then comparing it and the nurse's encouraged participants to have a clear image of the whole process of procedure and to understand it better. Regarding confirmation of whether they succeeded in inserting a needle into a vein precisely, after self-training, four participants were able to do it but they did not improve their procedures. After comparing the video images, however, all five participants succeeded in inserting a needle into a vein according to the precise procedure, suggesting that their skills of intravenous injection were improved. Results of interviews of participants as to what they kept in mind while doing intravenous injection revealed an important change: they have become conscious not only of procedures but also more practical and concrete contents (how to select a blood vessel or support for patients). That might be true because the learners were able to learn by seeing their own skill objectively and by being mindful of their own mistakes or what they had failed by describing their findings and recognizing it formally through video comparison. In other words, video comparisons and finding descriptions, which promoted the nursing students' reflective learning, were found to be effective for skill acquisition support in intravenous injection.
From the explanation presented above, even if self-training exerts some effect on improvement of the skill of "inserting a needle into a vein precisely," it was found to be less effective for improvement of procedures. Furthermore, learning through video comparison had effects not only on knowledge-level improvement such as procedures but also on skill-level improvements such as "selection of a blood vessel and support for patients." Therefore, results suggest that conventional learning using only training can only insufficiently facilitate learners to acquire the procedures of intravenous injection and more practical skills.
Moreover, based on results of the interview after comparing video images, we came to learn that the participants want to know peer nursing students' opinions and thoughts. They examined themselves through video comparison and their questions therefore became

clarified. Consequently, they might have come to know of other people's opinions and learned about them more deeply. Furthermore, they might have come to want to know about their friends with skills of the same level as their own.

6. Conclusion

Results of this study confirmed that conducting a "procedure check, video comparison, and finding description" using the system enabled nursing students to obtain new findings and that it has effects on improvement of intravenous injection skill acquisition. Future tasks are to investigate the effectiveness of the system on more nursing students, evaluate the efficiency of the system in skills other than the intravenous injection, and to facilitate skill learning support for nurses using the system. From these experimentally obtained results, we also know that the nursing students who examined themselves by comparing video images have come to accept better listening to people around them. That is true probably because learners who were more conscious of their questions through introspection, might have wanted to know others' opinion and learn the subject more deeply. Therefore, we must investigate whether it is necessary that learners should share in others' findings after they obtain experience and findings through comparison and subsequent reflection.

Acknowledgements

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Articulation Animation Generated from Speech for Pronunciation Training

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Abstract: We automatically generate CG animations to express the pronunciation movement of speech through articulatory feature (AF) extraction to help learn a pronunciation. The proposed system uses MRI data to map AFs to coordinate values that are needed to generate the animations. By using magnetic resonance imaging (MRI) data, we can observe the movements of the tongue, palate, and pharynx in detail while a person utters words. AFs and coordinate values are extracted by multi-layer neural networks (MLN). Specifically, the system displays animations of the pronunciation movements of both the learner and teacher from their speech in order to show in what way the learner's pronunciation is wrong. Learners can thus understand their wrong pronunciation and the correct pronunciation method through specific animated pronunciations. Experiments to compare MRI data with the generated animations confirmed the accuracy of articulatory features. Additionally, we verified the effectiveness of using AF to generate animation.

Keywords: Animated pronunciation, Pronunciation learning, Articulatory feature

Introduction

Computer Assisted Language Learning (CALL) systems have been introduced for language education in recent years [1][2]. CALL systems typically analyze a learner's speech by using speech recognition technology, and point out pronunciation problems with specific phonemes in words and automatically score the pronunciation quality [3][4][5]. However, although the learner can thus realize that his/her speech is different from the teacher's, the learner cannot understand how to correctly move the appropriate articulation organ. The system should show how to do this when the learner makes a wrong pronunciation, in the same way that teachers teach. On the other hand, although other studies have examined making correct pronunciation animations and video in advance [6][7][8], they do not automatically produce animations of the learner's wrong pronunciation. The proposed system visually represents the teacher's and the learner's articulatory movements (movement of the tongue, palate, and lips) by using CG animations. As a result, the learner can study how to move an articulatory organ while visually comparing their mispronunciation animation with the correct pronunciation animations. To represent the teacher's and the learner's articulatory movements, the proposed system extracts the articulatory features (AFs) from the learner and teacher speeches automatically. Next, the system converts speech from articulatory features into

coordinate distances based on MRI data by two MLN. This paper describes the method of automatically generating animated pronunciations from speech.
In section 2 we describe the method of articulatory feature extraction, coordinate distance extraction and CG animation generation. Section 3 discusses the experimental evaluation to confirm the accuracy of the generated animated pronunciation. The last section summarizes this paper.

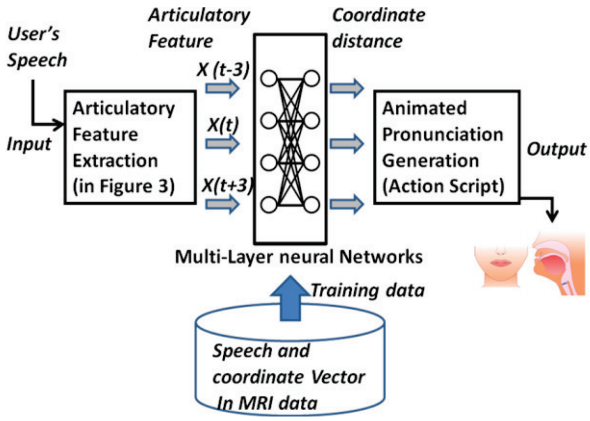

Fig.1: System outline.

1. CG Animation Generation System

1.1 System outline

Figure 1 shows an outline of the system. The system consists mainly of articulatory feature extraction by first multi-layer neural networks (MLN), coordinate distance extraction by second MLN, and CG animation generation programs.
We use the articulatory features composed of place of articulation and manner of articulation extracted from the speech, and use them to generate highly accurate CG animations. Concretely, the articulatory features are extracted from the speech input to first MLN, and the articulatory features and the coordinate distances of the MRI data are trained by second MLN. As for articulatory extraction, we use existing developed technologies as described in the next paragraph. The CG animation is generated based on the y-coordinate distances (Δy) extracted from trained MLN. As a result, the user's speech is input in our system, and a CG animation that visualizes the pronunciation movement is automatically generated.

1.2 Articulatory Feature Extraction

In order to vocalize, human beings change the shape of the vocal tract and move articulatory organs such as the lips, alveolar arch, palate, tongue and pharynx. This is called articulatory movement. Each attribute of the place of articulation (back vowel, front vowel, palate, etc.) and manner of articulation (fricative, plosive, nasal, etc.) in the

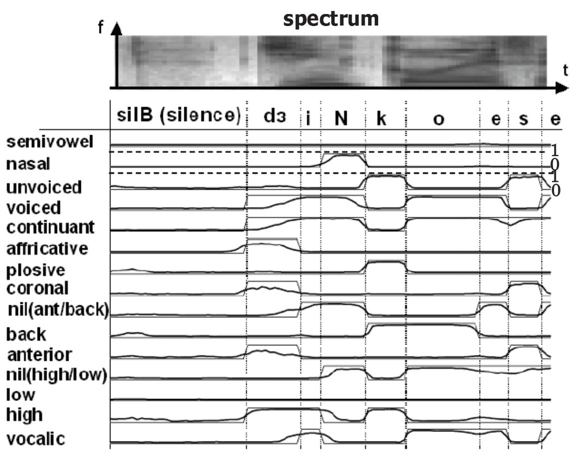

Fig.2: Articulatory feature sequence: /jiNkoese (artificial satellite)/.

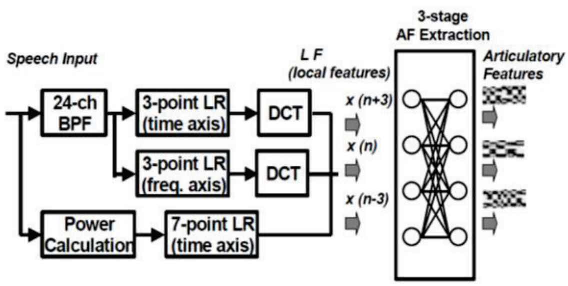

Fig.3: *Articulatory feature extraction*.

articulatory movement is called an articulatory feature. In short, articulatory features are information (for instance, closing the lips to pronounce "m") about the movement of the articulatory organ that contributes to the articulatory movement. In this paper, articulatory features are expressed by assigning +/- as the feature of each articulation in a phoneme. For example, the articulatory feature sequence of "/jiNkoese/ (space satellite)" in Japanese is shown in Figure 2. Because phoneme N is a voiced sound, "voiced" in Figure 2 is given [+] (Actually, [+] is given a value of "1" (right side of Figure 2)) as the teacher signal. Because phoneme k is a voiceless sound, "voiced" in Figure 2 is given [-]. Actually, [-] is given a value of "0" (right side of Figure 2) as the teacher signal and "unvoiced" in Figure 2 is given [+]. We generated an articulatory feature table of 15 dimensions corresponding to 25 Japanese phonemes. We defined the articulatory features based on distinctive phonetic features (DPF) involved in Japanese phonemes in international phonetic symbols (International Phonetic Alphabet; IPA) [10].

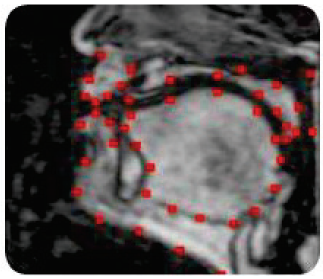

Fig.4: *Feature points on MRI data.*

We also used our previously developed articulatory feature (AF) extraction technology [11]. The extraction accuracy is about 95 %. Figure 3 shows the AF extractor. An input speech is sampled at 16 kHz and a 512-point FFT of the 25 ms Hamming-windowed speech segment is applied every 10 ms. The resultant FFT power spectrum is then integrated into a 24-ch BPFs output with mel-scaled center frequencies. At the acoustic feature extraction stage, the BPF outputs are first converted to local features (LFs) by applying three-point linear regression (LR) along the time and frequency axes. LFs represent variation in a spectrum pattern along two axes. After compressing these two LFs with 24 dimensions into LFs with 12 dimensions using a discrete cosine transform (DCT), a 25-dimensional (12 Δt, 12 Δf, and ΔP, where P stands for the log power of a raw speech signal) feature vector called LF is extracted. Our previous work showed that LF is superior to MFCC as the input to MLNs for the extraction of AFs. LFs then enter a three-stage AF extractor. The first stage extracts 45-dimensional AF vectors from the LFs of input speech using two MLNs, where the first MLN maps acoustic features, or LFs, onto discrete AFs and the second MLN reduces misclassification at phoneme boundaries by constraining the AF context. The second stage incorporates inhibition/enhancement (In/En) functionalities to obtain modified AF patterns. The third stage decorrelates three context vectors of AFs.

1.3 Coordinate Distance Extraction

We use the magnetic resonance imaging (MRI) data to map AFs to coordinate values that are necessary to generate CG animations. MRI captures images within the body by using magnetic fields and electric waves. We used MRI data captured in three dimensions, which shows in detail the movements of the person’s tongue, larynx, and palate while making an utterance. CG animations are generated based on coordinate distances. Concretely, MLN inputs AFs extracted from speeches included in the MRI data and outputs coordinate distances. As a result, after the user’s voice is input, the coordinate vectors adjusted to the speech are extracted, and a CG animation is generated based on them. This section describes the extraction of the feature points on the MRI data and the method of calculating the y-coordinate distance from them.

We assigned feature points to the mouth shape on the MRI data (tongue, palate, lips, and lower jaw) beforehand. To generate CG animations automatically, the proposed system uses the distance of the y coordinate of each feature point. We assigned 15 tongue points, 2 lip points, and 18 palate points as the initial feature points in view of the frequency of movement of the articulatory organs. Figure 4 shows these feature points.

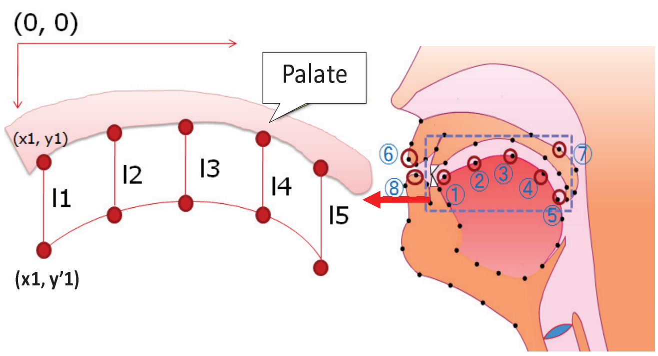

Fig.5: Feature point used in MLN training.

The relative, not absolute, coordinate distance is used for CG animations because the feature points of each articulatory organ in the MRI data vary among individuals.

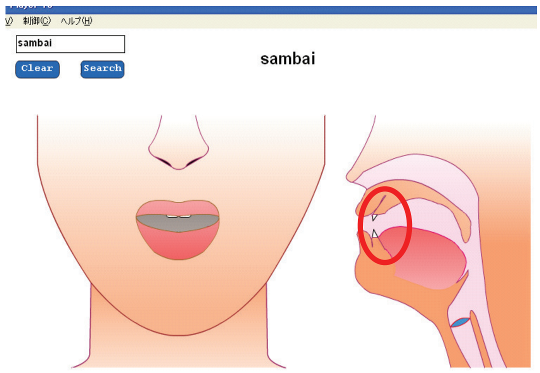

Fig.6: CG animation of *pronunciation*

The coordinate distances are extracted as follows. Firstly, we imported 10-ms speech and image segment in the MRI data because speech segment is 10 ms. The coordinate value of each feature point is extracted by the optical flow calculation program for each frame. The input data for the program is the MRI images and coordinate vectors of the initial feature points. Next Acquisition of many MRI data costs time and money, so we decreased the number of dimensions of MLN training data in order to train MLN effectively by even a small amount of MRI data. Therefore, only eight feature points having large changes in movement are trained in MLN (Figure 5). Moreover, the proposed system calculates only the y-coordinate distance of each feature point used as MLN training data to decrease the number of dimensions. The y-coordinate distance is calculated by subtracting y from y'. The x-coordinate value is the same as x-coordinate of the initial feature point (Figure 5). That is, the distance is calculated only the y-axis.

Specifically, to fix the palate with a little movement and to acquire the change of the uvula, we set feature point ⑦. Moreover, to express the movement of the tongue, the system determines the distance of the y coordinate (Δy) from feature point ① to feature point ⑤. To acquire the movement of the lips, the change in y-coordinate distance (Δy) between feature point ⑥ and feature point ⑧ was calculated. The spline curve mainly supplements the y-coordinate distance (Δy) of other initial feature points based on the above-mentioned eight points. On the other hand, to consider co-articulation, the system calculates the y-coordinate distance of the preceding and subsequent frames (t-3, t+3) in each frame (t), and trains these data in MLN. That is, the output of MLN is 8×3 dimensions.

Next, we explain the training method of MLN. AF is obtained by converting the speeches that accompany the MRI data. MLN projects the extracted AF to the y-coordinate distance. The number of dimensions of MLN is articulatory features (15×3 dimensions) as inputs and y-coordinate distances (8×3 dimensions) as outputs.

1.4 CG Animation Generation Programs

We used the moving average method, spline curve, and median filter to construct smooth CG animations by using the y-coordinate distance extracted from MLN.

Firstly, the system smoothes the movement of the tongue, palate, upper lip, and lower jaw by the moving average method to average the coordinate vectors of each frame. Moreover, the spline curve is used to complement between 8 feature points (training by MLN) and other feature points. This generates a CG animation having a smooth curve and movement. The movement is drawn based on the y-coordinate distance, but it moved twitchily, so we used a median filter to smooth the movement. The median value means the intermediate value when it is arranged finite data in descending order. The present study outputs as the median value the intermediate value of five data: the y-coordinate value of the third frame is used as the median value when the coordinate values of five frames are sorted in ascending order.

The pronunciation learning system is designed to play CG animations on a web browser so that various users can use it.

The CG animation program was implemented with Actionscript3.0 to operate on a Web browser with a Flash Player plug-in installed. Figure 6 shows a screen shot of a CG animation developed in the present study. The animation can be played slowly at half speed. Users can see the pronunciation in slow-motion by adjusting the play speed

Table 1. Words and syllables included in MRI data

Japanese vowels and consonants	/i/ /u/ /e/ /o/ /ka/ /ki/ /ku/ /ke/ /ko/ /sa/ /si/ /su/ /se/ /so/ /ta/ /ti/ /tu/ /te/ /to/ /na/ /ni/ /nu/ /ne/ /no/ /ha/ /hi/ /hu/ /he/ /ho/ /ma/ /mi/ /mu/ /me/ /mo/ /ya/ /yi/ /yu/ /ye/ /yo/ /ra/ /ri/ /ru/ /re/ /ro/ /wa/ /ga/ /gi/ /gu/ /ge/ /go/ /za/ /zi/ /zu/ /ze/ /zo/ /da/ /di/ /du/ /de/ /do/ /ba/ /bi/ /bu/ /be/ /bo/ /pa/ /pi/ /pu/ /pe/ /po/
Contracted sounds	/k ya/ /kyu/ /kyo/ /sya/ /syu/ /syo/ /cya/ /cyu/ /cyo/ /nya/ /nyu/ /nyo/ /hya/ /hyu/ /hyo/ /mya/ /my/ /myo/ /rya/ /ryu/ /ryo/ /gya/ /gyu/ /gyo/ /zya/ /zyu/ /zyo/ /bya/ /byu/ /byo/ /pya/ /pyu/ /pyo/
Sound of the kana /N/	/saNbai/, /saNdai/, /saNnin/, /saNko/, /saNen/, /saNwari/, /saNsai/
Double consonant /Q/	/iQpai/, /iQtai/, /iQko/, /iQsai/, /iQsyo/, /iQtu/, /iQcho/

2. Evaluation

We calculated the correlation coefficient between the coordinate values of generated CG animations and MRI data to confirm the accuracy of the animations. Moreover, to show the effectiveness of using articulatory features to extract coordinate distances, we compared the correlation coefficients of the case of AF with the case of LF as MLN inputs.

2.1 Experimental Setup and Method

We used MRI data pronounced by a 39-year-old Japanese male who specializes in Japanese-language education and who has received phonology training. The data is consisted of pictures and Japanese speeches when the subject pronounced in an MRI machine.

We used 5 vowels and 99 syllables, 11 words as MLN training data and 3 words ("sandai," "sanbai," "sanko") as test data among 41 Japanese words included in the MRI data. Table 1 shows the Japanese MRI data used by MLN.

Each MLN has three layers. The number of input layer is 75, hidden layer is 150, and output layer is 45 in the first MLN to extract AF. The number of input layer is 45, hidden layer is 90, and output layer is 24 in the second MLN to extract coordinate distances.

2.2 Experimental Results

Here, we discuss mainly the results of three words with the kana /N/ because the pronunciation movement of this sound differs according to the back phoneme. As a typical example, /N/ in "sanbai" is the same as the nasal sound of the English /m/ with both lips shut. As for /N/ of "sandai," it is the nasal sound when uttering with the tongue tip touching the alveolar ridge behind the anterior teeth as in the English /n/. The /N/ of "sanko" is created without the tongue tip touching the alveolar ridge behind the anterior teeth unlike /N/ of "sandai". It is the nasal sound that is made by stopping the flow of air to the mouth and breathing out from the nose. When uttered, the back of the tongue rises just a little. We evaluated whether the animated pronunciation including /N/ was accurately generated according to the different back phoneme. Thus, the experimental method compared the correlation coefficient of the coordinate value of CG animation automatically generated from the speech and the coordinate value of the MRI data for each frame for three words. The key point is that these three words are not trained in MLN.

Firstly we calculated the correct rate of AF that is important to generate CG animation (Figure 7). Although the overall average was about 82%, it is necessary to improve AF extraction because the correct rate of /d/ was low. Next we also compared LF with AF as the input of the second MLN to

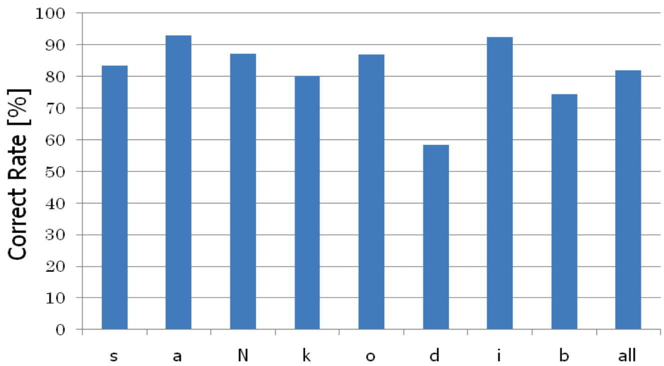

Fig.7: AF correct rate for each phoneme.

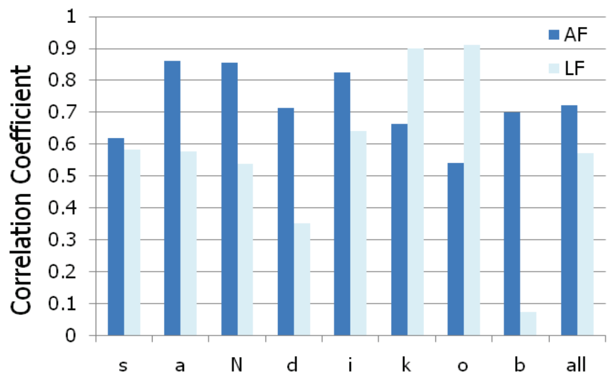

Fig.8: Correlation coefficient for each phoneme.

ph

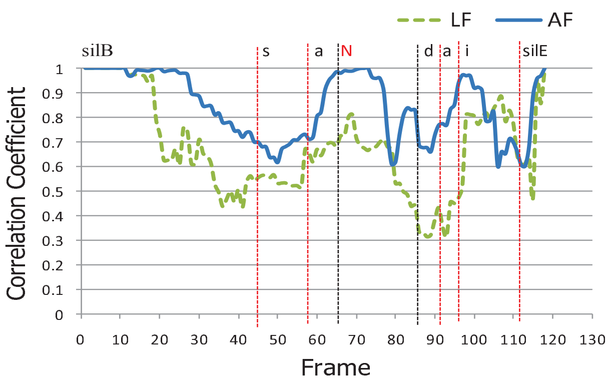

Fig.9: Correlation coefficient of “sandai”.

show the effectiveness of using AF extracted from speech. Figure 8 also shows the results of them. The all in Figure 8 is average correlation coefficient of target phonemes. AF shows a higher correlation coefficient than LF overall. The results showed the pronunciation movement was expressed more accurately by mapping the speech to the articulatory feature. Although the pronunciation movement of /N/ differs according to the back phoneme (that is coarticulation), the result of /N/ is about 0.85 which is high. The results showed that the proposed system can accurately generate CG animations while considering coarticulation. Although the AF correct rate of /o/ in Figure 7 was high, its correlation coefficient in Figure 8 was not good. Therefore, it is important to improve second MLN. Figure 9 shows the correlation coefficient per frame. The change rate of the correlation coefficient in a phoneme boundary is large depending on phoneme (Figure 9)・As for /N/, the correlation coefficient decreases rapidly from around 80ms. The small amount of MRI data was used in this experiment. To generate more accurate animation, we intend to use more MRI data in future. Moreover, we will generate not only Japanese animation but also English animation by using English MRI data.

3. Conclusions

We developed a system to automatically generate CG animations to express pronunciation movement through articulatory features extracted from speech. The pronunciation mistakes of the user can be pointed out by expressing the pronunciation movements of the user's tongue, palate, lips, and lower jaw as animated pronunciations. We conducted experiments which confirmed the accuracy of the generated CG animations. The correlation coefficient was more than about 0.7, and we confirmed that smooth animations were generated from speech automatically. We will also improve the system to make the animation motions more natural, and build a pronunciation instructor system including the CG animation program. In the future, we will conduct experiments to compare AF and MFCC as the inputs of MLN.

Acknowledgements

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Trial Development of A Peer Evaluation System of Presentation Skills Using Web

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Abstract: Presentation skills have recently become essential in many business situations, and a number of tertiary educational institutes have introduced presentation activities into classes. Feedback from the audience is very important in the development of individual presentation skills, but a speaker and an audience do not always have enough time available to watch and evaluate the presentation. Consequently, we have developed a system to improve presentation skills by using the Web. Presentation videos uploaded to the Web site enable peer evaluation, and analysis of video sound can evaluate speech rate and pause information. In this system, a user can not only see the evaluation or the reviews of his/her presentation by other users and features of his/her speech, but can also realize the process of improvement of his/her presentation skills by repeated practice or modification. Enhanced presentation skills are developed because the learner can practice through understanding the variations in the evaluation of his/her presentation in graphic form. We have assumed that the learner is a student who is practicing for a presentation of his/her study, and the reviewers are peers or his/her adviser.

Keywords: Presentation skill, Web, Video, Peer evaluation, Speech analysis

Introduction

Recently, presentation skills have become essential in various business situations, and a number of tertiary educational institutes have introduced presentation activities into classes. Feedback from the audience about content, visual aids such as slides, voice, and other aspects of performance is very important for developing presentation skills. Furthermore, a presenter must rehearse repeatedly in response to the feedback, if his/her presentation is to be improved. Repeated rehearsal and review from advisers or peers is particularly important for students or beginners. However, it is often difficult for students and reviewers to find enough time to watch and critically evaluate the presentation.

As a result, several systems that provide feedback efficiently from audiences have been introduced to assist in the development of presentation skills e.g. [1]-[4]. The systems developed by Yamashita et al. [1] and De Grez et al. [2] enable presenters to view audience evaluation immediately, in some graphic form of data sent by response devices. Miyawaki et al. [3] and Shibasaki[4] developed systems that can distribute presentation videos and can send reviews of presentations, to make the review process more efficient. However, although learners can get feedback from audiences in these systems, it is not easy for them to recognize how much their presentations have been improved by repeated practice.

Conversely, according to Yamashita et al. [5], using good presentations as models helps learners become aware of improvement in their skills by self-learning.

As described above, the goal of this study is to develop an e-learning system with four presentation-training functions, as follows:

1) Watch presentation movies, input reviews from peer evaluation and display evaluation results in a graphic form.
2) Automatic evaluation of presentation speech by sound analysis.
3) Display presentation history as thumbnails and show variations in evaluation using graphics.
4) Search for good presentations and watch them.

The aims of the above functions are: 1) improving efficiency; 3) identifying and understanding learning effects; and 2) and 4) supporting independent learning. Functions 2) and 3) are particular features of this system. Function 2) evaluates vocal performance from different perspectives. A presentation is not valuable if it doesn't interest the audience, even if its content may be important [6], so we have also given priority to improvement of speech. In addition, a higher learning effect can be expected by using functions 3) or 4). In this paper, we describe a prototype system in which functions 1) to 3) have been implemented and tested.

1. System Outline

1.1 System Configuration

The system configuration (Figure 1) consists of a Web server and several client PCs. Apache, PHP and MySQL are installed on the Web server, and the MySQL database is used to manage user information, video files, and evaluation data. In addition, the server uses FFmpeg [7] for video conversion or extraction of speech sound from the video, and uses Julius [8] as a speech recognition (SR) engine for automatic evaluation of speech. The client PC for the learner or reviewer requires a web browser with a Flash player. The learner also needs a video camera or software that can convert his/her presentation into a video file such as Microsoft PowerPoint 2010.
We assumed that this trial system would be used within a limited network such as an intra-school LAN.

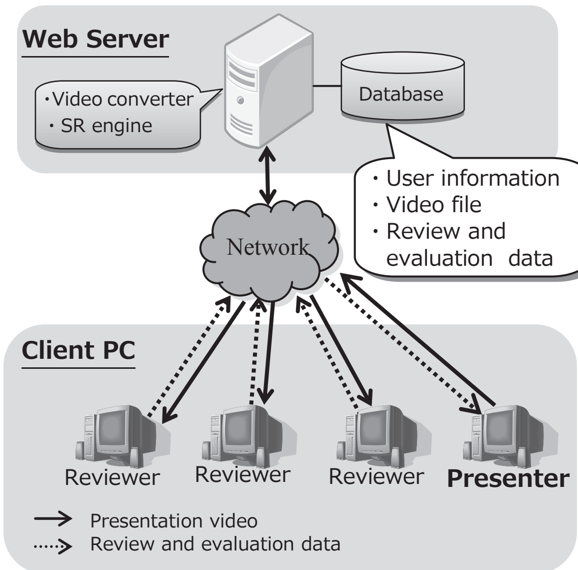


Figure 1: System Configuration

1.2 Using the System

The top page of this system (Figure 2) displays thumbnails linked to video files uploaded by users. The sequence of usage for a learner and a reviewer are described below.

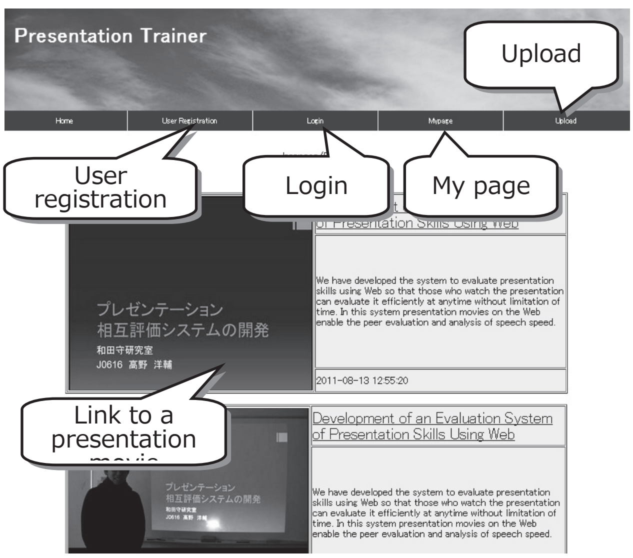


Figure 2: Top Page

After login, a learner selects "Upload" on the top page, and the upload page shown in Figure 3 is displayed. The learner selects a video file, inputs the information required, and uploads it by clicking the "upload" button. The learner then accesses "MyPage" to see the evaluation of his/her presentation. Since we assumed that there will be multiple rehearsals for a presentation event, video thumbnails are displayed separately for each event. For example, when four presentation videos for the interim report on his/her graduate study are uploaded, the four videos are displayed with dates, as shown in Figure 4. The evaluation of these videos is also displayed in graphic form on the left of Figure 4, in time order. This enables the learner to recognize how repeated practice or modification has improved his or her presentation. In addition, by clicking on the presentation image on the right of Figure 4, the learner can understand the detailed evaluation of his/her presentation, by access to the page to watch the video and to see the evaluation. It is assumed that the learners are college students or beginners.
After login, a reviewer clicks on the selected video from the thumbnails of presentation videos on the top page, and accesses the “Watch and Review” page as shown in Figure 5. Before watching the video selected as described above, the reviewer must click the "Create your review" button to display the page for input of comments and rating as shown in Figure 6. After the window appears as a separate display, the reviewer can watch the video, and

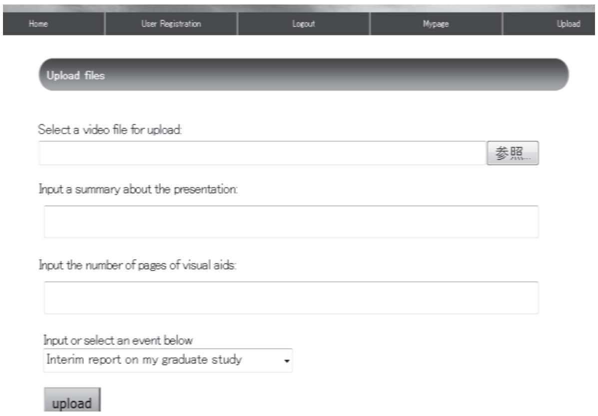


Figure 3: Page for uploading a Video File

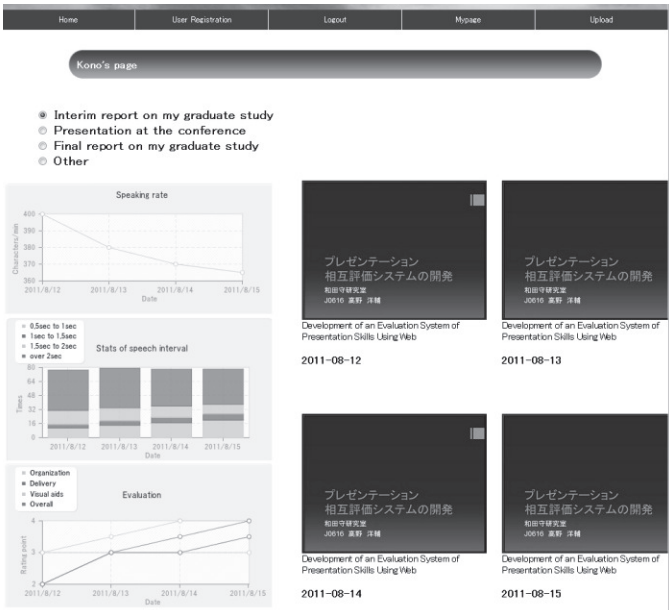
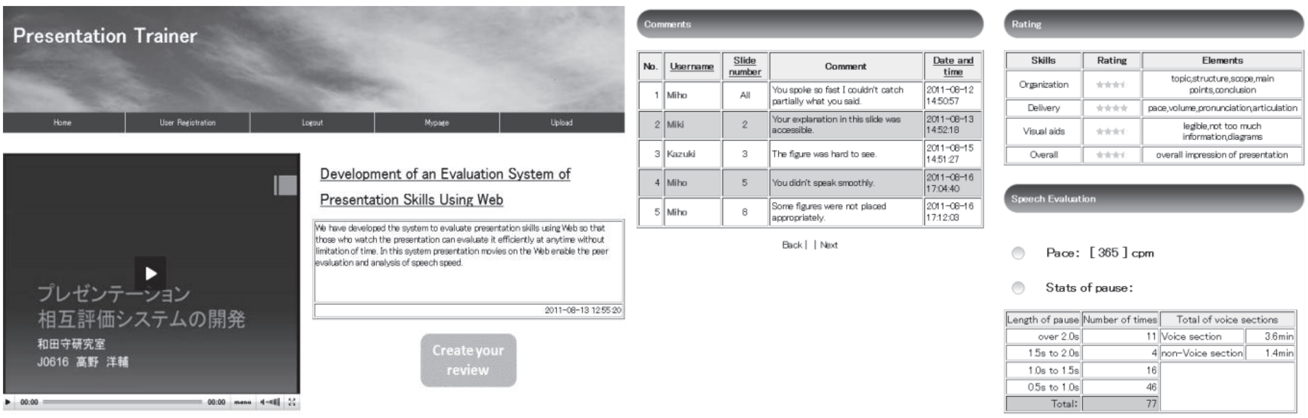


Figure 4: My Page



(a) Upper part of the page (b) Lower part of the page

Figure 5: Page for watching and reviewing a video file

input comments in parallel. He/she should input the comments about the presentation slide or speech and use the five-grade rating of the evaluation items, as described in the next section. The evaluation results are saved to the database and the presenter's "MyPage" is updated. It is assumed that the reviewers are peers or advisers of the learner.

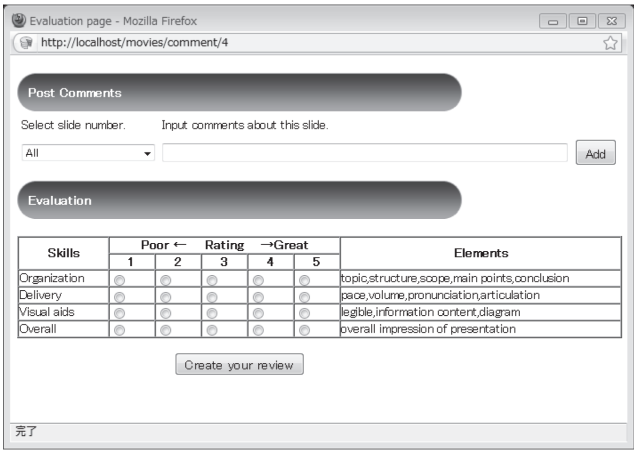


Figure 6: Page for inputting comment and rating

2. Evaluation of Presentation

2.1 Peer Evaluation by users

Reviewers can evaluate the presentation slides or speech by inputting comments for a specific slide number, as shown in Figure 6. Overall evaluation or advice for a presentation is input when "All" is selected. In addition, reviewers should give a rating of their impression of the presentation, using the 5 tier rankings as at the bottom of Figure 6.
In this system, four elements of presentation have been selected for rating: organization, delivery, visual aids and overall impression. A feature of the system is that a learner can understand the effect of his/her own learning efforts by seeing the variation of evaluation. In the future we will consider additional evaluation elements to increase the learning effect or motivation of learners, and will add or modify these elements within the system. Although reviewers can make evaluations at a time convenient to themselves, the input is time consuming. Consequently, improvement of user interfaces will be needed to make them as efficient as possible.

2.2 Evaluation by Speech Analysis

One of the main features of this system is that it can analyze speech sound and calculate speech evaluation data automatically. This enables the learner to gain not only a subjective evaluation from reviewers, but also objective data. Although there are many potential elements to speech evaluation, for this system only simplified methods of speech rate and pause information were adopted.
First, we will explain the speech rate calculation method. Speech rate is an important element affecting comprehension of the audience. In this system, we use a calculation method in which we suppose the number of characters (average) in Japanese per minute, as speech rate by SR using Julius. Slow speaking rates do not necessarily result in good audience comprehension. However, by comparing their performance with other presenters or by understanding the variation in their speaking speed after practice, creates learner awareness. Furthermore, when speaking speed is extremely slow, speakers should question their articulation, because the number of characters by SR is much reduced below the actual rate if articulation is indistinct. While it is difficult to calculate speech rate correctly, it has potential in evaluation of articulation. It should be noted that, at present, the evaluated speech rate cannot be displayed for each slide, as it is calculated as an average value over an entire presentation. Therefore, we will implement some functions such as synchronization between evaluation and a presentation video in the future system. This will provide more detailed information.

Second, we will explain the method of calculating pause information. Pausing is an important element if the audience is to understand the presentation, and presenters sometimes use pauses intentionally, to attract the attention of the audience. Therefore, it is important to understand how pauses are made in a presentation whether they are for comprehension or to gain attention. In this system, pause information has been classified into four intervals: 1) 0.5 - 1.0s, 2) 1.0 - 1.5s, 3) 1.5 – 2.0s and 4) over 2.0s, and the statistics of non-voice sections throughout the presentation are displayed. This does not provide direct clarification of whether the speech is good or bad but a learner can understand the variations in their pause patterns during repeated practices for an individual presentation event. This means that a learner can understand from his/her point of view whether they speak fluently or not, and whether they are using pauses effectively. We will improve the system to create synchronization between pause information and slides or speech sound.
Additional improvements will include incorporating evaluation criteria such as volume and intonation to increase the learning effect, since at present only speech rate and pause information are available.

3. Training Methods of Presentation Skills

We will describe the presentation skills training methods to be realized.

3.1 Being Aware of Learner's Own Ability

First, after uploading his/her presentation video to this system, a learner becomes aware of his/her presentation ability by seeing the reviews from other users, and the objective speech analysis of his/her presentation. Although interactive discussions between a presenter and the audience are more effective than one-way evaluations by the audience, in this system we have adopted the method of comment input regarding presentation or slides on the Web, to reduce the burden. Reviewers can add comments piece by piece at their convenience, and may input only the five-grade rating if they do have not enough time to complete the entire evaluation. This should result in a presenter getting more reviews or ratings, but it is still difficult to review sufficiently. Furthermore, although it takes considerable time to re-evaluate whenever presentation videos are uploaded, a learner can see only evaluation by speech analysis when uploads are repeated.
As described above, the learner should become aware of their individual presentation ability and understand the points to be improved.

3.2 Repeated Rehearsal and Improvement

After the learner has recognized the areas for improvement, they should practice or modify their presentations based on those points. Specifically, the content or organization, modification of slides, and speaking practice should be reconsidered. Following that, the learner should rehearse again, record his/her presentation and upload it to the system. It is then re-evaluated, and the evaluations are added to the graphs on his/her "MyPage". After practice or modification, the learner can then understand what has improved compared with their previous presentation, so that they can make use of that during the next rehearsal. The system thus increases not only effective learning, but also motivation.

3.3 Following Model of Presentation

Comparison with good presentations is useful in that a learner has a model to follow. In this system, a user can view videos of other users and can see their evaluations. The user can also follow the history of a presentation, which has gained a good evaluation on features such as the design of slides, use of diagrams and speech. This helps him/her to consider the points for improvement after understanding the evaluation of his/her presentation. However, a search function for uploaded presentations needs to be added to the system in the future.

4. Conclusions

We described the trial system in which a user can develop his/her presentation skills efficiently by peer evaluation of presentation video and by speech analysis on the Web. This system helps a learner to practice and modify repeatedly seeing the effect of his/her own efforts. Furthermore, a learner can also refer to other users' presentation to improve his/her presentation. We will improve the system to be more useful for such aspects as speech evaluation, how to input reviews or evaluations and a search function for good presentations. In the future, we will conduct experiments to evaluate this system and improve its usability.

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Learning and Training with Force Feedback for an Acupuncture Education System

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Abstract: It is mostly important in acupuncture to become highly skilled by training with repeated practice. However, such practice can hardly be done on a real human body, which may always be accompanied with pain and misery. In this study, a computer training system with force feedback for acupuncture was proposed. A human acu-points model with acu-point name, position, meridians, stinging techniques and healing functions was created within the computer, and devices with force feedback functions for skill training were used in the system. A trainee gets acupuncture experience not only by visual information, but also from sensing the force information with a true-false judgment of his movement being real-timely given during the exercise.

Keywords: Acupuncture, Computer Learning and Training System, Force-feedback, Training Environments for Skills, Quantification of Technique

Introduction

Acupuncture is an ancient Chinese healing method in which stimulations are applied to the acupoints (defined position on the human body), leading to an increase of the healing power of the human himself and the recovery of the sickness [1]. Recently, acupuncture has been paid more attention worldwide, so the Acupuncture of Chinese Medicine has been registered in the humanity national intangible cultural heritage list by UNESCO in November 2010. Although the miraculous ancient Chinese healing method has still some parts not yet being explained scientifically, it is used with increased worldwide interests, and even an Acupuncture Universities has been established in Japan [2].

It is important in acupuncture, similar as most of the oriental medical treatments, to use fully the human 5 senses, and to become skillful mainly by repeated exercises [3]-[5]. However, there are problems in learning and training for acupuncture, such as the lack of clarity in the textbook, the difficulties for a judgment of the accuracy when stinging an acu-point, and so on. Thus, the development of an acupuncture training system using the advanced computer technology can be of great help [6].

We have been doing researches on the development of a computer-assisted acupuncture training system for quite a long time. In this study, we reported an improvement on such system. An acu-point human body model was created within a computer, with which the study of recognition of correct 3D acu-point position, and the sting action on them was done with a true-false judgment. When building up the system, we paid more attention to the representation, teaching and training of the tiny operation force applied in the sting action.

The teaching of the insertion angle and insertion speed for a sting operation on an acu-point using a mechanical force feedback system was proposed [7]-[11].
As one of the series researches for the training system, this study reported an improvement on the system by introducing a haptic device PHANTOM. The teaching of the tiny force adjustment in sting was studied with the system, and the results were tested by repeated exercises of trainees with real-timely true- false judgments.

1. Learning and Training of Acupuncture Skills

1.1 Needle Therapy

Acupuncture therapy is a medical treatment using acupuncture needle or moxibustion to stimulate the acu-points of body according to the symptoms. An acu-point is the defined point on the human body, going to receive the needle with proper stimulus. There are hundreds of such acu-points located on the important positions over the human body on the meridian. And the meridian is such an imaged flow (you may not see them) connecting the acu-points to the internal organs. Therefore, it is very important to find the correct position of the acu-points, and the proper stimulus for the highest healing effect.
That is, the acupuncture education requires both a textbook for memorizing, and repeated practice/exercises to master the skill. With the help of advanced computer technology, a better training effect can be expected using the textbook with the series of processes of basic theory, case prehension, treatment policy, acu-points combination and handling, which are systematically combined with a computer.
Acupuncture has techniques of not only holding and insertion, but also those of stinging, trail, whirl, according to different symptoms (Fig. 1). It is further required for good healing to use different techniques such as the stinging angle, the speed, and the depth upon different acu-points for each symptom. Therefore, it is especially important to be trained by repeated practice.

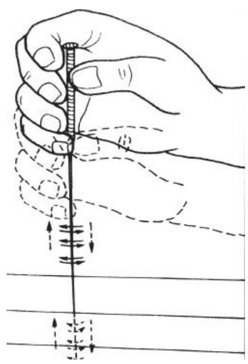

Fig. 1 Normalized of vertical needle speed

1.2 Training with Force Feedback

The proposed system can be roughly divided into two parts. One is the software for teaching and explanation of the sequence of basic theory, case prehension, treatment policy, acu-points combination and handling. The software contains detailed description on the names, position, depths of meridian and meridian point, and its flow or moving, some are demonstrated by 3D expressions for a better understanding. Another, and one of the most important things in the acupuncture training, is the development of a training system with force feedback function with a precise correspondence to the acu-point model. For such a system with force feedback function, firstly, information of operation forces from well-experienced doctors are measured and stored in the computer as a training index. Then,

training functions are input to the computer based on the human model and basic techniques of acupuncture.
A trainee is trained, using the system with force feedback, to master the basic techniques such as the methods of holding, stinging, and so on (Fig.1). He gets the correct feeling by repeated practice referring the standard from well-experienced doctors. The system has the character of real-timely response, giving a true-false judgment during the practice. The results are evaluated by the computer.
As stated above, while the former part can be found a lot in the E-learning or database fields, the latter part is quite few because of being a kind of practice training accompanied by technical difficulties. This study has paid attention to the latter, and experiment was done for a development of a computer training system for acupuncture. In this paper, the construction of a training system using force feedback device PHANTON was done, and the problems and perspectives were addressed.

2. The Acupuncture Training System

2.1 System Construction

A 3D human acu-point model was created on a computer. A training system was constructed upon the 3D model. The schematic of the system composed of a computer (XPS6, 30Dell) for simulation, a monitor to show the information, and a haptic device (PHANTOM Omni®. SensAble Technologies, Inc.), and the software of OpenHaptic toolkit, is shown in Figure 2.

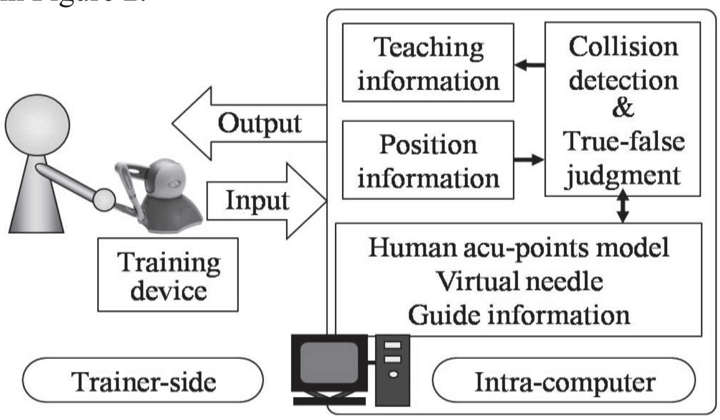

Fig.2 The construction of the training system

Computer system development environment is shown in Table 1.

Table 1 System development environment

OS	Window XP
CPU	Pentium4 2.8G
Memory	480MB
Video card	OpenGL compatible video card
Interface	IEEE1394 Board
Haptic devices	PHANTOM Omni
Software	Microsoft Visual Studio 6.0 OpenHaptics Toolkit version 2.0

2.2 *Haptic Devices- PHANTOM-*

The PHANTOM is a 3D input-output haptic device capable of force interaction with high precision. The interaction between a 3D object and the operator makes it possible to present not only visual but also force information. The reaction force from the hand when touching an object, therefore, can be real-timely represented, to achieve a high operational effect with real-time response.

The PHANTOM Omni model (Fig.3) is one of the most high cost-effective haptic devices available today. Portable design, compact footprint, and IEEE-1394a FireWire® port interface ensure quick installation and ease-of-use performance. The PHANTOM Omni specification is shown in Table 2.

Fig.3 PHANTOM Omni haptic device

Table 2 PHANTOM Omni specification

Model	**Model The PHANTOM Omni Device**
Force feedback workspace	~6.4 W x 4.8 H x 2.8 D in > 160 W x 120 H x 70 D mm
Footprint Physical area the base of device occupies on the desk	6 5/8 W x 8 D in ~168 W x 203 D mm
Weight (device only)	3 lb 15 oz
Range of motion	Hand movement pivoting at wrist
Nominal position resolution	> 450 dpi ~ 0.055 mm
Backdrive friction	<1 oz (0.26 N)
Maximum exertable force at nominal (orthogonal arms) position	0.75 lbf. (3.3 N)
Continuous exertable force (24 hrs.)	> 0.2 lbf. (0.88 N)
Stiffness	X axis > 7.3 lb/in (1.26 N/mm) Y axis > 13.4 lb/in (2.31 N/mm) Z axis > 5.9 lb/in (1.02 N/mm)
Inertia (apparent mass at tip)	~0.101 lbm. (45 g)
Force feedback	x, y, z
Position sensing …………… **[Stylus gimbal]**	x, y, z (digital encoders) ……………… [Pitch, roll, yaw (± 5% linearity potentiometers)]
Interface	IEEE-1394 FireWire® port: 6-pin to 6-pin*
Supported platforms	Intel or AMD-based PCs
OpenHaptics® SDK compatibility	Yes

The PHANTOM is equipped with position sensors capable of doing precise force operations. A reactive force corresponding to the hand movement is produced by reverse rotating of inner motors to wind the wires. A 3D force vector is output on the tip of the stylus by controlling the torque of the DC motor. The maximum force output is 3.5N. A high rate of input-output change is achieved by 1 kHz high speed processing. The PHANTOM was then introduced into the system considering such characteristics. Acupuncture training with high reality, most near the practical sting, is expected with the system.

3. System Functions

The functions of the system can be that to provide information on both visual and operational (force) at the same time, satisfying the skill training with presence.

3.1 Presentation of the Information not Visible in the Real World

The precise positions of the acu-points, which are usually invisible on the human body with the human eyes, can be easily displayed on the 3D model on a computer. The acu-points of a human body in the ordinary textbook are described in a 2D form so it is difficult to identify the 3D information (such as the depth of the acu-points). The developed system, however, is with the ability to demonstrate 3D information because of the use of a 3D human body model, resulting in a highly improved understanding of the 3D position of acu-point including the depth and the relationship with the surrounding organs, which has not been possible in the conventional training.

3.2 Repetitive Training with Force Feedback

It is easy to use the system to carry out exercises repeatedly almost without limitation, which is very important for learning and training skills of acupuncture in contrast to the conventional training using human body. In conventional training process, a trainee usually learn technique by sting the points of himself or between the trainees each other and this may lead to a resistance or fear to continue further the acupuncture practice.

A trainee is trained, using the system with force feedback, to master the basic techniques with tiny force operations such as the methods of stinging, insertion, holding, and so on. He gets the correct feeling by repeated practice referring the standard from well-experienced doctors. The system has the character of real-timely response during the practice. The results are evaluated by the computer.

3.3 True-False Judgment in Real Time

A precise judgment of a correct stinging to the proper acu-point position with the proper force has been difficult in the conventional training method, while it can be easily and real-timely done with the developed computer system. Using the device with force feedback on hand movement promotes the training towards the most practical one. It is also possible to do reliable true-false judgment on a sting using the computer system, because a beginner is difficult to judge the correct force used to sting into an acu-point. A trainee gets acupuncture experience not only by visual information, but also from sensing the force information with a true-false judgment of his movement being real-timely given during the exercise. The teaching of the tiny force adjustment in sting was studied with the system, and the results were tested by repeated exercises of trainees.

4. Conclusions and Future Work

In summary of this research, a computer training system for acupuncture with force feedback functions was proposed. An acu-point model with precise name, position, flow, sting techniques and healing function, was created on a computer. The information on each operation, especially the tiny force adjustment was obtained and made visualized on the computer. A trainee gets experience not only by visual information, but also senses the force information with a true or false judgment of his movement being real-timely given during the exercise. The system has the character of doing exercise repeatedly without pain, and the ability of reducing operation mistakes at low cost, even with more information not yet possible in reality. The system is expected to contribute to a successful training of acupuncture doctors through the realization of the series processes of study of the basic theory, case prehension, decision of the treatment policy, acu-points combine and technique training on computer.

One of the research subjects for the next step is the enrichment of the acupuncture data base and training-related environment. The quantification of operation force has to be done in more detail using the system by more experiments and analysis. For this purpose, more operation data from the experienced doctors are to be introduced as the standard for training. Further, evaluation and score-taken of the trainees are to be added. Continued studies are carried on towards the realization of a simulation system capable of quantitative study, training, evaluation etc.

Acknowledgements

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Sizhi: Self-Dialogue Training through Reflective Case-Writing for Medical Service Education

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Abstract: In this research, by developing the learning support system for medical services, we will establish an approach that supports the medical profession novices to improve the proficiency of view of patient-centered medical services. In this paper, as a first step of the project, we organized a learning model which promotes reflective learning the case-method for medical service education. As an implementation of the learning model, a learning environment that support learners to reflect on their thinking process in their experiences by a learning strategy which consists of three case-writing phases: the description phase, the cognitive conflict phase, the knowledge building phase.

Keywords: Case-Method, Ontology, Medical Service Education

Introduction

There are always many difficult problems continually appearing in various viewpoints in medical practice. Actually, the medical staffs always feel a vague anxiety that their dedicated efforts could not catch up with the increasing amount of the problems. Moreover, to provide the high quality medical services that can respond to the various and high-degree increasing patients' demand is becoming an important and urgent issue in medical service practice. The subjects in medical service education in a broad sense include both the medical knowledge/skills for the medical diagnosis or the treatment and one for the interpersonal skill to facilitate the prompt and smooth implementation of medical services. In this research, we focus on the latter as the matter of medical service sciences in a narrow sense, while we address the former as the matter of "medical education" and will not be deeply involved in it.

We believe that the service science approaches can make a contribution to establishing a methodology to improve the quality of Medical Services in a narrow sense. The one of the pioneers in the field of Service Science, Yoshikawa has proposed that the model for service improvement is that the knowledge circulation of intellectual collaboration by the persons concerned in the service promotes to create and refine the service knowledge. Moreover, he implies that the knowledge circulation will cause the ideal of society innovation [1]. In the medical viewpoint, we think it is necessary to refine the education approaches for supporting the medical knowledge circulation by improving the medical practitioners' thinking ability to collaboratively create and refine the medical service knowledge.

In this research, by developing the learning support system for medical services, we will establish an approach that supports the medical profession novices to improve the proficiency of view of patient-centered medical services. The current goal of this research is to make a rational learning model for medical service education and try to establish a methodology to conduct the design loop for the medical service educational program development but not to make strong contributions to technological medical service education.

1. The Difficulties in Medical Service Education

In the recent medical practice, the traditional apprenticeship-style on-the-job training system, so-called, “seniors train novices strictly on the job” is vanishing gradually because of the mental resistance for novices to accept the evidence-lacked, experience-based guidance of implicit medical service knowledge from seniors. Moreover, the newcomers who have poor insight and sensitivity to people are increasing and there appears the increasing pronounced tendency for the medical staff to unable to learn the medical service knowledge or skills to understand patients’ mind through the communication with other medical staff.

For example, when a novice nurse takes charge of pediatrics, he may puzzled by the complexity of emotional engagement among the child patients who are weaker than himself, their parents who are exceptionally anxious about their children’s health and the doctors who conducts a medical treatment. In order to have an acute insight into the complex structure of emotional engagement, it is necessary to have a rich sensitivity for understanding the others’ mind, a rational attitude of the acceptance of and respect to the immature hearts of the pediatric patients. That is a typical tacit knowledge which is not easy to acquire for novice medical staff.

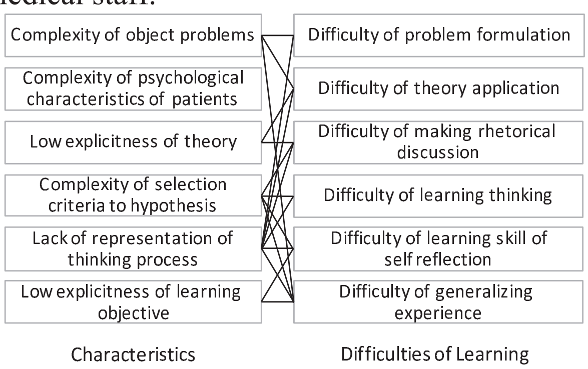

Figure 1. The characteristics of medical service and difficulties of learning the knowledge required for it

For the purpose of developing medical human resources with higher cognitive ability as shown in Figure 1, a variety of educational methods to foster the tacit knowledge or tacit skill by coaching the thinking process has been offered to the medical staff. For example, in the field of nursing education, the teaching approaches such as clinical conferences, reflective journals, narrative methods, case-method, etc. are conducted on a routine basis at many hospitals. However, in such a practical learning environment, it is said that the major difference between the learners who can learn what should be learned and the learners who cannot learn very well comes from differences of learners' sensibility or insight to others' mind. Moreover, even though learners has been successfully learned tacit knowledge in the practical learning environment, most of them face with more serious difficulties to assimilate the knowledge to their own existing knowledge and organize it as general knowledge to be applicable to the future similar situations. The difficulties caused by lack of the experience of making “thinking about others’ mind” as a subject to meta-level logical thinking, while most people guess others’ mind only by intuition. Therefore, to foster the ability of meta-level logical thinking seems to be an accompanied by an essential difficulty caused by the essential nature of human. In addition, the complexity of the matters of mind, the low explicitness of theory, the complexity of selection criteria to hypothesis, a lack of representation of thinking process, etc. make it difficult for novices to learn the knowledge required for medical services(Figure 2).

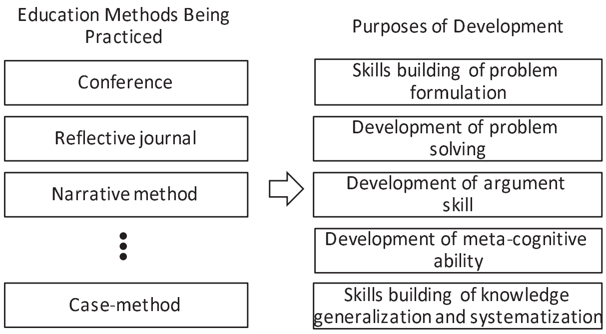

Figure 2. Fostering tacit knowledge/skills by coaching thinking process

In this research, we focus on the case-method as an approach to Medical Service Education. One of the educational principles behind the case-method in business management education is “if you want to teach how to deal with a new problem that you have not yet experienced, we should teach them how to think. In fact, the ability of thinking about thinking and the ability of dealing with new problems can be regarded as the different issues in principle but they are completely the same issue in practice.” [2]

2. The Overview of Case-Method

In the case-method, in order to acquire “skills to deal with new problem that have not been experienced yet”, the learners are assigned the task to think how to deal with the "real" problems that have occurred in their own practices and write their thought and behavior to cope with the problems as "cases". And then, they join the group discussion on the case with other learners to investigate the validity of their own thinking process from various viewpoints and co-create new solution to the “real” problem. Through these learning experiences, they could learn the learning ability to deal with the highly-non-deterministic and highly-complex practical problems [2].

The actual flows of the case-method in business management education are as follows: (1) the instructor distributes the prepared case materials to the learners in advance. (2) The learners organize the contents of the case to analyze and identify the core issues. The analysis should be made based on the facts in the case, the assertion inferred from the facts the insight into the thinking processes of the agents in the case and the learners’ own knowledge. (3) According to the analysis, they think out their own solutions to the problem. After that, (4) the learners join the discussion on the validity of each learner’s solution where the instructor will not join the discussion actively but just rise the topic to be discussed and lead the flow of the discussion [3].

When designing the learning materials for the case-method, it is necessary to (1) write down the events that actually occurred, (2) to consider how the learners think about the case and how they will discuss about it. Therefore, it is essentially how required for a case-writer to be able to estimate how learners think or how their discussion goes on from the deep understanding of written issues on the case [4].

2.1 The Learning in Case-Method

In the survey paper on the argument study, Maruno and Tomita [5] claims that most researchers focus on the argumentative skills to examine the rationality or validity of information or knowledge used in the discussion. On the other hand, the skills to produce or externalize the ideas in the discussion have not been studied in the research field. However, based on the empirical and the theoretical research so far, the former skills cannot be acquired without the latter ability. It implies that by participating in activities in which the latter skill in required repeatedly, the former skills can be acquired."

Moreover, they support the Kuhn(1991)'s model of internal thinking process as a dynamic internal dialogue base on the Billig's idea that "people engaged in problem solving or decisions making, try to make the best judgment of selecting one from the some possible options by justifying each of them from many different viewpoints and comparing the justifications to the options" [6] [7]. The reason why they strongly rely on Kuhn's model is that the model shows clear socio-cultural explanation on how the argument guides the thinking process, which is, it regards the thinking developing process as a more dynamic and clarify the tight relationship between individual internal process of thinking and social process of thinking such as exchanging the position with others and the individual process. Standing on this viewpoint, the case-method can be used as a concrete educational approach for learning the internal dialogue. However, on the other hand, it is difficult to learn the dynamic internal dialogue associated with social interaction for the reason (shown in Figure 1) the particularly higher cognitive ability is required. In our research project, in parallel, we have been developing an educational program that can reduce the learner's load in learning the association between internal dialogue [8] and social interaction [9].

2.2 The Learning by Designing Case Learning Materials

Ito proposed, by analyzing of the effect of the verbalization as a learning strategy, a model of the learning goals achievement by verbalization as an integrated model of three learning mechanisms, that is, the tutoring that focuses on the learning effect of the teaching activities, the self-explanatory of learning activities, and collaborative learning among learners [10].

We believe that the learners can be active entities who can find a meaningful entity for the goal of knowledge acquisition by themselves, and they can achieve the goal by externalizing their self-explanatory of their thinking process to other learners. The externalization processes consist of the two phases of the knowledge description phase and knowledge building phase and the cognitive conflict can be bridging activities of the two phases as shown in Figure 3. We will discuss the three phases in detail below.

The description phase is an iteration of the internal learning activities to achieve the goal of verbalization by externalizing one's thought in his own experiences. The cognitive conflict is a trigger cognitive process for learners to go into knowledge building phase by facing the conflict states (realization of cognitive gap among learners' mental models, cognitive differences with other learners, or errors in their knowledge) through the verbalization of their thought and the interaction with others. And then, in the knowledge building phase the learners aim at achieving the goal of resolving those conflict states. The goal of verbalization in the knowledge building phase is to resolve the conflicts and is essentially different from the goal of verbalization in the knowledge description phase. This goal achievement model can be regarded as a learning model that includes the model of thought for dynamic internal dialogue mentioned above.

As it mentioned at the beginning of this chapter, the design of the case materials requires: (1) writing case, (2) the content what should be thought and the set of branch points to discussion. In this research, we aim at developing learners' meta-cognitive skills by imposing the design tasks of case-method learning materials on the learners and promoting the cognitive interaction with others.

In particular, as an educational program for the medical professions (the nurses in this paper), we developed a learning environment for realizing a model of the learning goals achievement by verbalization. Using the environment, the nurses write down (the description) their own thinking process in his experience as cases, guess others' different thoughts, find a cognitive conflict among the thoughts and try to resolve the conflicts by building new knowledge [11] [12].

3. The Environment Supporting Learning in Design Learning Materials

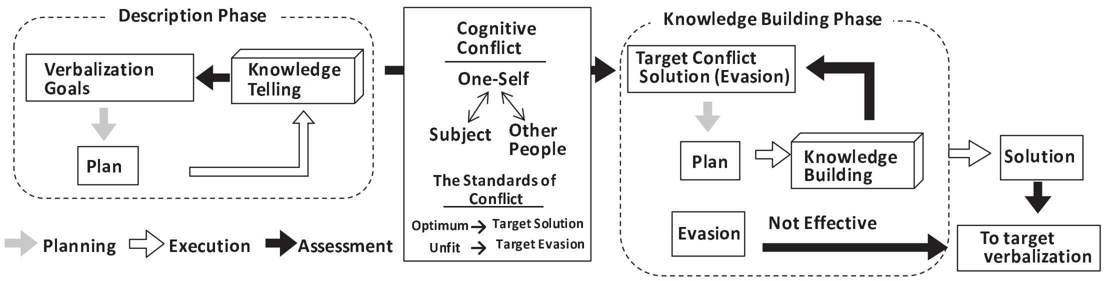

Figure 3. A goal-attainment model of verbalization as a learning strategy

In Figure 3, in the learning strategy, learners engage with verbalization activities in the description phase and the knowledge building phase and the activities are externally observable at behavioral level. Meanwhile, the activities of making goal, plan, cognitive conflict, resolving conflicts etc., are not externally observable internal cognitive activities. Since those activities are relatively abstract and ambiguous, it is difficult for the learners to achieve the learning goals. The difficulties of learning shown as Figure 1 can also be considered as the reason to this ambiguity and abstraction. Our idea of a leaning model to reduce the cognitive load for the learners to achieve the learning goal is to provide a easy-to-use environment to support learners to reflect his thinking process in his medical services practices. The ontology for patient psychology, medical services, thinking activities and learning activities are incorporated in the environment. And a user-friendly interface for writing case learning materials is provided [13].

4. The Thinking Representation in Case Design

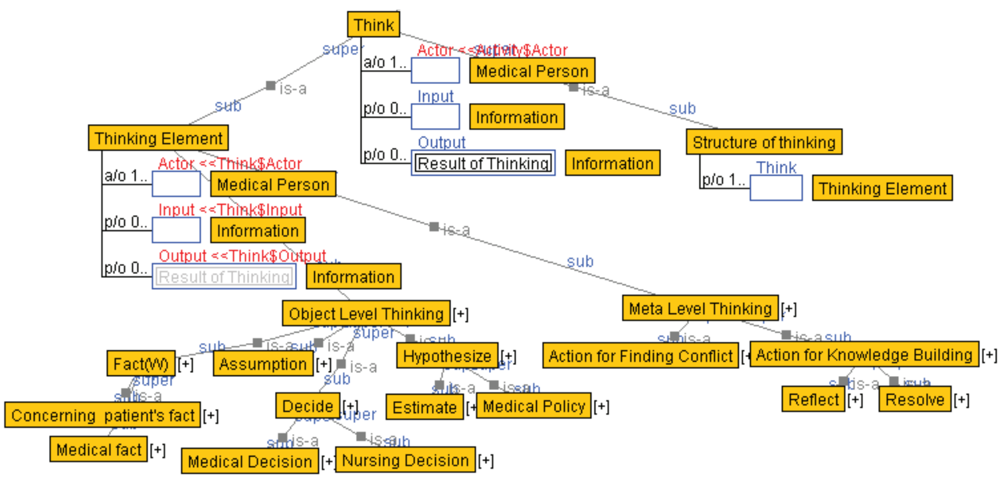

Figure 4. Thinking skill ontology (partially)

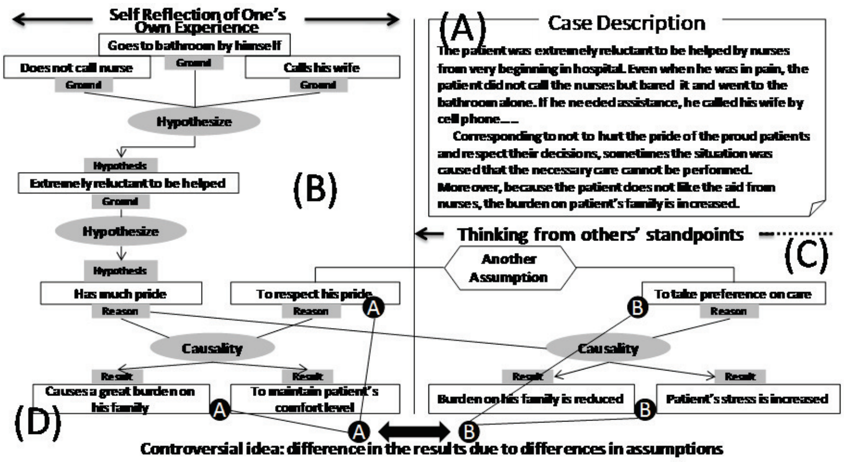

Figure 5. An example of thinking representation in case learning material designing

Figure 4 shows an overview of a part of the ontology for thinking process in medical services [8]. Using the concepts in the ontology, the learners externalize the reflection of their thinking process in their experiences in the graphic representation as shown in Figure 5.

Figure 5(A) shows the reflection description of thinking in one's own experience and Figure 5(B) shows its graphic representation. The square nodes represent the assertions and the elliptic nodes represent thinking activities such as "hypothesizing", "finding cause and effect" and so on. Figure 5(C) shows the guessed thinking process of another nurse with different stance from the learner. Figure 5(D) shows the intended issues (cognitive conflict) to be discussed in the case materials, thought that she should not care the patient too much and respects the patients feeling because the patient does not want it because of his too much pride, even though it is unavoidable to increase the load of the family to take care of the patient. Meanwhile, she guesses that there may be a nurse who thinks, on the assumption of "care priority", that she should provide the enough care to the patients even though it may cause the strong stress on the patient's mind. And then the learner investigated the advantages and disadvantages of the results of different assumptions.

Associating with the discussion in the previous chapter, (B) the visualization of one's own self-reflection can correspond to the description phase. And (C) according to the assumptions at different standpoint, (D) the discussion setting up can correspond to the evocation of knowledge building by cognitive conflicts.

5. Sizhi: A Learning Environment for Externalizing the Reflection on Thinking Processes for Internal Dialogue

Combining the learning strategies based on the goal-attainment model of verbalization (Chapter 3) and the thinking representation in case design (Chapter 4), we developed a learning environment named Sizhi. The Sizhi is designed for developing the learner's ability to conduct logical thinking for internal dialogue and to appropriately reflect on ones' thinking process by one's own. In order to improve the quality of discussions, we designed a model of thinking process for self-dialogue consists of three phases, where the learners are required to be able to conduct high quality thinking for self-dialogue, to describe high quality of reflection on ones' own thinking, to find meaningful conflicts, to create high quality knowledge in order to overcome the conflicts, by continuously developing their ability using the Sizhi tags.

Figure 6 shows an example of a case written by a nurse with Sizhi. As shown in the figure, there are three tabs that correspond to the description phase, the cognitive conflict and the knowledge building phase in learning strategies. Each line consists of a statement ID (number), a Sizhi tag, and statement, and may have an additional tag and ID's that refer the logical foundation of the statement in the line.

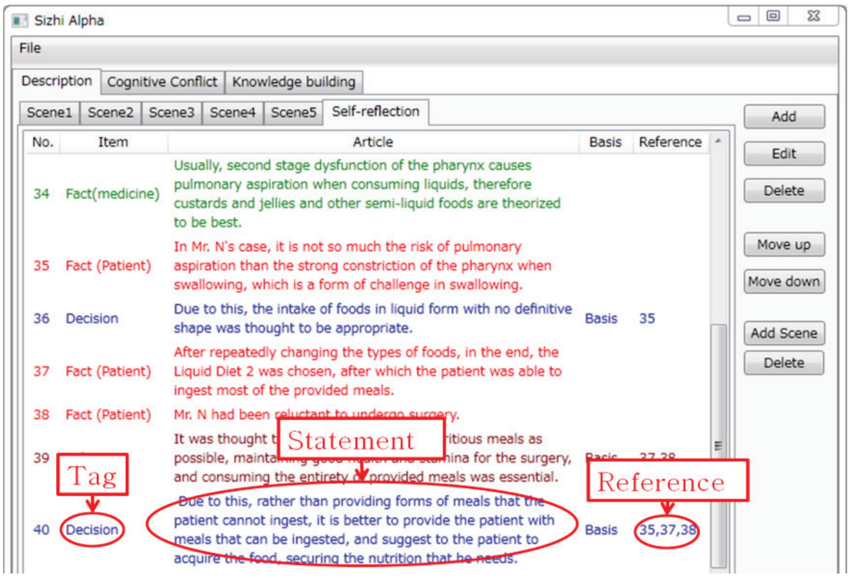

Figure 6. The description phase

Sizhi refers the thinking ontology mentioned in the above section to clarify the logical structure of learners' thoughts by Sizhi tags, and the learners is required to express the thinking processes using a set of Sizhi tags. The set of Sizhi tags is designed for nurses to reflect on their thinking process for internal dialogue and consists of nine tags: fact (patient), fact (medical), policy/principle, assumption, decision, medical decision, conflicts, reflect and resolve. The nurses' learning task in the case writing is to reflect on their own thinking process and clarify the structure of the thinking process using the Sizhi tags.

The most important aspect in designing Sizhi is for learners to clearly write ones' own case by reflecting on their thinking process using Sizhi tags, and reflect on the thinking process to find meaningful conflicts. To promote learners to gain deep insight into conflicts, for instance, Sizhi encourages learners to find conflicts between the statements with policy/principle tag, because the policy/principle tag implies the statement is one of logical foundation of the thinking process.

A preliminary experiment was conducted with the help of medical specialists from Faculty of Medicine, Miyazaki University and Juntendo University Hospital Group. In order to investigate the participants' motivation and their self-evaluation, we conducted two questionnaires, before and after using Sizhi. The Figure 7 (left) describes the mean difference in the target (related with self-dialogue process) column and the distractor (not related with self-dialogue process) column before and after using Sizhi. As a result, we found that as the preliminary experiment progressed, the target became higher and the distractor became lower. This result suggests that the understanding of the importance of thinking skills increased by using Sizhi. Moreover, we asked the learners for a self-evaluation of their thinking ability. And we split the learners into 3 groups according to the magnitude of the change in cognition of importance when analyzing the results and found that the self-evaluation of medium and small growth groups improved after using Sizhi (Figure 7 right).

In summary, for visualizing the invisible, shapeless, complex structure of thinking process to support knowledge creation, Sizhi provides learners with the Sizhi tags which clarify various thinking processes, and the Sizhi tab which encourages the awareness of the three thinking phases of knowledge building process, and is designed with the intent to encourage externalization and careful investigation of ideas that follow those processes.

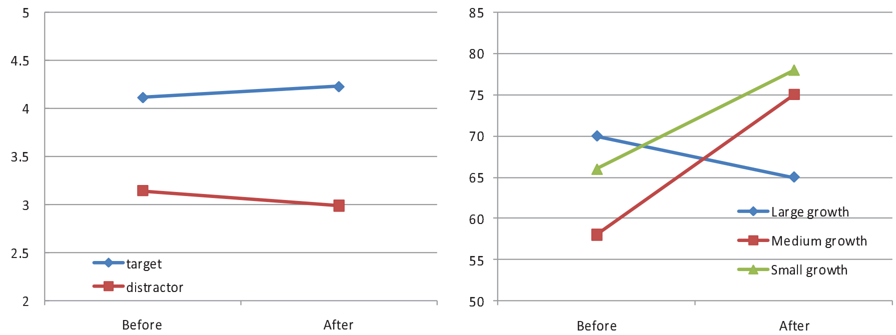

Figure 7. Changes in cognition of the importance of thinking skills (left) and changes in self-evaluation for each growing (right) before and after using Sizhi

6. Conclusion

In this paper, we organized a learning model which promotes reflective learning the case-method for medical service education. As an implementation of the learning model, a learning environment that support learners to reflect on their thinking process in their experiences by a learning strategy which consists of three case-writing phases: the description phase, the cognitive conflict phase, the knowledge building phase. The final goal of this research is not to make contributions to technological improvement in medical service education but to conduct a proposal of a rational learning model for medical service education. In the future, we will establish a methodology to the educational program that contains the scientific rationale for the continuous program procedures included the designing, executing, analyzing and revising for service education.

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Chapter 10

The Applications of Information and Communication Technologies in Adult and Continuing Education

Preface

In this workshop, a wide spectrum of research or practical topics relating to the usage of ICTs in adult education or continuing learning will be explored and discussed. The aim of this workshop is to provide a forum in which international participants can share knowledge, experiences and concerns regarding the application of ICTs for adult and continuing education and for professional development, and explore directions for future research collaborations. In addition, there are twelve articles from four countries (***Malaysia, New Zealand, Singapore and Taiwan***) in this workshop and hope to build on the fruitful results to bring about innovative advancements in adult education and continuing learning.

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Analyzing Knowledge Construction Behavior of a Project Based Online Discussion Instructional Activity Using Facebook – An Example of Art Course of Adult and Continuing Education

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Abstract: Social networking service (SNS) is known for its ability to facilitate people's interaction and build connections. Recent research also showed students' interest in learning activity using SNSs. Besides, few studies have also investigated the effect of adopting SNSs in learning activity. However, studies that examine knowledge construction behaviors in asynchronous online discussion using SNSs in adult and continuing education are quite limited. The purpose of this study is to explore the knowledge construction behavior in an art course which involved a project-based learning activity using a popular SNS, Facebook, as a discussion tool. Participants are comprised of 62 students in the school of continuing education of a university in northern Taiwan. The results show that students primarily share knowledge and information when discussing online. The diversity of knowledge construction is limited in the context of this study. In addition, further analysis on the relationship between students' individual differences and knowledge construction and the extent of participation suggests that there is a gender difference in and correlation between age and knowledge construction behavior. Implications and limitations are discussed while pedagogical suggestions for instructors using SNS as an online discussion tool for teaching activity in adult and continuing education are also proposed.

Keywords: Social Networking Service, Adult education, Continuing education, Knowledge construction, project-based learning, Facebook

Introduction

The maturity of networking environment and information technology facilitates the applications which implement web 2.0 concepts in various fields. Among web 2.0 applications, social networking service (SNS) is known to be the most popular one. On a SNS, people can easily share information in forms of text, picture, audio and video. Regarding its popularity, SNS has attracted experts across fields in exploring its practical implications, applications and users' behavior [2].

Facebook is known to be a popular SNS in the world. According to the statistics from Checkfacebook.com, Facebook now has over 700 million users worldwide. In Taiwan, there are over 10 million Facebook users. Most of the users in Taiwan are of age between 18 ~ 34 years (65% approximately). Witnessing Facebook's highly social interactive and multi-media features, researchers also centered their focus on investigating the possibilities and effectiveness of using Facebook in teaching activity [1][14][19]. Gray (2010) points out that students are interested in learning activities involving Facebook [6]. However, it is not addressed in their work whether the discussion process on Facebook can achieve meaningful interaction and knowledge construction. It needs further investigation.

Adult learners have special characteristics other than traditional college students; for example, they have a wide span of age, most of them have to play multiple roles in whether work or home, etc. These characteristics may thus constrain the commitment or time that adult learners can devote themselves to learning [18]. Homberg (1995) suggest that incorporating information and communication technology (ICT) in support learning help address time and location constraints [8]. Moreover, adult learners are usually more experienced and may have more individual differences. Through intensive interaction among learners, instructors and learning environment, adult learners may be able to collaboratively construct deeper understanding which leads to meaningful learning [17-18]. LeNoue et al. (2011) suggest that a well-designed SNS could provide opportunities for learners to broadly and intensively interact with each other which allow them to work collaboratively in discovering, processing information and learning with multiple styles [18].

Previous research has investigated adult social activity on Facebook [25]. However, studies that further examined the effect of using SNSs in adult and continuing education with online discussion are quite limited. Moreover, despite the fact that many studies investigated the application of online discussion to teaching [5][10][13], very few studies have conducted further analysis over learners' knowledge construction in online discussion using SNSs.

To understand the knowledge construction of adult learners in asynchronous online discussion using SNSs, this study seeks to adopt Interaction Analysis Model (IAM) [7] as coding scheme to quantitatively analyze students' online discussion content on SNS. The distribution of knowledge construction phases is to be explored in this study. Moreover, Payne and Monk-Turner (2006) suggested that each learner has his own preferred approach of learning [23]. This diversity of preferences may come from individual differences, such as gender, age, or race etc. Justice and Doman (2001) pointed out that older students are more likely to adopt higher level learning strategies. Meanwhile, older female students exhibit higher cognitive monitoring ability than their male counterpart [16]. Bye et al. (2007) suggested that age is a significant predictor of cognitive maturity and learning styles for university students [3]. Besides, previous studies have also shown there are differences in learning approach, motivation, cognitive ability and learning performance among learners of varied ages and genders [3-4][20-21].

Adult learners are known for their diversity of individual differences. Knowing the relationships among adult learners' individual differences and their knowledge construction behavior and the extent of participation in online discussion may be helpful in designing better pedagogical methods. Therefore, this study seeks to further explore the potential differences of knowledge construction phases and the extent of participation in learners of different ages and genders. Concluding from above, the objectives of this study are presented as follows:

1. To explore the distribution of different knowledge construction phases in an online discussion activity using Facebook among adult learners.
2. To explore the gender difference in knowledge construction and the extent of participation in an online discussion activity using Facebook among adult learners.
3. To explore the relationship between age and knowledge construction behaviors and the extent of participation in an online discussion activity using Facebook among adult learners.

The implications of the results are to be discussed. Furthermore, practical pedagogical suggestions and future research for adult education are also presented in this study.

Method

1. Participants and procedure

Participants of this study are comprised of 62 students from school of continuing education of a university in northern Taiwan. All students have either full-time or part-time jobs. 40, or 64.52%, of participants are female while 22(35.48%) of them are male. These students are of wide span of age from 20 to 43. The course that students were enrolled is “Appreciation of Arts and Design Aesthetic”. The primary purpose of this course is to introduce major, famous, and influential artists or ideology. A project-based learning (PBL) activity that incorporated Facebook online discussion was arranged in the course. Students were divided into twelve groups with 2-7 members in each group. This project required students to jointly collect data of an artist, ideology or art movement, and collaboratively complete the project with an electronic slide for oral presentation in the classroom.

In order to understand the knowledge construction of students in Facebook discussions, closed discussion groups, i.e. secret group of Facebook, were set up by the first author for each group. Members of each discussion group are comprised of students in the same group, instructor, and the first author of this study. Students can only assess the content of their respective secret group. The course required students to discuss their project in the secret group in two weeks. Besides, after in-class oral presentation, students were also asked to reflect on both of their own and other group’s project in another two weeks. The instructor only made announcement at very beginning stage of discussion in secret group. The instructor didn’t participate or provide guidance in the subsequent discussions to avoid the instructor’s subjective guidance.

2. Coding Scheme and Data Analysis

To explore the students’ knowledge construction in the online asynchronous discussion process, the study adopted the IAM as the coding scheme [7]. IAM have been widely adopted as coding scheme to analyze the knowledge construction of online discussions (e.g., [9-12][15]). As shown in Table 1, the IAM coding scheme is divided into five phases (C1 -C5). Each phase represents a type of knowledge construction of discussion content while C6 refers to those not relevant to knowledge construction.

The unit of coding is a single message that students post or reply in the secret group. 585 messages in total were retrieved for content analysis. One of the authors coded each messages based on IAM as shown in Table 1. To ensure the reliability of coding, another experienced coder independently coded all messages. The Kappa of the two coders is 0.91 ($p < 0.01$) which indicates high inter-coder reliability. The results of coding were thus used for further analysis.

Table 1: Interaction Analysis Model (Gunawardena, Lowe & Anderson’s, 1997)

Code	Phase	Content
C1	Sharing or comparing of information about discussion topics	Statement of observation or opinion; statement of agreement between participants
C2	Discovery and exploration of dissonance or inconsistency among participants	Identifying areas of disagreement, asking, or answering questions to clarify disagreement
C3	Negotiation of meaning or construction of knowledge	Negotiating the meaning of terms and negotiation of the relative weight to be used for various agreement
C4	Testing and modification of proposed synthesis or co-construction	Testing the proposed new knowledge against existing cognitive schema, personal experience, or other sources
C5	Agreement statement(s) or application of newly constructed meaning	Summarizing agreement and metacognitive statements that show new knowledge construction

C6	Off Topic	Discussion that irrelevant to knowledge construction

Results

Among the 585 message codes, the distribution of each code is as shown in figure 1. The result indicates that knowledge construction in students' discussion process was primarily C1 (sharing or comparing information about discussion topics) (86.7%). Besides, few C2 (discovery and exploration of dissonance or inconsistency among participants) was also found in students' discussion. C3 (Negotiation of meaning or construction of knowledge), C4 (Testing and modification of proposed synthesis or co-construction), and C5 (Agreement statement(s) or application of newly constructed meaning) were not observed in the discussions and thus excluded in the subsequent analysis. Moreover, the result also shows a fair proportion of C6 (off topic discussion) (12.82%).

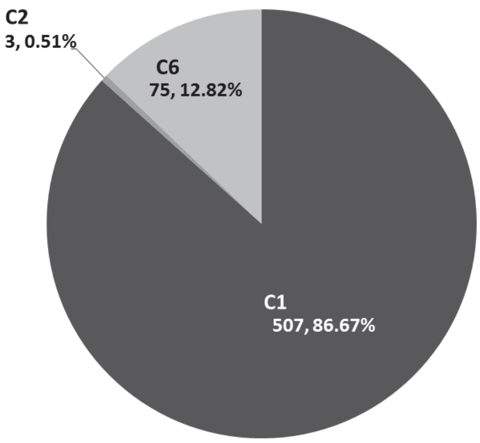

Figure 1: Pie chart of the coding of knowledge construction in the online discussion

To explore the possible gender differences of knowledge construction, this study conducted a t-test on the average number of C1, C2, and C6 between different genders of participants. As shown in Table 2, the results suggest that, in average, females have more off topic discussions (C6) than males do.

Table 2: Results of t-test for mean difference in knowledge construction in gender

	Gender		
	Female (n=40)	Male (n=22)	
Code	M (SD)	M (SD)	t
C1	8.70(6.91)	7.23(7.63)	- .77
C2	.05(.22)	.05(.21)	- .08
C6	1.53(1.93)	.64(1.09)	-2.31*
*p<.05			

To understand the relationship between students' age and knowledge construction, this study employed Pearson correlation analysis of students' age and C1, C2, C6 code respectively. The results show that students' age is significantly correlated with C2 ($r = .341$, $p < 0.01$) and C6 ($r = 0.309$, $p < 0.05$).

The extent of students' participation, i.e. the number of posts of each student, in online discussion and its relationship with students' age and gender were further examined. The extent of participation was assessed by classifying the 585 messages into new posts (i.e. posts that initialize a new discussion thread) and reply posts (i.e. posts that reply others' messages) for each student. In addition, students' total posts refer to the summation of their respective total number of new posts and reply posts. The higher the number is, the higher the extent of a student's participation in online discussion is. Table 3 exhibits results of t-test of the extent of participation in different genders. The results show that there is no significant difference between females and males in terms of participation. Moreover, the Pearson correlation analysis of age and the extent of participation was conducted. The results showed that age has no significant correlation with whether new posts, reply posts or total posts. Interpretation and discussion of the results are to be presented in the following section.

Table 3: t-test of mean differences in the extent of participation in genders

	Gender		
	Female (n=40)	Male (n=22)	
Post categories	M (SD)	M (SD)	t
Total posts	10.28(7.71)	7.91(8.20)	.96
New posts	6.73(7.10)	4.59(4.88)	.22
Reply posts	3.55(3.11)	3.32(5.67)	.14

$^{*}p<.05$

Discussion and Conclusion

The purpose of this study is to explore students' knowledge construction in the context of incorporating SNSs to support asynchronous online discussion in adult and continue education. Facebook, a popular SNS, was chosen to support a project based discussion activity for 62 students enrolled in the course - Appreciation of Arts and Design Aesthetics. A total of 585 messages which discuss the assigned PBL activity in the course were retrieved for content analysis.

As the results of content analysis show, students' knowledge construction is primarily knowledge and information sharing (C1=507, 86.7%), little exploration of inconsistency among participants (C2=3, 0.5%) was observed during the online discussion. Negotiation of meaning or construction of knowledge (C3), testing and modification of proposed synthesis or co-construction (C4), and agreement statement(s) or application of newly constructed meaning (C5) were not found in this study. Consistent with previous studies, in the context of incorporating asynchronous online discussion, students' knowledge construction is mostly knowledge and information sharing [7][15].

However, the results from related studies, which adopted college students as participants, showed fair proportion of C2 and C3 [10][13]. These findings are not found in this study. One possible explanation is that the time for students to discuss was not ample enough. Schering (2011) points out that the ample time for online groups to discuss and reach a consensus of the project is necessary considering the characteristics of distance learners [24]. Adult learners usually play multiple roles in both work and home which may constrain their time and effort in learning [18]. Therefore, to achieve richer multiplicity of knowledge construction, they may need more time to reflect and give feedback to the project discussion than traditional college students do. All participants in this study have either full- or part-time jobs; therefore, deeper and increasing diversity of knowledge construction may not be achieved within few weeks.

Another plausible reason could be the topics of project are not controversial. Paulus (2005) pointed out the type of group project could influence students' decision on working the project cooperatively or collaboratively [22]. According to Paulus (2005), project designed for collaborative learning requires student working collaboratively in reaching a consensus. On the other hand, project designed with cooperative approach, students may be able to distribute the workload to each member. They could thus work independently instead of collaboratively reaching a consensus. The project activity in this study required students to collect and present information of specific artists. Meanwhile, the instructor didn't give obvious rubrics or guideline of the project's final presentation. Therefore, student may distribute the project work by assigning each group member to collect specific data. In this way, students may relatively not need to seek a consensus or negotiate on the dissonance between members' ideas, which in turn, lead to the lack of depth and diversity in knowledge construction behavior.

To further explore the relationship of adult learners' individual differences with knowledge construction and the extent of participation, this study conducted mean difference and correlation analysis of knowledge construction phases and the extent of participation in students of different ages and genders. The results suggest that females show more off topic discussions than males do. Besides, correlation analysis shows that student's age exhibits significant positive correlation with discovery and exploration of dissonance or inconsistency among participants (C2) and off topic discussion (C6). For C2, one possible explanation could be that older adults have better metacognitive knowledge and ability which may be influenced by past academic or life experience [4]. Thus, they were able to discover the dissonance or inconsistency of other members' ideas. For off topic discussion (C6), previous research suggests that older learners relatively more appreciate the opportunities and experiences of learning. Furthermore, they would apply various strategies in compensating the compressed time due to commitment in work or family [4]. This situation may drive them to participate in online discussion more often than younger students, even off topics.

Monk-Turner and Payne (2004) found gender differences in perceptions of group project [20]. Despite the fact that females are more likely to perceive that they did more work than males did, they are less likely to perceive that they devote meaningful contribution to the group project than males are. In this study, females, comparing to males, might be more likely to post encouraging messages or report the current status of project which were coded as off topic discussion (C6) in content analysis. This phenomenon may serve as a plausible explanation for gender difference in C6.

Previous studies showed gender differences in perception of participation of group project [20] and higher participation in class discussion of non-traditional, i.e. older, students than traditional college students [4]. However, in this study, the extent of participation has neither statistically differences in genders nor correlation with students' age. One plausible explanation could be that the project-based activity in this study asked students to collect information about artist(s). Besides, the instructor also asked all group members to join the discussion in the Facebook. In this information age, people can easily surf the internet and retrieve abundant information. Students may have brief discussion of distribution of work. Each group member could then collect data of a specific part of the whole project and post them on the Facebook. Therefore, all group members, regardless of their gender and age, may exhibit certain extent of participation in terms of posting collected information. This phenomenon might explain both the majority of C1 in knowledge construction codes and the insignificant results of statistical analysis.

Suggestions for pedagogical practice

Based on the research findings, this study proposes suggestion for pedagogical practice as following:

1. **Allowing ample time for project discussion**: Regarding to the multiple roles that adult learners may play, they may not be able to promptly give response or feedback to the

discussion content. Thus, relatively longer time for the discussion might be necessary for adult learners to achieve meaningful online discourse.

2. **Setting controversial topic and clearly specifying the goal of project**: For example, comparing the achievements of artists in the same era or ideology with their influence over the subsequent thinking of art; in this way, students have to collaboratively achieve the consensus over the project topic instead of working cooperatively but independently. A richer multiplicity of knowledge construction is expected to be shown in the interactive process of students' reaching a consensus.
3. **Increasing the structure of online discussion activity**: Gilbert and Dabbagh (2005) suggest that providing criteria or structural guideline, such as addition of posting protocols or evaluation rubrics, is helpful in achieving meaningful online discussion [5]. Thus, this study suggests that the instructors should give the guideline or evaluation rubrics as scaffolds for student to post their messages.
4. **Focusing on developing effective pedagogical strategies**: Among current SNSs, this study adopted Facebook, which has the largest user base, as the discussion tool. Most of the students have experiences in using Facebook to interact with others and are familiar with its interface. However, incorporating technology itself doesn't automatically drive meaningful learning [17]. Rather, a well-designed pedagogical strategy, which utilizes the benefits of SNSs, could be a key to foster effective learning. Gray (2010) pointed out it could be a challenge for both students and instructors when incorporating Facebook in the learning process [6]. Therefore, the focus should be placed on how to design pedagogical strategies which can improve the depth and multiplicity of students' knowledge construction.

Research limitations and future research

This study investigates students' knowledge construction phases in asynchronous online discussion process of the Art introductory course which incorporates Facebook as a discussion tool. The characteristics of the art course may limit the generalization ability of this study. Therefore, future research could further apply Facebook in supporting students' discussion in various courses or disciplines other than Art related courses. In addition, future studies are suggested to explore students' cognitive phases and knowledge structure in the process of online discussion. Furthermore, integrating advanced analysis techniques could help depict a clearer picture of adult learners' asynchronous online discussion behavior using Facebook. For example, a sequential analysis of adult learners' online discussion behavior in Facebook could advance the understanding of their behavioral patterns in discussion process. Also, a qualitative analysis of students' discussion content is also helpful in exploring the patterns and meaning of their discussion. Lastly, the multiplicity of knowledge construction is not observed in this study, the lack of ample time for online discussion could be the possible reason. Future research is suggested to investigate into the relationship between the length of time for discussion and the multiplicity of knowledge construction.

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The differences on the information commitments toward online medical information between people in the hospital and general public

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Abstract: The purpose of present study is to explore peoples' online medical information commitments (MIC) and to compare peoples' online MIC between different groups. A Medical Information Commitment Survey (MICS) was employed to investigate peoples' evaluative standards of assessing online medical information and their searching strategies used on Internet. Two groups, including 247 samples from the group of people in hospital and 293 samples from the group of people in general public, were surveyed. The results showed that the MICS was a sufficiently reliable tool to assess peoples' MIC. It was also found that for seeking more credible online medical information, people would tend to employ both basic and sophisticated evaluative standards (i.e. mixed standards) for judging online medical information, and to utilize "elaboration," the advanced searching strategy, as well. Especially for people in hospital, they showed higher tendencies to use mixed standards and "elaboration" searching strategy than people in general public.

Keywords: Information commitment, medical information, Internet

1. Introduction

With the exploration of online information in recent years, Internet has become a preferred source of medical information (Lemire, Pare, Sicotte, & Harvey, 2008; Morahan-Martin, 2004). Many people around the world accustom themselves to search medical and health information on Internet (McMullan, 2006; Renahy, Parizot, & Chauvin, 2010). The abundant online information plays the role that provides people to have more opportunities to manage their own health problem and to make decision about medical issues (Morahan-Martin, 2004; Renahy, et al., 2010).

However, the plentiful medical information on Internet not only makes people feel overwhelming, but also suffers its low credibility (Metzger, 2007; Morahan-Martin, 2004). The quality of online health information varies dramatically. Most of them are inaccurate and incomplete (Metzger, 2007). The quality of online medical information is one of the issues that has received considerable attentions (Hanif, Read, Goodacre, Chaudhry, & Gibbs, 2009; Lemire, et al., 2008). The questionable quality of online medical information has resulted in potential dangers related to its unsuitable use (Benigeri & Pluye, 2003).

Therefore, understanding how people search online medical information and evaluate their credibility has become an essential issue.

For investigating peoples' online information evaluative standards and searching strategies, Tsai (2004) has interviewed with a group of web users and then proposed a theoretical framework called as "Information commitments" (IC). The IC framework includes two components: a set of *evaluative standards* for assessing the web-based material and the information *searching strategies* on Internet. According the framework, an Information Commitment Survey (ICS) was developed and confirmed as a reliable tool for investigating students' information commiment by previous studies (Liang & Tsai, 2009; Wu & Tsai, 2005, 2007). Therefore, for understanding peoples' information commiment (i.e. evaluative standards and searching strategies) toward online medical information, a Medical Information Commitment Survey (MICS) was developed, and the validity and credibility would be assessed in this study.

Moreover, Wu and Tsai (2005) have suggested that peoples' information commitments might vary across individuals. In other words, different information searchers may possess various evaluative standards and searching strategies. For example, web users with more health consciousness and perceived health risk showed tendency to search medical information online (Yun & Park, 2010). Further, Eysenbach (2003) indicated that most patients will seek explanatory information about their diseases or treatments before or after their consulting with doctors. If they or their relatives were diagnosed with a medical condition, most people will seek information from multiple websites on the Internet (Morahan-Martin, 2004). These results imply that people in such a context (i.e. people in hospital) might have a higher information need for accurate and abundant medical information. Consequently, when seeking online medical information, they might use different evaluative standards and searching strategies from those in general public. This present study attempts to compare information commitment toward online medical information possessing by these two different populations.

In sum, two research questions will be investigated in this study:

- Is the MICS as a sufficient tool to measure people's information commitments toward medical information on Internet?
- Is there any difference on medical information commitment on Internet between these two groups, patients in the hospital and people in general public?

2. Method

2.1 Participants

The participants of this study were 540 volunteers, ranging in age from 30 to 69 years (M= 45.1 years), who all had experiences toward online medical information searching in Taiwan.

For investigating the online medical information commitment in different context, relevant information was collected from two groups: 247 people in hospital (135 males and 112 females) and 293 people in general public (140 males and 153 females). The people in former group, including patients or, patients' relatives and friends, were surveyed when they were in hospital, while the people in latter group were volunteers in general population who showed interests to this survey.

2.2 Instrument

In order to investigate people's evaluative standards and searching strategies, a questionnaire called "Medical Information Commitment Survey (MICS)" was employed in this study. The MICS, which was modified from Wu and Tsai's (2005) ICS, comprised three scales: (1) standards for accuracy, (2) standards for usefulness, and (3) searching strategy. Each scale contains two orientations. The six orientations which include 30 items construct the main structure of the MICS:

- *Multiple sources as* <u>*accuracy scale*</u> *(Multiple sources) with 4 items*: measuring the extent to which web users will validate the correctness of unknown online medical information by various sources. *Sample item*: *I will try to find more websites to validate whether the medical information is correct.*
- *Authority as* <u>*accuracy scale*</u> *(Authority) with 5 items*: assessing the extent to which web users will examine the accuracy of unknown online medical information by the 'authority' of the websites or sources. *Sample item: I will believe in its accuracy if the medical information appears in some websites recommended by experts.*
- *Content as* <u>*usefulness scale*</u> *(Content) with 5 items*: measuring the extent to which web users will assess the usefulness of the online medical information by the relevancy of its content. *Sample item: If it can provide more related links, the medical information for me is useful.*
- *Technical issues as* <u>*usefulness scale*</u> *(Technical) with 4 items*: assessing the extent to which web users will judge the usefulness of the online medical information by the ease of retrieval, the ease of searching or the ease of obtaining information. *Sample item: If it does not take much time to be retrieved, the medical information is useful for me.*
- *Elaboration as* <u>*searching strategy scale*</u> *(Elaboration) with 6 items*: measuring the extent to which web users will have purposeful (metacognitive) thinking or integrate online medical information from several websites to find the best fit that fulfills their purpose. *Sample item: I can integrate the medical information obtained from a variety of websites.*
- *Match as* <u>*searching strategy scale*</u> *(Match) with 6 items*: investigating the extent to which web users will apt to start searching from single searching engine, or find only a few websites that contain the most fruitful and fitted information when they search for online medical information. Their strategy is oriented towards matching the purposes of their search. *Sample item: If I find the first relevant medical information website, I will not search others.*

The MICS in present study employed a six point Likert-scale which statements were presented with bipolar strong disagree/strong agree (from strong disagree=1 to strong agree=6). As aforementioned, the three scales ("Multiple sources", "Content", and "Elaborate") which experts commonly used are categorized as sophisticated information commitments while the others ("Authority", "Technical", and "Match") which novices commonly utilized are categorized as less sophisticated.

The modified items are all examined by experts. The reliabily and validity of the MICS will be examined through EFA in this study,and further adopted to investigate people's information commitment toward online medical information.

3. Results

3.1 Factor analysis

To clarify the structure of MICS for exploring people's medical information commitment, a series of exploratory factor analysis by principle component analysis with varimax rotation were used. The results of EFA revealed that a total of six factors were extracted with eigenvalues exceeding 1.0: "Multiple sources", "Authority", "Content", "Technical", "Elaborate" and "Match." These factors accounted for 61.11% of variance. The factors and responding factor loadings of items are presented in Table 1. Moreover, the reliability (alpha) coefficients for these factors are 0.74, 0.80, 0.87, 0.79, 0.86, and 0.86 respectively, and overall alpha is 0.86. Therefore, the MICS were suggested as a sufficiently reliable tool for assessing people's online medical information commitment.

Table 1. Factor loadings and Crobach's α values for the six scales of the MICS (n=540)

Item	Factor1:	Factor2	Factor3	Factor4	Factor5	Factor6
Factor 1Multiple sources: α = .74 (4 items, mean= 4.96, SD= .53)						
Multiple sources 1	.64					
Multiple sources 2	.73					
Multiple sources 3	.76					
Multiple sources 4	.68					
Factor 2: Authority α = .80 (5items, mean= 4.67 SD= .69)						
Authority 1		.61				
Authority 2		.61				
Authority 3		.82				
Authority 4		.78				
Authority 5		.70				
Factor 3: Content α = .87 (5 items, mean= 4.99, SD= .59)						
Content 1			.72			
Content 2			.80			
Content 3			.81			
Content 4			.72			
Content 5			.68			
Factor 4: Technical α = .79 (4 items, mean= 4.60, SD= .80)						
Technical 1				.73		
Technical 2				.70		
Technical 3				.79		
Technical 4				.72		
Factor 5: Elaboration α = .86 (6 items, mean= 4.75, SD= .66)						
Elaborate 1					.68	
Elaborate 2					.80	
Elaborate 3					.80	
Elaborate 4					.67	
Elaborate 5					.76	
Elaborate 6					.70	
Factor 6: Match α = .86 (6 items, mean= 3.91, SD= .96)						
Match 1						.68
Match 2						.76
Match 3						.80
Match 4						.79
Match 5						.80
Match 6						.74
% of variance	7.62	9.29	11.42	8.79	12.04	11.96
Eigenvalue	2.29	2.79	3.43	2.64	3.61	3.59

3.2 Scores on the six scales

For further investigate people's information commitment toward online medical information, Table 1 also shows people's average scores and standard deviations of the six scales of the MICS. The people scored highest on the "Content" (an average of 4.99), followed by "Multiple sources" (an average of 4.96), "Elaboration" (an average of 4.75), "Authority" (an average of 4.67), "Technical" (an average of 4.60), and "Match" (an average of 3.91).

People's average scores in the first four scales (i.e. evaluative standards) are all higher than four points and the average scores in "Multiple sources" and "Content" almost close to five points. It implied that people in this study might apt to employ all these evaluative standards, so-called as a "mixed standards" tendency. Moreover, using "Multiple sources" and "Content", which are considered as more sophisticated evaluative standards, are much preferred.

Regarding to the part of searching strategies, people showed a neutral preference to employ "Match" as a searching strategy (M=3.91). Nevertheless, using "Elaboration" as a searching strategy is much preferred (M=4.75).

3.3 Group differences on information commitments

For comparing the differences on online medical information commitments between the two groups (people in hospital and people in general public), a series of t-tests were used. Table 2 shows the results of comparisons on MICS scales identified by t-tests. The results indicated that, on the one hand, the people in hospital are more oriented towards using "Multiple sources" (t=2.53, p<.05), "Authority" (t=4.44, p<.001), "Content" (t=4.15, p<.001), "Technical" (t=2.86, p<.01) as evaluative standards. On the other hand, they tend to employ "Elaboration" (t=2.47, p<.05) as searching strategy to seek online medical information, and to show less orientation toward using "Match" (t=-3.90, p<.001) than people in general public.

Table 2. Groups' comparison of the ICS Scales between the group of General publication (n=293) and Hospital (n=247)

Scale	Groups	Mean	t value
Multiple sources	Hospital	5.03	2.53*
	General	4.91	
Authority	Hospital	4.80	4.44***
	General	4.55	
Content	Hospital	5.10	4.15***
	General	4.90	
Technical	Hospital	4.71	2.86**
	General	4.51	
Elaboration	Hospital	4.82	2.47*
	General	4.69	
Match	Hospital	3.73	-3.90***
	General	4.05	

*p< .05; **p<.01; ***p<.001

Regarding to the evaluative standards, people in hospital would show a higher tendency than people in general public on all standards for judging the accuracy and the usefulness of online medical information. In other words, people in hospital might much prefer to filter the online medical information with mixed standards. Moreover, in terms of searching strategies, their search strategy is more oriented to "Elaboration" which is commonly used by experts, and less oriented to "Match" which is commonly held by novices.

4. Discussion and Conclusion

In this study, MICS is confirmed as a sufficiently reliable tool to measure people's information commitments toward online medical information by exploratory factor analysis. The structure of MICS in the present study is consistent with the results from Wu and Tsai's (2005; 2007) and Liang and Tsai's (2009) studies. Accordingly, the framework proposed by Tsai (2004) is also adequate for assessing people's information commitment toward online medical information in this study.

From the scores of each scale in MICS, people in this study apt to judge the online medical information with mixed standards. The results from Benotsh and Kalichman's (2004) research indicated that inaccurate or misleading information found on Internet might have potentially negative impacts on the medical decision making. For seeking accurate online medical information, people have to verify the information carefully. Therefore, using mixed standards for assessing online medical information might be one of the possible tendencies.

Due to the specific situation people encounter when searching medical information on Internet, the evaluative standards which are commonly held by novices might play as "basic" standards. When searching online medical information, people commonly confront medical terminologies. These terminologies might be some key words as good start points for online medical information searching, but they are also obstacles for impeding the comprehension of health information (Liu & Lu, 2010). Moreover, the Internet is a huge database with explosive information. Too much medical information retrieved also causes information overload (Zeng et al, 2004). By using these basic evaluative standards, for example, people could find preliminary understandings toward a medical terminology from a website organized by governments. Hence, these standards would provide basic assistances for helping people to interpret the medical terminologies and to reduce the information overload as well.

Most importantly, in this study, people still show higher orientations to employ "Multiple sources" for the accuracy of, and "Content" for the usefulness of online medical information. Tsai (2004) has indicated that these evaluative standards which are commonly held by experts would lead to an effective information seeking, and be helpful for seeking adequate online medical information. Therefore, people could find medical information with more credibility with these advanced evaluative standards.

In addition, people in this study showed a strong preference for using "Elaboration" as a searching strategy which is also preferred by university students and medical students in previous studies (Wu & Tsai, 2007; Liang & Tsai 2009). "Elaboration" is categorized as an advanced searching strategy and commonly expressed by experts (Tsai, 2004). As known as the abundant unreliable information online, using "Exploration" should be a preferred searching strategy for exploring useful and adequate online medical information.

By comparing the means of MICS, there are significant differences on the evaluative standards and searching strategies between the people in hospital and people in general public. First, people in hospital have higher scores on the four evaluative standards than people in general. In other words, people in hospital show a higher orientation to employ "mixed standards" to judge online medical information than people in general do. Second, people in the hospital also have higher tendency to use "Elaboration" as a searching strategy than people in general do. For deeply and carefully understanding the diagnoses and the information of their diseases, people in hospital would summarize and compare the online medical information they found.

People in hospital (patients or their relatives) often encounter a more critical medical problem than people in general public. They have a higher need for seeking most credible medical information as references to deal with the medical problem. Therefore, using mixed standards and elaboration as a searching strategy for verifying online medical information they found is more expectable for people in hospital.

5. Implications and future study

MICS, the tool developed in this study, might be a reliable tool for exploring people's information commitment toward online medical information. More related studies are suggested to be conducted for extending our understanding toward different groups. And the reliability and validity could be confirmed by using advanced statistical methods, such as Confirmatory Factor Analysis (CFA). Furthermore, due to the crucial influences of online medical information on peoples' health, people (especially for people in hospital) would tend to employ mixed information commitment when searching online. For helping people get more credible online medical information, some instructional courses should be presented. People might have chances to cultivate their information commitment. It would be helpful for them to hold advanced information commitment toward online medical information, and to find reliable information for dealing with their medical problems.

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Evaluation of DM-Tutor, an ITS for Training on Plantation Decision Making

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Abstract: Over the years many Intelligent Tutoring Systems (ITSs) have been used successfully as teaching and training tools with proven results through evaluation studies. Even though ITSs are effective in providing individualized tutoring to many students at the same time, very few attempts have been made to embed them with existing systems. This area of research has a lot of potential in providing life-long learning and work place training anytime and anywhere. We present the evaluation of DM-Tutor, an ITS that provides training on plantation decision making. DM-Tutor has been embedded with a Management Information System (MIS) to provide scenario-based training using real life operational data and actual plantation conditions. The pilot study conducted in February 2011 shows that DM-Tutor is an effective teaching tool; the performance of the participants on the post-test was significantly higher than their performance on the pre-test. The questionnaire responses show that the participants found the system easy to use and useful.

Keywords: Intelligent tutoring systems, embedded ITSs, management information system, scenario-based training.

Introduction

Rapid technological advances have created profound implications for all levels of education and training around the world. Intelligent Tutoring Systems (ITSs) have become an important class of educational technology that is capable of playing a crucial role helping learners of any age acquire the skills needed to succeed. ITSs have been developed and effectively used for teaching and learning for many years and have been proven in the past to be successful in providing tutoring to any number of students through highly interactive environments [8]. The ultimate goal of ITSs is to achieve the learning gain of 2 standard deviation, the same level achieved by master human tutors in one-to-one interactions with students [5]. Over the years many ITSs including LISP tutor [3], Andes [22], PUMP

Algebra Tutor [11] and others have been effectively used in many teaching and learning domains. SQL-Tutor [13], NORMIT [14], KERMIT [21], UML Tutor [4] and J-Latte [9] are among the many constraint-based tutors (CBT) [15] that have been developed and successfully implemented by the Intelligent Computer Tutoring Group.

Even though ITSs have been proven as effective teaching tools, there have been very few attempts to embed them within other systems. ETS (Embedded Training System) [6], Macsyma Advisor [10], Geometer Sketchpad Tutor [20], Excel Algebraic Tutor [12] and PAT (Personal Access Tutor) [19] are some of the attempts made to embed ITSs into existing systems. Macsyma Advisor was developed to assist users in using Macsyma, the algebraic manipulation system. Macsyma Advisor focused on assisting rather than training, which meant the user, may not have learned how to solve problems unassisted in the future. Although various parts of Macsyma Advisor were implemented, they were not combined into a full working system; and evaluation studies were not carried out to assess the effectiveness of Macsyma. Excel Tutor provided descriptive explanations and interactive guidance for students to solve excel problems and Geometer Sketchpad Tutor taught students how to sketch geometric diagrams. For Geometer Sketchpad Tutor and Excel Algebraic Tutor, users' actions were observed and monitored through the system's interface. Initial evaluations showed that Excel Tutor provided a higher learning outcome for students. However, to our knowledge no detailed empirical evaluation was done to analyze students' interactions with the system. The tutors were not assessed for their effectiveness as educational systems. ETS was developed and integrated with an existing Complex Information System for military tasks and operations. The goal of ETS was to train users on military based scenarios. ETS however was not robust enough to handle a variety of student's actions and behaviors within the system. Evaluation studies were not conducted for the system and the learning outcome was also not evaluated. PAT was added into MS Access to help students build reports and forms. Although the students seemed to like PAT, the system has not been fully evaluated.

In this paper, we present DM-Tutor (Decision-Making Tutor) [1], an ITS that provides training on plantation decision making for the palm oil domain. We aim to make several significant contributions in our research. This will be the first attempt to embed a CBT with an existing system. Secondly, we will investigate the benefits of providing on-the-job training through this integration. Thirdly, we aim to develop a framework for embedded ITSs and prove its research contribution through the development of DM-Tutor and its integration with the MIS for palm oil.

DM-Tutor has been embedded with a Management Information System (MIS) [18] that is currently being used to manage palm oil plantations in Malaysia and Indonesia. The MIS for palm oil contains operational data of yield records and plantation cultivation details. As the information contained is highly domain specific, managers who are new to the domain or to the MIS face difficulties in making accurate operational analyses and this affects the decisions they make at the palm oil plantations. As DM-Tutor is embedded within the MIS for palm oil, users will be able to practice plantation decision making using real-life operational data from the MIS. The goal of DM-Tutor is to help users apply theoretical concepts of plantation analyses into real-life plantation decision making.

This paper is organized as follows. In section 1 we describe the architecture and components of DM-Tutor. Section 2 describes the evaluation study conducted for DM-Tutor and in section 3 we present conclusions and future work.

1. DM Tutor

To the best of our knowledge, there has not been an ITS for plantation decision making, and DM-Tutor is novel in that respect. It is also the first CBT to be embedded with an existing system. DM-Tutor was developed using ASPIRE [16], an authoring system and deployment environment for constraint-based tutors. DM-Tutor is a procedural based tutor. This means that problem solving is divided into several steps and student's solution is evaluated at every step. Students will not be able to continue to the next problem solving step before submitting the correct solution for the present step. Figure 1 presents the overall architecture of DM-Tutor. DM-Tutor consists of a student model, pedagogical module, interface module, constraints that represent domain knowledge and a database of problems and solutions [2].

Student model contains information of student's knowledge and is updated every time the student uses DM-Tutor. Constraint based modeling [17] is used to model the domain and the student. The student's solution is matched to the constraints in order to identify any mistakes, and the student model is updated. The pedagogical module selects instructional actions relevant to the scenario-based problem solving strategy used. It also has the role of providing helpful feedback to users when they submit an incorrect solution.

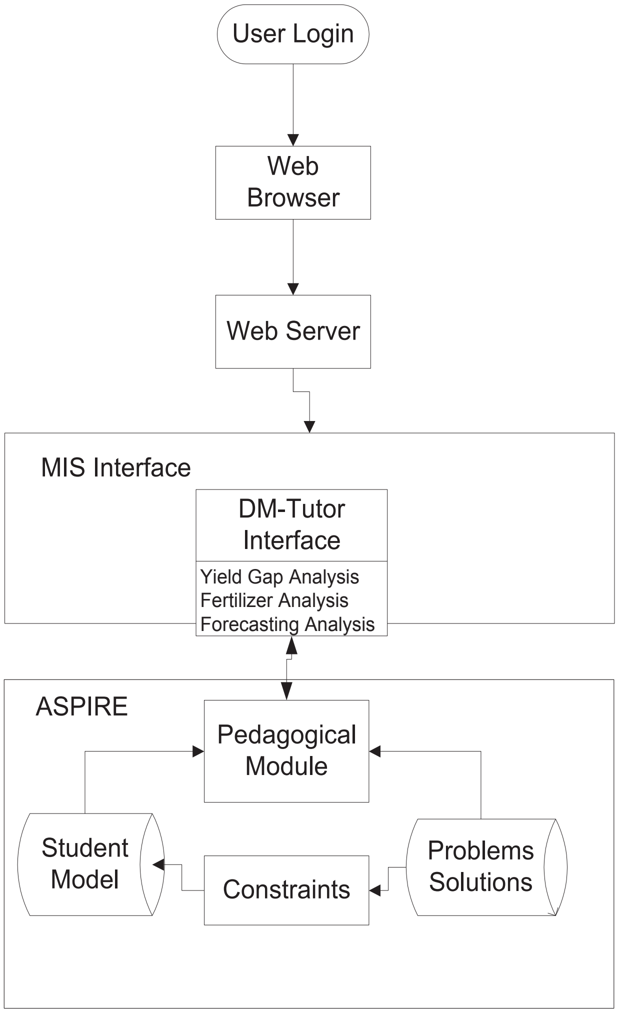

Figure 1: DM-Tutor Architecture

The interface module presents the student interface of DM-Tutor. The problems and solutions component focuses on *Yield Gap Analysis*, *Fertilizer Management* and *Yield Forecasting*, three main analyses for palm oil plantation management [1]. DM-Tutor's interface is designed to reduce the cognitive load so that the student could concentrate on how to solve the problems rather than trying to understand the interface. The interface is developed using Java applets. In order to solve problems presented in DM-Tutor, users need to access relevant reports from the MIS. DM-Tutor logs information on the MIS reports that users accessed. This enables the system to provide helpful feedback about student mistakes.

The MIS is a web-based system and is accessed via a web browser. When users log into the MIS, they would see a menu on the left side of the screen. The menu consists of the various information that MIS contains. This includes maps, graphs and various reports, including yield analysis, upkeep and cultivation analysis, store analysis and vehicle management analysis. An MIS user would access the type of information she/he needs by selecting the type of analysis required, estate name, year and month to view the particular report she/ he needs to work with. Figure 2 illustrates the MIS interface, with the menu of information on the left pane, and a sample of analysis showing *Yield Analysis* for a particular estate on the right. When user selects to view a particular report, a window opens up showing the report (center window of right pane).

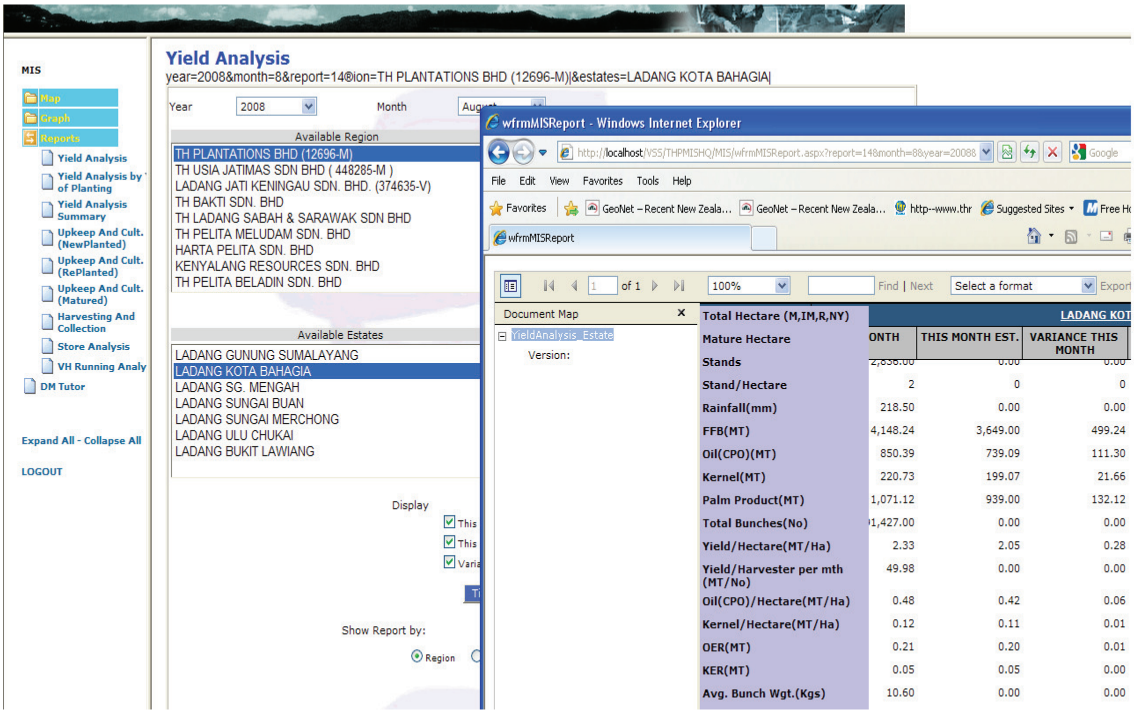

Figure 2: MIS Interface showing a yield analysis report

MIS was modified to allow the integration with DM-Tutor. The menu pane of MIS was changed by adding a selection button (visible in Figure 2) for DM-Tutor. When the student clicks on this button, he/she will be logged into DM-Tutor automatically. The tutor is served by ASPIRE, which assigns a user ID to the user. The interface of DM-Tutor is displayed in a separate window. Once logged in, DM-Tutor users are presented with the three tasks within DM-Tutor: *Yield gap analysis, Fertilizer management analysis* and *Forecasting analysis*. The tasks posed by DM-Tutor contain real life plantation situations and problems. Each task in DM Tutor focuses on one area of the plantation management's concern and requires students to access various plantation areas and specific reports from the MIS in order to answer the questions in DM Tutor. Students also need to use the correct formulas for each analysis.

For *Yield gap analysis* [23], students first have to identify relevant plantation areas and their potential yield in the MIS. Next they need to calculate yield gap between plantation areas using the correct formula. Lastly, they need to give their recommendation on how to improve yield of that particular area. The focus of this task is to train students on how to focus management's efforts on improving conditions in plantation areas that needs management attention the most.

For *Fertilizer management analysis* [7], students need to calculate the *partial factor productivity* (PFP) and *agronomic efficiency* (AE) for a given plantation area in the MIS using a formula. They need to select the accurate nutrition combination required for the palm trees based on the age of the tree (identified from the MIS). Lastly, they need to solve a fertilizer management problem to improve yield for the given plantation location. This task teaches users on how to efficiently manage plantation nutrition.

For *Forecasting analysis* [23], students are required to calculate a future yield value based on the present yield value of a given plantation area in the MIS. They will then need to provide their solution to a given plantation scenario problem where yield losses have occurred due to various plantation conditions. This task teaches students to plan the plantation area's future yield based on current yield conditions.

When students select a task, they are presented with the window that shows the problem and solution workspace. DM Tutor evaluates the student's solution step-by-step, immediately after the student submits his/her solution for the current step. If the submitted solution is incorrect, DM-Tutor provides various levels of feedback that guides the student towards the correct solution. Only when the solution is correct, the student is allowed to move to the next step of the problem. Figure 3 shows a screen shot of a problem step in the Forecasting Analysis task in DM-Tutor.

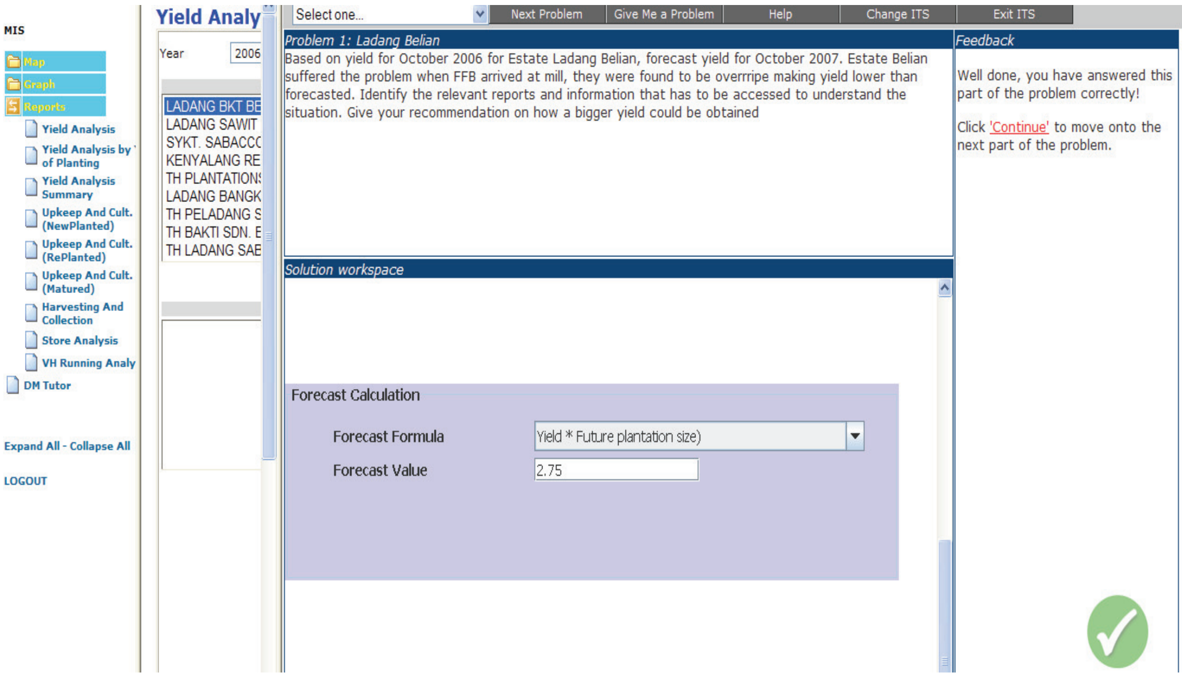

Figure 3: MIS interface with DM-Tutor's problem-solution workspace

In the example shown in Figure 3, the student has selected the correct formula to calculate yield forecast and has calculated the forecast accurately. As a response, DM-Tutor has provided a feedback message for the student to continue to the next problem step in Forecasting analysis task. The MIS and DM-Tutor frame can both be resized by the student at any time to allow more visibility for either system. All of the user's actions within DM-Tutor are recorded and used to model the student's knowledge of the domain. Once the student has completed a problem correctly she/he can choose to practice another problem or a different analysis.

2. Evaluation Study

Evaluation of ITSs should focus on the educational impact on students. We conducted a pilot study of DM-Tutor in February 2011 with the goal of evaluating its effectiveness as a teaching and training tool for the palm oil plantation decision making domains. We also wanted to identify any technical issues, interface problems and system usability concerns that needed to be solved. The study was conducted with a group of 22 employees working for a palm oil plantation company in Kuala Lumpur, Malaysia. All the participants were already familiar with the MIS for palm oil as they use a similar version of the system for their everyday work, so their knowledge of the MIS system was not evaluated.

We provided the participants with a demonstration on DM-Tutor, describing the different tasks contained inside DM-Tutor, problem selection and the various levels of feedback messages available. They were informed during this demonstration that their participation in the study was on a voluntary basis. The participants were given a pre-test before interacting with the system. The pre-test contains three questions, one for each task of DM Tutor. Each pre-test question is a shorter and simpler version of the actual problems in DM Tutor. Participants spent 15 minutes doing the pre-test, after which they interacted with the system for one hour. Lastly, they worked on the post-test for another 15 minutes and also completed the questionnaire. The post-test also consisted of three questions, of similar complexity to those in the pre-test. Out of the 22 participants who initially volunteered, only 19 stayed through the whole study. Table 1 presents the basic statistics about the participant's interaction with DM-Tutor**.**

Table 1: DM-Tutor Interaction Results

User log data from DM-Tutor	Mean (sd)
Interaction time (min)	27.20 (24.43)
Number of problems attempted	2.85 (1.23)
Number of problems solved	2.05 (1.05)
Number of submissions made	38.05 (8.96)
Number of feedback messages seen	19.80 (8.25)
Pre-test result (%)	50 (16)
Post-test result (%)	78 (21)
Gain (%)	28 (0.15)

Only three participants interacted with DM-Tutor for one hour or more. On average, the participants interacted with the system for about 27 minutes. The possible reason for this could be that the study was held during office hours and the participants had to complete their pre-assigned daily work load as well. The number of problems attempted by participants is higher than the number of problems they managed to solve. To solve the given problems, the participants made around 38 submissions of answers to DM-Tutor (please note that a submission is a partial answer, which covers only the current step of the task). From Table 1, we can observe that the participants have utilized the feedback messages in DM-Tutor to help them to solve the given problems.

Out of the 19 participants, only 8 completed both the pre-test and post-test for this study (the others completed only one test). Therefore, we only report the pre/post test results for those 8 participants in Table 1. We found that the performance on the post-test is significantly higher than the performance on the pre-test ($t= 1.89$, $p= 0.005$, $df=7$). From the pre-test and post- test results we could observe that the participants' knowledge in palm oil plantation decision making increased after using the system; the amount of increase is strongly correlated with the time the participants spent with the system ($r=0.92$).

From the 19 questionnaire responses obtained, we found out that 74% of the participants thought that DM-Tutor was easy to use. 52% of the participants found the feedback messages in DM-Tutor to be helpful in answering the questions. When they were asked if they liked DM-Tutor's interface, 63% of the participants said that they did. One of the participants commented that he liked this new version of the MIS. When asked if DM-Tutor was able to teach them any new palm oil plantation decision making analyses, all the participants answered ‘yes’. One participant said that DM-Tutor helped to teach her how to use the information in the MIS to make better decisions. Another participant said that she knew now what yield gap analysis and fertilizer efficiency were, after using DM-Tutor. When the participants were asked if they felt that by integrating the Management Information System (MIS) with DM-Tutor they were able to learn the plantation analyses better? All of them answered ‘yes’. One participant said that he liked to see the MIS and the teaching system together. Another participant stated that she liked the idea that she could stop learning and continue to work with MIS when she needed to and another participant was happy that she could choose the analyses that she needed to learn and that she could check the analysis again if she was not sure.

3. Conclusions and Future Work

ITSs have proven to be successful in many instructional domains. ITSs are better than computer-based training or multimedia-based training methods that only present information and test recall of factual information through multiple choice questions. ITSs are effective in providing individualized one-to-one teaching or learning to many people at the same time. By embedding DM-Tutor, a constraint-based tutor, into a MIS for palm oil we hoped to provide scenario-based training (SBT) on palm oil plantation decision making using real life operational data and actual plantation conditions. Our goal was to make several significant contributions through this research. DM-Tutor is the first CBT embedded within an existing live system. Through this research we aim to develop a framework for embedded ITSs. We aimed to investigate the benefits of providing training through this integration. We hoped to prove our research contribution through the development of DM-Tutor and its integration with the MIS for palm oil.

From the pilot study, we found that the users have interacted well with DM-Tutor. They have used the information from the MIS to answer the questions posed by DM-Tutor. The participants have also utilized the feedback messages in DM-Tutor to help them answer the given questions. From the pre- and post-test results it is proven that the users have improved their knowledge of palm oil plantation decision making after using DM-Tutor. It was also very encouraging to get positive comments on DM-Tutor from the participants of the study. However, our study was small in terms of the number of participants, and therefore more evaluation is needed.

Currently, we are making further enhancements to DM-Tutor. We have modified the MIS to automatically send information about which reports the user has looked at in MIS directly to DM-Tutor, thus making interaction easier for users (as they do not have to type report details). We plan to conduct a full evaluation study of DM-Tutor in 2011 with a group of students currently enrolled in the Master’s in Plantation Management program at the Putra University of Malaysia. We believe that our research has many potential benefits. Apart from the research contributions discussed above, DM-Tutor also has the potential benefit of providing life-long workplace learning, anywhere and anytime.

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Professional Development Needs of Singaporean Teachers for the 3rd ICT Master Plan

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Abstract: This paper reports the current implementation status of the ICT masterplan 3 in Singapore schools. The focus is on teachers' use of ICT to promote self-directed learning and collaborative learning among students in primary and secondary schools. We employed a mixed method: an online survey complemented by focus group discussions (FGDs) and interviews. The survey was administered on 50 primary and 50 secondary schools across Singapore. FGDs and interviews were conducted with teachers and school leaders from 12 participating schools. The survey indicated that teachers perceived a low use of ICT for SDL and CoL. FGDs revealed that they faced problems of time constraint, mindset issue and students' ability when delivering lessons with ICT. Interviews with school leaders indicated that teachers need to enhance their understanding of the concepts and ICT tools. In moving forward with the reform directions, we proposed professional learning community among teachers to co-construct curriculum-based usage of ICT for the two strategic foci (SDL and CoL).

Keywords: ICT, teachers' perception, SDL, CoL

Introduction

The rapid advancement of information and communication technology (ICT) has led to many developed countries implementing educational reforms for the integration of ICT in education [1]. In Singapore, the Third Masterplan for ICT in Education (mp3) was launched in August 2008 to take schools forward in the use of ICT for enhancing 21st century learning. This educational reform seeks to enrich and transform the learning environments of students in Singapore schools and equip them with the critical competencies and dispositions for self-directed learning (SDL) and collaborative learning (CoL) through the effective use of ICT [2]. In the following year, a longitudinal (5 years) evaluation study was commissioned by the Ministry to assess the implementation status. The study aims to find out the possible impact of mp3 on school leaders and teachers and students as well as how schools implement mp3 and the possible contributing factors leading to the outcomes over the five years. This paper reports the findings over the first three years (2009 to 2011). The focus is on the teachers' use of ICT to promote self-directed learning and collaborative learning among students in primary and secondary schools.

1. Literature Review

1.1 SDL and ICT

According to Knowles [3], self-directed learning can be defined generally as a process in which individuals take the initiative with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying resources and learning strategies, implementing the plan and evaluating outcomes. SDL stresses on personal autonomy, self management and control and the independent pursuit of learning [4]. It regards learners as responsible owners, managers and regulators of their own learning process [5]. Therefore, self-directed learners should possess various traits which include motivation, goal orientation, locus of control, self-efficacy, self-regulation and metacognition [6].

Recent research evidence has revealed that ICT is an important medium for students to develop SDL competencies. Vonderwell and Turner [7] held that online learning environment provide more control of the instruction to the learners and thereby could enhance aspects of SDL in areas such as students' responsibility and initiative towards learning. Likewise, Song and Hill [8] reported that in an online environment, self-directed learners demonstrate control, critical reflection and responsibility.

1.2 CoL and ICT

Collaborative learning refers to the social process whereby students interact for the purpose of learning [9]. CoL emphasizes co-construction of knowledge within social contexts of learning such as negotiation and group processing [10]. Besides, successful collaborative learning environments entails positive interdependence and individual accountability in a group setting [11]. Technology is increasingly providing new possibilities for collaborative learning [12]. For example, social software such as Blogs, Wikis, or other collaboration systems, has the unique effect of spurring online interaction, which is the foundation for cognitive development, teaching, and social presence [13]. More importantly, research studies [14] have reported positive learning outcomes of collaborative Internet projects: increased student motivation and understanding of learning as students learn in groups through the use of ICT.

1.3 Research gap

The affordances of ICT to facilitate SDL and CoL have been well-documented in the past decade. However, teachers' use of ICT for these two strategic foci in Singapore schools appears less informed. In this paper, we report the teachers' perceptions of their use of ICT for SDL and CoL in Singapore schools.

2. Methods

The study adopts a mixed-method design by including survey data (quantitative) and FGDs with teachers and classroom observations (qualitative). This paper reports the survey results on teachers' perceptions on the use of ICT for SDL and Col as well as the key findings from the FGDs and leaders interviews. The survey was administered online while the semi-structured FGDs and interviews were conducted face-to-face with teachers and school leaders. Each FGD or interview session lasted 40 to 60 minutes and was audio-recorded. Transcripts of the recorded audios were analysed. Sample items of survey and FGD/interview questions are provided in the appendixes.

3. Participants

The survey was administered in 50 primary and 50 secondary schools. Random sampling was employed in the first year and the same schools were studied over the 5 years. A total of 1684 primary and 1899 secondary teachers participated in the online survey in 2009. The 2010 and 2011 survey respondents included respectively: 1654 primary and 1899 secondary teachers; 2049 primary and 2121 secondary teachers. The FGDs were conducted in 6 Primary and 6 Secondary schools. Sampling was purposive: based on their level of ICT use for SDL and CoL drawn from the 2009 baseline survey results. In each school, one FGD with 6 to 8 teacher participants was conducted.

4. Findings and Discussion

4.1 Survey findings

A mid-point of 3.50 was chosen based on a likert scale of 1 to 6, with 1 as “not at all” and 6 as “all the time”. Results on teachers’ engagement in promoting SDL and CoL among students were generally positive. The overall mean responses from 2009 to 2011 were 4.26 for engagement in SDL and 4.28 for engagement in CoL, both above the mid-point over the 3 years. However, the overall mean responses for use of ICT for SDL (SDLT) were below the mid-point over the 3 years (M=3.09 for the three years). The results indicated a less desirable use of ICT from teachers in promoting SDL among students. Similarly, the overall mean response for use of ICT for CoL from 2009 to 2011 is 3.43, slightly below the mid-point, which indicated a less desirable use of ICT among teachers for fostering CoL in the class.

4.2 FGDs findings

Data collection for current year is ongoing hence we present findings from year 2009 and 2010. The FGDs revealed 3 key obstacles that teachers faced in using ICT for promoting SDL and CoL among students. These problems were common to both primary and secondary school teachers. First, teachers interviewed felt that time constraint was a key obstacle for them to infuse ICT into their lessons. They elaborated that these constraints were imposed by a need to rush for the syllabus; lack of time to explore ICT resources and technical problems associated with computer use.

> Time is actually the factor that… influences the use of ICT during my lessons. Because we still need to rush for the syllabus… so… not every single lesson is actually possible to infuse the ICT tool… (Secondary school teacher)
>
> MOE (Ministry of Education) do give us resources like edumall, and also the sharing portal within the cluster and in the cluster. I think that is a very good platform for us to actually look for resources. But one thing we don’t have is… the time to go and search for resources which is like thousands… of them (Primary school teacher)

Next, the teachers interviewed reported mindset problems. Some believed that they “might not see the full potential for IT” because they are “not… IT-savvy” or “not familiar with the software”. Others felt that the use of ICT may not “adds value” or “enhances the lesson” and these teachers are less motivated to "go through the trouble to try to do it". Instead, they preferred to stick to the pen and paper.

> The reason why I use ICT is to… enhance the learning. But if pen and paper can do a better job then I might as well use pen and paper… (Secondary school teacher)

The third obstacle teachers faced was related to the students' ability in using ICT for SDL and CoL. Teachers were cognizant of irresponsible students and they felt that lessons using ICT for SDL or CoL were less effective to engage them.

> Students can just go to internet and copy a whole chunk of thing and they can say that they have researched and they have found the answer. But we question them we realize that they don't know anything. (primary school teacher)

> When teachers bring [students] to the class then they would prefer to go to internet to surf and go to sites that excite them rather than follow the lesson… (Secondary school teacher)

4.3 Interviews findings

Findings from the school leaders corroborated with that reported from the teachers. The leaders also reported obstacles to mp3 implementation associated with teachers' mindset and time constraints imposed by syllabus coverage.

> Some people might feel that, chalk and talk, the old traditional method will get it done. So why should I bother. So mindset change is an issue for some. (Primary school principal)

In addition, the leaders felt that teachers could enhance their capacity to use ICT for pedagogical purposes. Most leaders reported that their teachers were competent in the use of ICT tools but they have yet to integrate ICT into pedagogy effectively. One primary school principal described, "sometimes the technology does not really adds value to the lesson" and "the focus is on the technology rather than the pedagogy". Another key concern among the leaders was related to the understanding of SDL and CoL. The leader generally agreed that the understanding of these concepts need to be enhanced and regulated among teachers.

> mp3 is calling for self directed, a very high level. But if your HODs, the level heads and all do not know, then how will it carry out. I think the training that has to be provided… probably more of a collaboration with them implementing it in the school (Primary school principal)

> You have got to figure out what it means first, perhaps take away the ICT and understand what CoL is in terms of the pedagogy itself, the understanding of what the students are supposed to develop at the end. And after we can figure out and are quite consistent in our understanding of what the idea is, then we ask what does SDL and CoL look like when we have IT in use in the lessons, so that we have a common understanding of what these phrases mean and in the classroom in terms of lesson design, that has to be sorted out. (Secondary school principal)

The findings from the FGDs and interviews suggested that there is a considerable level of challenge for both primary and secondary school teachers in using ICT to promote SDL and CoL among students. To help teachers in moving forward with the reform goals, school leaders could consider more support structures for ICT integration. For example, infusing some form of curriculum space for teachers to plan ICT-based lessons and creating more professional development opportunities for teachers to enhance their ICT and pedagogical competencies. As a suggested way forward, schools might adopt teacher professional learning communities (PLC) [15] to co-construct curriculum-based use of ICT for SDL and CoL. Through PLC, leaders and teachers could collaborate to set the directions for the school to bring about positive student outcomes related to mp3. Moreover, PLCs within schools enable teachers from the same level and teaching the same subjects to regularly share best practices and learn from one another. Such continuous professional dialogue and feedback could help teachers enhance their understanding of ICT tools and pedagogy and hone their own classroom practice for using ICT for 21st century learning.

5. Conclusion

The implementation of mp3 aims to bring about 21st century learning through the use of ICT in Singapore schools. Specifically, schools are called to integrate the use of ICT for SDL and CoL among students. From this study, we concluded that the integration of ICT into lessons for developing students' SDL and CoL competencies among teachers is less pervasive. Teachers are still caught up with problems related to time constraints and mindset issues. These findings were corroborated with those from the leader interviews. It is perhaps useful for schools to adopt more implementation strategies. Schools for example are encouraged to form teacher PLCs to co-construct curriculum-based used of ICT for the two strategic foci. This is hoped to promote better awareness and understanding on the use of ICT for SDL and CoL among teachers and help them to hone and align teaching practices toward the reform directions.

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Appendix 1

Sample items of online survey questions for the teachers' use of ICT to promote SDL and CoL among students

	Sample items
SDL	I get my students to use ICT as part of their schoolwork in the following ways: a. Share their thoughts and ideas about their schoolwork (e.g. through multimedia storytelling, voice-recording, blogs) b. Find out more information on the Internet on their own to understand their lessons better
CoL	I get my students to use ICT as part of their schoolwork in the following ways: a. Work with their group members to complete a project b. Share their thoughts with their group members on how they can work better together.

Appendix 2

Sample questions for FGDs and Interviews

Teachers

1. Can you describe the most recent ICT–integrated lessons that you have conducted in class?
2. How do you promote or encourage self-directed learning in your lessons?
3. How do you promote or encourage collaborative learning in your lessons?
4. Can you describe some factors that influence your use of ICT to facilitate teaching and learning at a class level?

School leaders

1. Can you describe some plans/goals for the use of ICT in your school currently?
2. What are the directions you give to your staff concerning the use ICT for teaching and learning?
3. What are the processes in place to promote ICT integration and use among staff?
4. What are some key problems that you have encountered in promoting and implementing ICT use? How did you overcome the problems?

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Exploring college students' perceptions of classroom learning in a knowledge building environment

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Abstract. This study examined students' perceptions of classroom learning in a knowledge building environment. The participants were 48 college students in Taiwan, who participated in a course titled "Introduction to Natural Sciences." The course was implemented based on knowledge building pedagogy. The online learning environment, Knowledge Forum, was employed to help engage students in collaborative knowledge building. A questionnaire (SPOCK) on the perceptions of classroom learning and knowledge building was employed to assess how students' viewed their learning activities in class. The findings indicated that the students involved in a knowledge-building environment perceived stronger student-centeredness for their classroom learning than those who were not involved in a knowledge-building class. Further analyses on students' online discourse will be conducted to better understand students' perceptual change.

Keywords: knowledge building, Knowledge Forum, perception of learning.

Introduction

Traditional instruction tends to be more teacher-centered in which learning usually emphasizes knowledge assimilation, rather than knowledge construction. However, with recent advances in computer-supported collaborative learning (CSCL) environments, more creative learning and knowledge construction have become possible [1][2]. Nevertheless, despite the widespread use of CSCL environments, less attention has been given to learners' perception of CSCL environments. Tsai [3] argues that students' conceptions and attitudes of web-based learning are important prerequisites to effective web-based instruction. If students thought that learning is an individualistic activity, they will be less likely to involve in collaborative learning. On the contrary, if students are often engaged in environments that emphasize knowledge sharing and co-construction, their conception of learning will be more group-oriented. Given the increasing importance of CSCL in today's education, it is timely to investigate students' perceptions of online learning environments.

Knowledge building theory

In the present study, we are interested in investigating students' perceptions of a knowledge building class. Whitehead [4] argues that learning should not be regarded as a process of accumulation of knowledge; instead, we have to take an innovative viewpoint that highlights the reproduction and transformation of knowledge in education and emphasizes learning as active, critical and creative activities. From a knowledge building perspective, knowledge can be changed or improved through continual idea generation and improvement [1][5. The concept of knowledge building theory was originally proposed by Scardamalia and Bereiter [5]. According to them, knowledge and ideas should not be seen as personal properties, but should be treated as public, social epistemic entities, which can be continuously improved via community members' collaboration, interaction, elaboration, and innovation of ideas. When engaged in knowledge building, members of a community are guided to address authentic problems, and to facilitate the exchange and transformation of ideas, in order to achieve the goal of collective knowledge advancement.

To facilitate knowledge building, Scardamalia [6] proposed a set of 12 principles to help conceptualize the complex social dynamics involved in knowledge building environments. They include authentic problem; improvable ideas; idea diversity; rise above; epistemic agency; community knowledge; democratizing knowledge; symmetrical knowledge advances; pervasive knowledge building; constructive uses of information; knowledge-building discourse, and concurrent assessment (see [6] for detailed explanations). These principles are intended to help teachers better understand the process of knowledge building so as to support the process of classroom knowledge work among student learners. Empirical research has demonstrated positive effects of knowledge building pedagogy on depth of inquiry, collaboration, and co-construction of knowledge, both from Western and Eastern cultures [5], [7], [8].

Researchers studying classroom climate have demonstrated the classroom climate which teachers construct has effects on students' learning [9][10]. To date, at least two broad types of learning environments have been identified. One is a teacher-centered learning environment, which usually focuses on lecturing and instilling textbook knowledge, and hopes that students' academic achievement can be improved by means of direct knowledge delivery [11]. In Taiwan, teaching is often presented this way, emphasizing on the importance of knowledge acquisition and neglecting students' creative capacity for knowledge creation. Another is a student-centered environment, which in contrast pays more attention to students' innovative learning processes and needs, with the role of teachers as someone who provides support to help students learn in a more self-initiated and self-directed manner. Pratt [12] argues that the student-focused learning environments provide students with more encouragement to build mutual confidence between teachers and students. Therefore, it is important to create more student-centered learning environments and we envisage that engaging students in a collaborative knowledge building environment should have positive effects on their views of classroom learning. Yet, such assumption remains to be tested (especially in an Eastern cultural context). As such, this study investigates the effect of implementing knowledge building pedagogy in shaping students' perception of classroom learning.

Method

The Participants in this study included 48 college students (26 females) in a top Taiwanese university (these students were ranked above the 95th percentile nationwide). Learning from textbook for the purpose of achieving high scores in standardized tests are considered as a cultural norm in the nation. As such, the adoption of knowledge building pedagogical approach represents a novel instructional approach. The study took place in a class titled "Introduction to Natural Sciences" over a period of an 18-week semester. Knowledge-building pedagogy and Knowledge Forum technology were implemented in the class to provide students a learning environment that emphasized collaborative learning and knowledge creation. To facilitate the adoption of knowledge building pedagogy and technology, a tutorial workshop was given in the beginning of the semester (e.g., students learned how to create, and build-on to others' notes). The instructor was familiar with knowledge building pedagogy, and had 6 years of experience of using Knowledge Forum at the time this study was implemented. Some instructional activities included reading papers, class discussion, watching videos, and online threaded discussion. Knowledge Forum was used to support knowledge building activities (e.g., helping students generate deeper ideas for solving practical problems through sustained generation, interaction and elaboration of ideas). Figure 1 shows a screenshot of a Knowledge Forum 'view' (a discussion board).

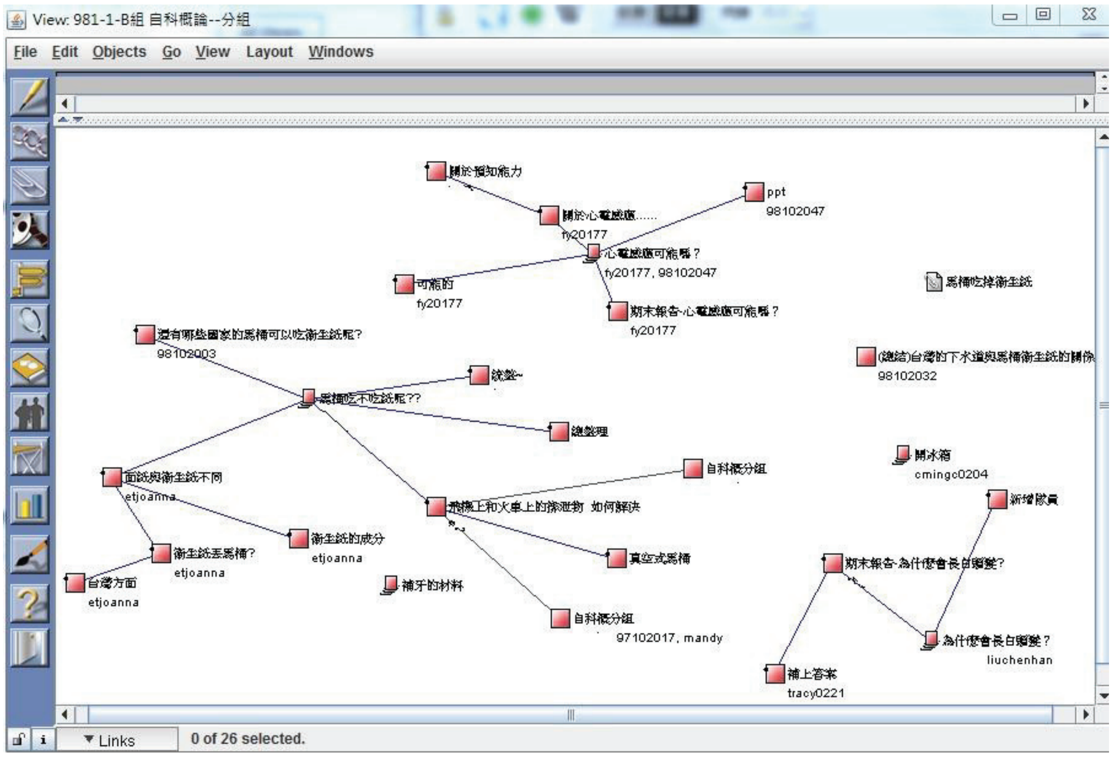

Figure 1. A screenshot of a Knowledge Forum 'view'

The data of this study came mainly from student's online performance; in addition, this study employed a 5-point Likert survey called Student Perception of Classroom Knowledge Building (SPOCK) [13]. The survey measures six aspects of student' perceptions in class: (a) Self-Regulation (nine questions; e.g., in this class, I take notes and jot down questions when I am reading the class materials); (b) Knowledge Building (10 questions; e.g., in this class, I think about different approaches or strategies I could use for studying the assignments); (c) Question Asking (three high-level questions, e.g., in this class, I ask questions about things I am curious about, and four low-level questions, e.g., in this class, I ask questions so that I can be sure I know the right answers for tests); (d) Lack of Initiative (10 questions; e.g., in this class, I rely on someone else to tell me what to do); (e) Cooperative Learning (five questions; e.g., in this class, my classmates and I actively share ideas); and (f) Teacher-Directed Classroom (seven questions; e.g., in this class, I get most of the information from the textbook and the instructor).

Coefficient alpha reliability estimates for SPOCK were consistent with those obtained for similar instruments, such as the Motivated Strategies for Learning Questionnaire (MSLQ) and LASSI [14][15]. The Cronbach's alpha for SPOCK for this study was .93. At the end of the semester, the students were asked to use the SPOCK survey to report their perceptions of learning in this particular knowledge building class. As it is only sensible to assess class climate after a class is finished, no pre-test was conducted; to compensate, an additional survey was made to the same students by asking their learning perceptions in other non-knowledge-building classes in the school, using the same survey. The results derived from the knowledge-building and the non-knowledge-building environments were then compared, by means of a paired-sample *t*-test.

Results

Table 1 shows data regarding basic knowledge building activities (derived from the Analytic ToolKit) which was used to show the intensity of collaborative learning activities over the semester (two phases,. each last for nine weeks, were divided using midterm exam as a separating point). Overall, paired-sample t-tests indicate that there were no significant differences between the two phases in all the knowledge building activities. The number of notes generated and worked-on, the number of notes being read, and the number of notes being built-on/linked indicate that the classroom community can be regarded as fairly active and collaborative (see for example, [16]). The findings suggest that the time and effort spent on learning and using the KF for discussion is equally distributed between the two phases. Table 2 further shows that there were significant correlations among most of basic KB activities, indicating that the more active the participants were in a KB activity, the more likely they would be actively engaged in another activity.

Table 1. Basic knowledge building activities

Activity	Phase 1	Phase 2	t-value
	M(SD)	M(SD)	
# of notes created and worked	14.27(12.45)	11.44(7.17)	1.58
# of notes read	162.17(111.64)	171.73(127.96)	-0.47
# of notes built-on	11.08(11.77)	8.21(6.66)	0.10
# of Reference	3.27(3.58)	1.96(3.85)	1.78
# of scaffolds used	10.81(13.05)	7.50(7.83)	1.88
# of annotation	0.13(0.44)	0.67(2.29)	-1.61

Table 2. Correlations among knowledge building activities in Knowledge Forum

KB activity	1	2	3	4	5

1. # of notes created/worked	-				
2. # of notes read	.488**	-			
3. # of notes built-on	.734**	.460**	-		
4. # of Reference	.27	.320*	.25	-	
5. # of scaffolds used	.676**	.578**	.85**	.28	-
6. # of annotation	-.00	.04	.09	-.06	.06

* $p < .05$. ** $p < .01$.

SPOCK analysis. Table 3 further shows a comparison between students' perceptions of learning in the knowledge building class and their overall perceptions of learning in non-knowledge classes in the school. Of the six aspects of SPOCK, it was found that students in a KB class were more likely to engage in knowledge building activities (*M*=3.94>3.50), in asking higher-level questions (*M*=3.68>3.21), and in working collaboratively (*M*=3.98>3.44). They are also less likely to be lack of self-initiative (*M*=3.12<2.93) and they perceived lesser teacher directedness in their classroom learning (*M*=3.69<3.07). On the other hand, students in a KB class were less likely to engage in a self-regulatory mode (*M*=3.40<3.65). Overall, the results suggested that students in a KB class tended to perceive their class as a more constructivist-oriented, student-centered classroom.

One thing to note is that the rating of students' perceived "Self-Regulation" is low in a KB class. This may be because the questions asked in the survey were mainly about the routine class assignments (e.g., a question item asked, "In this class, I think about the best ways to study each assignment."), rather than working for the purpose of knowledge building that was pedagogically designed for this class (e.g., asking whether students would become more self-directed learners in producing ideas for solving real-life, rather than textbook, problems). Thus, it is not surprising to see lower ratings in this aspect. Further, the reason why the lower-level questioning behaviors did not differ significantly as expected was perhaps because most students tended to use lower-level questions as a basis fundamentals to gradually build up to higher-level questions. To sum, the findings indicate that engaging students in knowledge building activities did help them perceive their class as more collaborative and interactive for the advancement of knowledge.

Another thing to note is that a significant correlation (r=.0297, p<.05) was found between the total number of notes created/contributed/worked in the KF and the combined SPOCK score (which was computed by adding all the average ratings of the positive dimensions and subtracting that of all the negative dimensions). This suggests that in general, the more activities students engaged in KF, the more likely they would perceive the class as student-centered. Whether this also represents a causal relationship, however, remains to be examined.

Table 3. Differences in terms of aspects of students' perception of classroom

Aspect	Non-Knowledge building environment *M (SD)*	Knowledge building environment *M (SD)*	*t*-value
Self-Regulation	3.65 (.52)	3.40 (.49)	3.35**

Knowledge Building		3.50 (.48)	3.94 (.46)	-6.70***
Question asking				
	Lower level	3.31 (.72)	3.27 (.59)	0.44
	Higher level	3.21 (.70)	3.68 (.82)	-4.67***
Lack of Initiative		3.12 (.38)	2.93 (.51)	2.91**
Cooperative Learning		3.44 (.61)	3.98 (.51)	-5.70***
Teacher Directed Classroom		3.69 (.48)	3.07 (.65)	5.22***

** $p < .01$. *** $p < .001$.

Discussion

In summary, the findings in the present study showed that engaging students in knowledge building activities was helpful to change how they perceived learning in many important aspects. For one, as compared with non-knowledge-building classes, students engaging in a knowledge building class tended to ask more high-level questions. Second, through the process of idea interaction and knowledge creation, students were more likely to see collaboration as part of their learning processes. Third, they also tended to perceive learning as student-centered rather than teacher-directed. Overall, engaging students in knowledge building activities seemed to help them develop more positive perceptions towards knowledge building practices.

Learning and teaching are not independent of each other. To make a learning environment more effective, it is important to bridge the gap between them. One way to mitigate this gap is to help teachers better understand students' perceptions of class learning. Doing so is helpful for teachers to figure out how to improve their instructional processes in order to help students develop more positive and enthusiastic perceptions of learning.

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Mobile technology and CAD technology integration in teaching architectural design process for producing creative product

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The purpose of this research is to examine the effect of integrating the mobile and CAD technology on teaching architectural design process for Malaysian polytechnic architectural students in producing a creative product. The website is set up based on Caroll's minimal theory, while mobile and CAD technology integration is based on Brown and Campione's technology of learning theory. This study utilized a quasi-experimental method. Final semester students from four (4) polytechnics being used as research samples where sixty (60) students are in the treatment group and another sixty (60) students are in the control group. The final products being evaluated by the experts in architectural field using an instrument based on Creative Product Analysis Model (CPAM). The inferential statistics namely T-Test and Pearson Correlation Analysis with a significant level p = 0.01 were utilized. Research outcome shows that there is a significant difference between the treatment group product (M=79.1) and control group product (M=70.5). This research contributes to the use of real case in the development of an architectural website, in the use of mobile technology as media information sources, the use of CAD technology integration in designing process and in the construction of validated instrument which is used to evaluate creative architectural products.

Keyword: real case, mobile technology, CAD technology, design, creative product

1.0 Introduction

Architectural design is a complex and open process. Designing process starts from abstract which had a problem to be developed stage by stage until a level where it can be produced as a product. Lawson (2007) states that architectural design is a process where an architect produces space, place and building which has a big amount of effects on human life quality. This research concentrates on schematic stage of design process which involves sketching and schematic design. As a conclusion, the beginning stage of design process involves collecting the information needs in the design process and producing new ideas. Technological development nowadays, has given chances for mobile and CAD technology to be integrated in design process. Mobile technology gives chances for students to have access to the information without time and place limits. Websites referring to real cases provide opportunity to gather quick information for design process purpose. CAD technological development in three dimensional digital model and computer simulation can provide new methods for designers to find more solution in schematic design process.

1.1 The purpose of the research

The purposes of the research are to identify the interest of the student in finding informations need in the design process through web mobile or conventional method, to study the effect of integrating mobile technology at the analysis stage in the design process , to study the effect of integrating CAD technology at the synthesis stage in the design process , to study the effect of integrating CAD technology at the simulation stage in the design process, to study the effect of integrating mobile and CAD technology in producing the final product of architectural design and to see the relationship between the integration of mobile and CAD technology in the design process with the creative product of architectural design

1.2 Conceptual framework

The conceptual framework for this research was built based on Carroll's minimal theory (1995), Brown's and Campione's learning with technology theory (1996) and creative product analysis matrix model (CPAM), Besemer dan Treffingger (1981). This conceptual frame consists of two independent variables and one independent variable. Two independent variables are the use of web mobile in obtaining design's information and the use of CAD technology in creating new ideas activities whereas the independent variable is the creative product from the design process. For this research the design project programme prepared by the researcher. The web mobile for gathering information activity had been developed by the researcher based on Carroll's minimal theory (1995). The intergration of CAD technology in the design process occurred at the synthesis stage, the simulation stage and before producing final creative product. Evaluation instruments created by the researcher being used to evaluate product from analysis stage, synthesis stage and simulation stage. The final products had been evaluated using the instrument that built by researcher based on CPAM model. The products from each stage compared by researcher to study the effect of integrating mobile technology and CAD technology in design process.

2.0 Research methodology

This research consists of two main activities in the design process which is designs' information development activity and creating new ideas activity. Information searching for design purposes on web site based on real case is provided by researcher using mobile device while for creating new ideas activity, CAD technology is used. The web site used in this research developed by the researcher using Caroll's minimal theory. In applying Carroll's Minimalist theory when developing the web site the researcher follows the recommendations by Kearsley (1994) which are to allow learners to start immediately on meaningful tasks to minimize the amount of reading and other passive forms of training by allowing users to fill in the gaps themselves and to make all learning activities self-contained and independent of sequence. The web site that had been developed for this research can be referred at http://www.kajian_senireka.param.mobi. The integration of the web mobile and CAD technology in the design process for this research is based on Brown and Campione (1996) learning with technology theory. With this theory the integration should be done with the latest equipments required to get the accurate results. Through this study, researcher wants to see the differences in final product designed using mobile and CAD technology integration with the final product build using conventional method. Researcher also wants to see upon how is the effect of integrating web site based on mobile device in the design information development activity. This is a quantitative research to study the effects of mobile and CAD technology integration in the design process to produce architectural creative product. Quasi experimental method is used to study mobile and CAD technology integration effects in design process.

2.1 Research Samples

Research has been made on final semester students of diploma architecture from four (4) polytechnics. The students have the basic skill for using ACAD 2007 and 3D Studio viz software. Research duration is for six weeks involving one hundred twenty students (120) students as research samples. In this research, research samples have been asked to design a kindergarten. Sixty (60) students from POLIPD and PMM were selected to design with the integration of mobile and CAD technology and they are used as treatment group while the other half of the students are from PUO and POLISAS perform the design process using conventional method and they are used as control group. All the four polytechnics selected are using the same curriculum for diploma in architecture which being developed by the Malaysian ministry of higher education. This research has been conducted by two lecturers from each polytechnic selected. Design process for treatment group and control group has been conducted simultaneously. Products for every activity from both of the design processes have been evaluated by selected lecturers using the research instruments provided.

3.0 Findings

The finding for this research being divided into five categories which are identifying students interest in finding design information, inferential data to compare design information created through analysis activity, inferential data to compare design product from synthesis and simulation activity and inferential data to compare final design product through conventional method compare to integrated method.

3.1 Student interest in finding information

In identifying student interest to find information needed in designing process whether it is via mobile technology based website or via conventional method, research outcomes show in Table 1.

Table 1 Descriptive statistics in finding information activity

No	Name of polytechnic	Finding information activities (Frequency)
1	POLIPD	204
2	PMM	188
	Total	392
	Mean	6.53
1	PUO	80
2	POLISAS	98
	Total	178
	Mean	2.97

This outcome clearly shows that student searching activities increased with web site integration related to real case based on mobile technology.

3.2 Comparing the product of analysis activity

This outcome comparing the quality of designs' information being created from analysis activity consists of two methods which are design information created through conventional method and design information created through integrated method. Research outcome shows in the Table 2.

Table 2 Finding on comparing design information produced in analysis activity

t-test	n	mean	s.d	t	p
Analysis Activity					
Treatment	60	81.2	5.13	18.369	0.000
Control	60	65.5	4.19		

The significant different on the product being produced in analysis activity proves that the integration of web site based on mobile technology helps the students to produce quality design information in analysis activity.

3.3 Creating new ideas in synthesis activity

In determining student skills at synthesis stage in design process with CAD integration, research has been made to decide whether students using CAD technology integration in synthesis stage has made more idea changes from two dimensional to three dimensional compared to students using conventional method in synthesis stage. The research outcomes of the synthesis activity in the design process show in Table 3.

Table 3 Finding on ideas produced in synthesis activity

No	Name of polytechnic	Conceptual diagram	Early ideas	2D to 3D
1	POLIPD	110	132	126
2	PMM	119	111	109
	Total	229	243	235
	Mean	3.82	4.05	3.92
1	PUO	69	70	61
2	POLISAS	81	80	66
	Total	150	150	127
	Mean	2.50	2.50	2.12

Research outcomes show that treatment group is actively involved in synthesis activity compared to control group.

3.4 Comparing the product of synthesis activity

The inferential finding data for synthesis activity are shown in Table 4. This inferential data will determine whether there is a significant different between the product being produced by treatment group at the synthesis stage compare to the product being produced by control group at the synthesis stage.

Table 4 T-test finding to compare mean between treatment group and control group product for synthesis activity in design process

t-test	n	mean	s.d	t	p
Synthesis Activity					
Treatment	60	80.6	3.72	17.184	0.000
Control	60	67.1	4.80		

Research outcomes show that the initial ideas being produced from integrated method better than the initial ideas being produced from conventional method.

3.5 Comparing the product of simulation activity

The inferential finding data for simulation activity are shown in Table 5. This inferential data will determine whether there is a significant different between the product being produced by treatment group at the simulation stage compare to the product being produced by control group at the simulation stage. The creative and quality product being produced at the simulation stage helps the students to produce a quality final design product.

Table 5 T-test finding to compare mean between treatment group and control group product for simulation activity in design process

t-test	n	mean	s.d	t	p
Simulation Activity					
Treatment	60	80.5	5.46	12.267	0.000
Control	60	66.9	6.68		

This outcome shows that the design idea that being produced from integrated method is better than the design idea being produced from conventional method.

3.6 Comparing the final product

In this research the creativity of the design product being determined based on CPAM model which are unique, practicality and detail. This inferential data will determine whether there is a significant different between the final product being produced by treatment group in the design process compare to the final product being produced by control group in the design process. The inferential finding data for comparing design product between treatment group and control group are shown in Table 6. This finding can prove positive effects on the integration of mobile and CAD technology in the design process for producing creative product.

Table 6 T-test finding to compare mean between treatment group product and control group product based on CPAM model

t-test	n	mean	s.d	t	p
Unique Aspect					
Treatment	60	78.0	7.07	7.134	0.000
Control	60	68.5	7.63		
Practical Aspect					
Treatment	60	78.0	4.69	6.901	0.000
Control	60	73.1	5.97		
Detailing Aspect					
Treatment	60	81.5	4.57	11.076	0.000
Control	60	71.9	4.85		
Overall Creative Aspect					
Treatment	60	79.1	4.27	10.610	0.000
Control	60	70.5	4.61		

Overall, inferential outcomes show that there is a concrete effect on mobile and CAD technology integration in producing a creative architectural design. This research shows on how the integration of web site being built using the real case approach based on the mobile device help the students to get more design information at anytime and any place. The integration of mobile technology in the design process generates students' interests to be more active in searching design information during the design process. More design information being gathered by the students makes it easy to produce creative products. The integration of CAD technology makes it easy for the students to change their designs' ideas from two dimensional to three dimensional. Three dimensional models in the form of digital model make it easy for the students to get the overall view of the building they want to design at the early stage of the design process. CAD technology also allows the students simulate the real situation in their design process. This simulation activity makes it easy for the students to generate ideas in creating their final design products to solve the problem being given to them.

4.0 Conclusions and discussions

In this research, positive research results for mobile technology based website shows that learning approach using mobile technology can be a perfect replacement for computer based learning approach. Students and lecturer can gain benefits from easier and faster access of information sources. Mobile technology offers an ideal educational approach in providing a unique learning community based on technology. In the future, graphic resolution and screen size for mobile equipment is expected to be better build. From CAD technology design aspects, it is proven that CAD technology are able to give comfort for student to produce three dimensional digital model and also increases students understanding of space through good visual effect. This is because CAD technology enhances student creativity and it also encourage student to appreciate interior space when student are doing simulation using different details and lighting into the same space. Student also get excited with produced space via simulation increment with different details and lighting towards their three dimensional digital model. Student understanding toward space is increased with the ability to run a simple interior animation. With the animation, student can look at the space from a different perspective. Student gives good response towards three dimensional digital model usage to produce good quality interior space design. Overall, CAD technology via three dimensional digital models helps student to produce a creative final product design. This research outcomes is also strengthen by Lawson (2007) research outcomes which states that architect Ian Ritchie has produced a creative gallery space in London Museum with the help of CAD technology integrated design. Lawson (2007) also says that the kindergarten design produced by kindergarten teachers with the help of CAD technology has higher esthetic value than the one produced by an architect using conventional method. From this research, it is concluded that CAD technology are able to help architectural student to produce a much more creative product design. CAD technology, specifically via three dimensional digital models can boost student understandings towards space while they are in designing process through the use of good visual impact.

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Adult Learners' attitudes toward web-based professional development and Internet self-efficacy in Taiwan

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Abstract: The purpose of this study was to investigate adult learners' Internet self-efficacy and attitudes toward web-based professional development. The sample consisted of 228 volunteer adult learners from a college in middle Taiwan. Two instruments, Internet self-efficacy (ISS) and attitudes toward web-based professional development (AWPD), were implemented for the investigation in this study. The results showed that the two instruments used revealed high reliability. The adult learners' Internet self-efficacy was positively related to their attitudes toward web-based professional development. In addition, adult learners of different ages or Internet experiences would express different attitudes toward web-based professional development.

Keywords: Adult learners, Internet self-efficacy, attitudes, web-based professional development

1. Introduction

Improvements in information and communication technology and the need for off-campus delivery have led to the increased use of web-based learning tools around the world. As the Internet is broadly used in the educational area, learners may have more opportunities to utilize web-based learning (Engelbrecht, 2005). The Web-based environment of learning focus on opening the access to education and training provision for adult learners, thus freeing the adult learners from the traditional constraints of time and place (Huang, 2002). As there are more and more adult learners pursuing vocational training or lifelong learning through online programs, their characteristics in terms of web-based professional development should be highlighted by educational researchers.

Some studies have revealed that attitudes toward a new technology play an important role in its acceptance and usage (Lu, Zhou, & Wang, 2009). Over the past decade, researchers have explored learners' attitudes toward computers and the Internet (Oral, 2008; Tsai & Lin, 2004). However, comparatively fewer studies have been conducted to investigate adult learners' attitudes toward web-based learning or web-based professional development. Hence, one of the purposes of this study was to assess adult learners' attitudes toward web-based learning or web-based professional development.

Internet self-efficacy refers to learners' expectations of and confidence in using the Internet. As previous studies stated (Tsai & Tsai, 2003; Wu & Tsai, 2006), learners with higher Internet self-efficacy are most likely to succeed in web-based learning tasks. Therefore, this study also focused on gauging adult learners' Internet self-efficacy.

Hence, this study was conducted to examine adult learners' attitudes toward web-based professional development, their Internet self-efficacy, and the relationships between them. Also, the roles of age and Internet experience were investigated.

2. Method

2.1 Sample

The participants of this study were 228 volunteers from a college in middle region of Taiwan. All of them were adult learners who had registered in web-based programs to earn workforce credits or advanced degrees. 137 (60%) of them were female while the remaining 91 (40%) were male.

2.2 Instruments

To assess adult learners' Attitudes toward Web-Based Professional Development (AWPD) and Internet Self-Efficacy (ISS), two instruments were implemented in this study. The Attitudes toward Web-Based Professional Development (AWPD) was modified from Kao and Tsai (2009). As a result, the initial pool of items in the survey included a total of 27 items, which were presented by using a five-point Likert scale (ranging from 1, "strongly disagree" to 5, "strongly agree"). Five factors were designed for AWPD. The details of the five scales are as follows:

1. Perceived usefulness scale: measuring perceptions of the extent to which adult learners perceive that the impact of web-based professional development are positive and useful.
2. Perceived ease of use scale: measuring perceptions of the extent to which adult learners perceive that the web-based professional development are easy to use.
3. Affection scale: assessing perceptions of the extent to which adult learners express favorable feeling about web-based professional development.
4. Anxiety scale: assessing perceptions of the extent to which adult learners experience the anxiety about web-based professional development.
5. Behavior scale: assessing perceptions of the extent to which adult learners perceive actual practice and willingness to use web-based professional development.

The second instrument of this study, the Internet Self-efficacy Survey (ISS), was also modified from Kao and Tsai's (2009). The ISS employed in this study included two scales, and the items of the two scales were presented with bipolar strongly confident/ strongly unconfident statement on a five-point Likert scale. The details of the two scales are as follows:

1. Basic self-efficacy scale: measuring adult-learners' self confidence at a basic level of using the Internet, such as using Internet-related tools.
2. Advanced self-efficacy scale: measuring adult-learners' confidence of Internet-based interaction or advanced usages of the Internet.

2.3 Data analysis

To fulfill the main purposes of this study, the factor analysis, correlation and one-way ANOVA analyses were conducted as the statistical methods in this study. The factor analysis was utilized to reveal the scales of the instruments on the adult learners' AWPD and ISS. The correlation analysis was employed to examine the relationship between AWPD and ISS. Then through one-way ANOVA analysis, the adult learners' AWPD and ISS among different age groups and Internet experiences were compared.

3. Results

3.1 Factor analysis

To clarity the structure of the adult learners' attitudes toward web-based professional development (AWPD), the principle component analysis was utilized as the extraction method, with the rotation method of varimax with Kasier normalization. An item was retained only when it loaded greater than 0.5 on the relevant factor and less than 0.5 on non-relevant factor. Thus, the initial 27 items were reduced to 13 items. The latest version of the AWPD consisted of 13 questionnaire items with three scales, namely, perceived usefulness, perceived ease of use, and behavior. The reliability coefficients for the three scales of the AWPD, respectively were 0.90 (perceived usefulness, 5 items), 0.88 (behavior, 4 items) and 0.73 (perceived ease of use, 4 items). The α value of the whole AWPD questionnaire is 0.84 and these factors explained 82.08 % of variance totally. Therefore, these scales are deemed to be sufficiently reliable for assessing adult learners' attitudes toward web-based professional development.

To clarify the structure of the adult learners' Internet self-efficacy, the same process of principle component analysis was utilized. As a result, the initial 16 items were reduced to 7 items, with two factors: "Basic self-efficacy (with 5 items)" and "Advanced self-efficacy (with 2 items)." 68.06 % variance was explained by these two scales. In addition, the α values for these two scales were 0.84 and 0.80, respectively, and 0.84 for the whole ISS questionnaire, indicating that these scales could be considered as adequately reliable for gauging adult learners' Internet self-efficacy.

3.2 Adult learners' scores on the scales

Adult learners' scores on three AWPD scales were all over 3 points on a five-point scale (see Table 1). They attained highest scores on the perceived ease of use scale (an average of 4.24 per item) on the 1-5 Likert measurement. Although they scored relatively low on the behavior scale, the average score (3.88 per item) was still higher than the mean of the 1-5 Likert scale (i.e. 3). The results indicated that the adult learners tended to focus more on the ease of use aspect of web-based professional development and appreciated the potential usefulness brought by web-based professional development courses. But their relatively low score on the behavior scale still implied that some of them might not be completely willing to exploit web-based professional development.

Table 1 also shows the adult learners' mean scores and the standard deviations on the ISS scales. The adult learners' had high scores on both ISS scales. They attained an average of 4.21 on basic self-efficacy scale and 4.22 on advanced self-efficacy scale. This result implied that the adult learners in this study tended to display high confidence of using the Internet for both basic and advanced purposes.

Table 1 Adult learners' scores on the scales of AWPD and ISS

Scale	Mean	SD

Attitudes toward web-based professional development		
Perceived usefulness	4.10	0.69
Perceived ease of use	4.24	0.97
Behavior	3.88	0.73
Internet self-efficacy		
Basic	4.21	0.62
Advanced	4.22	1.24

3.3 Correlation between attitudes toward web-based professional development and Internet self-efficacy

The Pearson correlation coefficients among the questionnaire scales are presented in Table 2. The relationships between the AWPD and ISS indicated that all of the variables were significantly positively correlated with each other. These results indicated that adult learners expressing high self-efficacy regarding the Internet would display more positive perceptions and frequent use toward web-based professional development. In particular, adult learners' responses on the behavioral scale were relatively highly correlated with those on the basic self-efficacy scale (r=0.50, p<0.01). It seemed that adult learners with higher basic self-efficacy regarding the Internet might tend to use web-based professional development more frequently.

Table 2 Correlation between the adult learners' attitudes toward web-based professional development and Internet self-efficacy

Scale	Perceived usefulness	Perceived ease of use	Behavior
Basic self-efficacy	0.30**	0.25**	0.50**
Advanced self-efficacy	0.37**	0.19**	0.38**

** p<0.01

3.4 The role of age groups and Internet experiences in adult learners' web-based professional development and Internet self-efficacy

In order to compare the possible differences derived from different age groups and Internet experiences, we categorized participants into three age groups (the less than 30 years group, the 31-40 years group and the more than 41 group) and seven Internet experience groups (the less than 3 hours group, the 3-6 hours group, the 6-12 hours group, the 12-18 hours group, the 18-24 hours group, the 24-30 hours group and the more than 30

hours group). The ANOVA tests followed by a series of post hoc tests (Scheffé tests) were performed. The results of these tests are presented in Table 3 and 6.
In table 3, the ANOVA test indicated that age groups played a role in adult learners' basic Internet self-efficacy and their perceived usefulness toward web-based professional development. Scores for the adult learners who are less than thirty years were higher than the corresponding scores of those who are more than forty years(F=6.01, p<0.01). Scores for adult learners who are between thirty and forty were higher than the corresponding scores of those who are less than thirty years old (F=5.29, p<0.01).

TABLE 3 Adult learners' Internet self-efficacy and attitude toward attitudes toward web-based professional development among different age groups

Age Group	(1) Less than 30 years (mean, SD)	(2) 31-40 years (mean, SD)	(3) 41+ years (mean, SD)	F(ANOVA) Scheffe Test
Basic self-efficacy	4.39(0.48)	4.18(0.64)	3.91(0.73)	6.01** (1)>(3)
Advanced self-efficacy	6.05(1.21)	5.10(1.31)	4.91(1.41)	1.79(n.s.)
Perceived Usefulness	3.91(0.78)	4.22(0.58)	3.94(0.82)	5.29** (2)>(1)
Behavior	5.51(0.98)	5.27(0.83)	5.30(0.74)	1.51(n.s.)
Perceived Ease of use	5.50(1.05)	5.21(1.05)	5.27(0.84)	0.61(n.s.)

** p <0.01.

In table 4, the ANOVA test indicates that Internet experience played a role in adult learners' behavior scale in their attitude toward web-based professional development. The scores for the adult learners' with Internet experience between eighteen and twenty-four hours were higher than those with less than three hours ((F=4.35, p<0.05).

TABLE 4 Adult learners' Internet self-efficacy and attitude toward web-based professional development among groups of different Internet experiences

Internet Exp.	(1) <3 hrs mean (SD)	(2) 3-6 hrs mean (SD)	(3) 6 -12 hrs mean (SD)	(4) 12 -18 hrs mean (SD)	(5) 18 -24 hrs mean (SD)	(6) 24 -30 hrs mean (SD)	(7) >30 hrs mean (SD)	F(ANOVA) Scheffe Test
Basic self-efficacy	3.57 (0.74)	4.07 (0.22)	4.25 (0.54)	4.35 (0.54)	4.43 (0.66)	4.19 (0.60)	4.36 (0.55)	1.61(n.s.)

Advanced	3.60	4.23	4.07	4.76	4.34	4.12	4.29	0.84(n.s.)
self-efficacy	(1.07)	(0.76)	(0.71)	(2.90)	(0.76)	(0.78)	(0.60)	
Perceived	4.04	4.04	4.08	4.16	4.14	4.00	4.22	1.81(n.s.)
Usefulness	(0.54)	(0.85)	(0.76)	(0.59)	(0.72)	(0.66)	(0.52)	
Behavior	3.35	3.83	3.87	4.06	4.25	3.84	3.88	4.35*
	(0.85)	(0.73)	(0.67)	(0.66)	(0.75)	(0.60)	(0.73)	(5) >(1)
Perceived	3.95	4.19	4.29	4.30	4.32	4.12	4.38	0.01(n.s.)
Ease of use	(0.85)	(0.58)	(1.64)	(0.50)	(0.65)	(0.66)	(0.55)	

* p <0.05.

4. Conclusion and Discussion

To explore adult learners' perspectives on web-based professional development, this study developed two questionnaires to assess adult learners' attitudes toward web-based professional development (AWPD) and Internet Self-efficacy (ISS). The results show that the AWPD and ISS developed in this study were deemed to be sufficiently reliable to assess the adult learners' attitudes toward web-based professional development and Internet self-efficacy. Moreover, through ANOVA analyses, the roles of adult learners' age and Internet experience were also revealed.

Adult learners in the present study scored high on perceived usefulness and ease of use scales, but relatively low on the behavior scale of web-based professional development. These results probably suggested that more things still need to be done to increase adult learners' willingness to take part in web-based learning activities. Thus, a better understanding regarding demands of adult learners and barriers faced by adult learners is needed to enable educators to have adequate planning to make web-based professional development more effective.

The mean scores of the ISS questionnaire revealed that the adult learners had both high basic Internet self-efficacy and advanced Internet self-efficacy. The AVONA tests showed that adult learners with different ages responded significantly differently on basic Internet self-efficacy and perceived usefulness scale. Adult learners with different Internet experience also displayed significantly different scores on the behavior scale of AWPD. Based on the results, the roles of age and Internet experience can be assured in adult learners' Internet self-efficacy and attitudes toward web-based professional development.

The results of this study are quite helpful to facilitate the understanding and implementation of adult learners' attitudes toward web-based professional development. By using the AWPD questionnaire, educators and researchers can assess and review adult learners' attitudes toward web-based professional development in a more effective way, with possibly higher validity. Previous studies (Donavant, 2009; Mak et al., 2001) have described the advantages of web-based learning over traditional ways of learning for adults for their continuing education of professional development. Further study about adult continuing education could also base on the results of this study to investigate more interrelations between factors in adult learners' web-based professional development.

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The information commitments toward online financial information among Taiwanese adults

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Abstract: This paper is to utilize the Information Commitment Survey (ICS) that proposed by Wu and Tsai (2004) for investigation of participant's standard of judging online financial information, and their search strategies on the Web. The sample included 192 participants more than 24 years old in Taiwan. The results indicated that participants in this study held advanced information commitments than less sophisticated information commitments when they sought financial information online. The results revealed that searching behavior and searching strategies of participants in this study were affected by gender; namely, the female participants often more used 'Multiple sources' standard for accuracy and 'Elaboration' searching strategies than male participants. Moreover, participants with more Internet experiences tended to use 'Authority' standard for accuracy information on the Web.

Keywords: information commitments, online financial information, Taiwan

1. Introduction

Searching for information on the Web is a common activity for many hundreds of millions of people around the World. According to (Strader & Ramaswami, 2004) more and more investors are using the Web to get financial information. To understand about the information searching behavior on the Web, researchers have identified aspects of user behavior, search tasks, system capabilities, epistemological beliefs, and search outcomes as important factors in information seeking on the website (Bråten & Strømsø, 2006, Andrew, 2007; Yuelin & Nicholas, 2008). Besides, online database search experience, and task type influence users' search behavior on the Web (Kim, 2001). Many studies carried out indicated that successful learning is related to students' features such as cognitive style, preferences, learning style, information processing strategy (Yang and Tsai, 2008).
Furthermore, research in some studies has shown that perceived usefulness to the individual investor is affected most decision quality, while perceived ease of use is influenced equally by consistency and technical convenience (Lee, Chung, & Kang, 2008), other study found that web user priorities their coping strategies according to the importance of the search topic and their determination to fulfill the search successfully (Mansourian, 2007).
This study adopts the concept of 'information commitment' as a set of evaluative standards in which Web users utilize in order to assess the accuracy and usefulness of web-based materials, and these commitments are also relevant to searching strategies. Moreover, to make this study more theoretically sound and more practically robust, other variables, which have

proven academically important in influencing consumers' intention to use information technology or internet-based information systems, were added such as investment experiences, financial products and Internet usage. In this study, the crucial objective was to use the ICS to survey the group investors in Taiwan to probe their financial information commitment toward Web information. To be more specific, this paper addressed the following research questions:
(1) What are the investor's financial information commitments toward Web financial information in Taiwan?
(2) Is there significant difference between the males and females which affect financial information commitments on the website?
(3) What is the role of investment experience, and Internet experience in their information commitments?

2. Method

Participating in this survey were 192 individuals (111 males and 108 females). Participants were more than 24 years old in order to make sure adult participating. Tsai (2004) included that the first, the three information commitments, including 'Multiple sources,' 'Content' and 'Elaboration' were advanced information commitments, and the second, three others, including 'Authority,' 'Technical,' 'Match' were less sophisticated. Wu and Tsai (2005, 2007) have found that ICS is sufficiently reliable for assessing learners' information commitment toward Web information. A momentary description of the six categories is exposed below:
1. Multiple sources as correctness scale (Multiple sources*)*: such as other websites, prior knowledge, peers, or other printed materials to examine the accuracy of Web information.
2. *Authority as correctness scale (Authority)*: authority of the websites or sources as major indicator of correctness.
3. *Content as usefulness scale (Content)*: refer to the relevance of Web content.
4. *Technical issues as usefulness scale (Technical)*: refers to the functional and technical issues of the Web.
5. *Elaboration as searching strategy scale (Elaboration)*: indicates that learners may have purposefull thinking when navigative in the Web
6. *Match as searching strategy scale (Match)*: indecates theat learners may be eager to find only a few websites that contain the most fruitful and relevant information.
The questionnaire in this study included two parts: the first that is background information, such as respondent's gender, ages, working experiences, investment experiences, investing financial products (such as stock, bond, golden, option), online search financial information status, and Internet usage experiences). The second comprises 24 items of the ICS, based on a six point Likert-type scale, with anchors ranging from 'strongly agree' to 'strongly disagree'. The questionnaire was presented in Chinese and administered by paper-and-pencil survey.

3. Result

3.1 Participant's score on the ICS scales

According to Table 1, the highest score belongs to the 'Content' (an average of 4.87 per item). The lowest is 'Technical' (an average of 3.75 per item). The results indicated that participants in this study, on average, did not agree that they often used the 'Technical' as the crucial tool to search financial information on the Web.

Table 1: Participants' scores on the ICS scales

	Mean	SD	Rank
Multiple sources	4.42	.67	3
Authority	3.98	.89	4
Content	4.87	.55	1
Technical	3.75	.70	6
Elaboration	4.49	.73	2
Match	3.96	.64	5

3.2 Gender differences on the financial information commitments

The result shows that the female participants in this study were more oriented towards using 'Multiple sources' (t-value = 2.10, $p < .01$) and 'Elaboration' (t-value = 2.73, $p < .01$) to look for information through the Internet. This finding judges that female participants often use 'Multiple sources' to estimate amount of correctness of the information. In addition, they usually use 'Elaboration' searching strategy to make sure the information they get will be the best things to fit their purpose. This behavior of female may be helping them reduce the risk which they will be taking in the future.

Table 2: Gender differences on the information commitments

	Female		Male		*t*-value
	Mean	SD	Mean	SD	
Multiple sources	4.53	.71	4.31	.62	2.10**
Authority	3.98	.87	3.98	.92	-.02
Content	4.90	.49	4.84	.59	.62
Technical	3.73	.73	3.76	.66	-.27
Elaboration	4.64	.65	4.34	.79	2.73**
Match	4.02	.65	3.90	.64	1.22

*$p < .05$; **$p < .01$

3.3 The role of investing behavior in financial information commitments

Results reveal that investment experiences hold crucial role in their used of 'Multiple sources' (r = .21, $p < .01$), 'Elaboration' (r = .30, $p < .01$), and there was a significant relationship between investing financial products and 'Multiple sources' (r = .19, $p < .05$), 'Content' (r = -.18, $p < .05$). The participants have more investing behavior tended to use the 'Multiple sources' like the best criteria to estimate online information and utilized the 'Elaboration' searching strategy while they were more toward collected more information of any other sources. However, they are relatively low in terms of the correlation coefficients.

Table 3: The correlations between participants' scores on the six scales of the ICS and their investing behaviors

	Multiple sources	Authority	Content	Technical	Elaboration	Match
Investment experiences	.21**	-.14	-.04	.01	.30**	-.04
Financial products	.19*	-.00	-.18*	-.04	.79	.07

*p < .05; **p < .01

3.4 The role of Internet experience in financial information commitments

As Table 4 reveals, there was a significant relationship between online search financial information status and 'Multiple sources' (r = .20, p < .05) standard for accuracy, and 'Elaboration' (r = .23, p < .01) search strategy. In addition, there was a significant relationship between Internet usage and 'Multiple sources' (r = -.34, p < .01), 'Authority' (r = .18, p < .05), 'Elaboration' (r = -.21, p < .01) and 'Match' scales (r = -.16, p < .05). As can see from the results in Table 4, to participants have more use information on the Web, they tended to utilize 'Multiple sources' to standard for correct their information. But, within participants have more time to use internet, they tend to use 'Authority' standard for correctness financial information on the Web. However, this relationship has relatively low in these terms of correlative coefficients.

Table 4: The correlations between participants' scores on the six scales of the ICS and their Internet experiences

	Multiple sources	Authority	Content	Technical	Elaboration	Match
Search status	.20*	.02	-.04	.16	.23**	-.00
Internet usage	-.34**	.18*	.02	.01	-.21**	-.16*

*p < .05; **p < .01

4. Discussion and conclusions

This study attempted to enhance our understanding of financial information commitments on the Web. Furthermore, the results indicated that participants in this study held advanced information commitments than less sophisticated information commitments when they sought financial information online. The results revealed that searching behavior and searching strategies of participants in this study were affected by gender; namely, the female participants often more used 'Multiple sources' standard for accuracy and 'Elaboration'

searching strategies than male participants. Moreover, participants with more Internet experiences tended to use 'Authority' standard for accuracy information on the Web.
The practical implication of these findings score, those financial corporations and implications for research and practice in psychology, especially in the subfields of educational institutions, training and performance appraisal. To results can be explained with more generality, the questionnaire survey should be extended into several sorts of participant so that. Future studies are encouraged to explore the influence of the financial information commitments on the website on investor's decisions when they buy or sell financial products.

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Exploring teachers' concerns toward implementing Internet-based learning: The role of Internet self-efficacy

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Abstract: The purpose of this study was to unveil Taiwanese junior high school teachers' concerns toward the implementation of Internet-based learning with relations to their perceived Internet self-efficacy. The Stages of Concern (SoC) questionnaire and Internet Self-efficacy (ISS) Survey were utilized to assess teachers' current concerns toward Internet-based learning and their Internet self-efficacy, respectively. A total of 243 junior high school (grade 7 to grade 9) teachers in Taiwan were invited to complete the two above-mentioned instruments. The results show that, first, three distinct teacher clusters were found based on their SoC questionnaire scores via k-means clustering analysis. In addition, teachers with higher Internet self-efficacy showed their concerns toward implementing IBL on higher stages. More specifically, teachers who concerned more in the lower stages tended to possess higher basic Internet self-efficacy. However, only those who concerned more in the higher stages showed higher advanced Internet self-efficacy.

Keywords: Internet-based learning, Internet self-efficacy, stages of concern, teachers

1. Introduction

Although some studies have emphasized that teachers' attitude is one of the major factors that influence their adoption of technologies or implementation behaviors in the classroom (e.g. Sugar, Crawley, & Fine, 2004), limited research results have been reported regarding teachers' concerns toward implementation IBL in the classroom. The development of concern theory suggests that different teachers have different concerns and need different interventions. Therefore, identifying teachers' stages of concern is necessary in order to provide appropriate support and assistance to facilitate the adoption. Furthermore, the process of implementing IBL would be more effective and successful if teachers' concerns are considered and scrutinized. In addition, since the promising educational applications of IBL, more studies are needed to investigate teachers' concerns of implementing IBL. The Stages of Concern (SoC) was developed to explore the educators' and administrators' concerns of an educational innovation during the educational change process (Hall & Hord, 1977). Accordingly, the present study attempted to adopt the SoC theory to identify teachers' concerns toward IBL.

As Overbaugh and Lu (2008) pointed out, one of the determinant factors that relates to a teacher's stages of concern is his or her confidence, namely, self-efficacy in adopting an innovation. Several researchers have stressed that teachers' self-efficacy has more or less impact on their adoption or implementing related teaching practice (e.g., Lee & Tsai, 2010). In addition, only a handful of research results have explored the relationship between individuals' self-efficacy and their concerns of implementing an innovation in educational contexts (e.g., Boz & Boz, 2010). It is implied that teachers' Internet self-efficacy may affect their concerns on usages of Internet-based learning in their implementation of Internet-based learning in the formal education. Therefore, one of the purposes in present study was to explore the relationships between teachers' Internet self-efficacy and their concerns toward implementing IBL.

In sum, the research questions in this study were as follows:

- What concerns toward implementation of IBL do the junior high teachers have?
- What are the relationships between the teachers' perceived Internet self-efficacy and their concerns toward IBL implementation?

2. Method

2.1 Participants

The sample of current study included 243 junior high school (grade 7 to grade 9) teachers in Taiwan. They came from eight different junior high schools across various demographic areas in northern and southern Taiwan and were chosen based on the percentages of the population distributions of the junior high school teachers in all city/county districts of Taiwan (Ministry of Education [MOE], 2010). Among these sample subjects, 72 (30.8%) were male and the remainder of 162 (69.2%) were female.

2.2 Instrument

The Stages of Concern (SoC) questionnaire designed by Hall, George and Rutherford (1977) was utilized to measure and understand teachers' current concerns toward Internet-based learning. Within each of the seven stages of concern, there are 5 statements, for a total of 35 items to which the participant responds. The wording of "the innovation" in each statement was replaced by the wording of "the Internet-based learning". For instance, one of the original statements "I am not concerned about the innovation (Stage 0, awareness)" was modified to "I am not concerned about the Internet-based learning". A five-point Likert scale of modified SoC questionnaire consisted of 35 items was administrated, ranging from "not true of me now" (1) to "very true of me" (5). The detailed descriptions of each stage and sample items are as follows:

- Awareness: teachers have little awareness or concern for IBL implementation.
- Informational: teachers have general or vague awareness of IBL implementation. Teachers may begin some information seeking to gain additional knowledge about IBL implementation.
- Personal: teachers' concerns are about the personal costs of implementation IBL.
- Management: teachers' concerns will focus around how to integrate the logistics of IBL into their daily jobs.
- Consequence: Teachers' concerns are mainly on the impact of the IBL on their students.
- Collaboration: teachers begin to have concerns about how they compare to their colleagues and how they can work with their fellow teachers on IBL implementation.
- Refocusing: teachers' concerns such as making adjustments, proposing alternatives and others to improve the current IBL practice.

In addition, for the further analysis and interpretations in the current study, the reverse items of the "Awareness (5 items)," "Informational (1 item)," and "Management (5 items)" scales were coded in reverse. Hence, teachers with higher scores in the above-mentioned three scales held higher awareness toward IBL (Awareness), were willing to know more about IBL implementation (Informational), and represented that they can manage IBL-related issues well (Management). As for the "Personal," "Consequence," "Collaboration," and "Refocusing" scales, teachers with higher scores in these scales represent that they concerned more about the issues such as issue related to themselves while implementing IBL (Personal), the impacts on their students (Consequence), collaboration with others (Collaboration), and revising the current IBL practice (Refocusing).

Furthermore, in order to assess teachers' Internet self-efficacy, the second instrument, Internet Self-efficacy Survey (ISS), was utilized. The ISS was modified based on existing questionnaires (Kao & Tsai, 2009) including a total of 16 items and two scales: basic and advanced Internet self-efficacy scales. The items of each scale were presented with bipolar ranging from strongly confident (5) to strongly unconfident (1) statements on a five-point Likert scale. Teachers who scored higher in both scales of ISS represents that they perceived themselves as possessing higher basic Internet self-efficacy and advanced Internet self-efficacy. The detailed descriptions of two scales are as follows:

- Basic self-efficacy scale: measuring teachers' self-perceived confidence and abilities of operating basic Internet functions. One of the sample items in this scale is "I feel confident about searching for information on the Web using keywords'"
- Advanced self-efficacy scale: measuring teachers' self-perceived confidence to engage themselves in online interaction or advanced usage of the Internet. A sample item of this scale is "I feel confident about making payments on the Internet"

3. Results

3.1 Factor analysis

To validate SoCQ, an exploratory factor analysis with the varimax rotation method was performed to clarify its structure. An item was retained only when its factor loading was greater than 0.5. As a result, the participants' responses were grouped into six orthogonal factors, which were: "Awareness", "Personal", "Management", "Consequence", "Collaboration" and "Refocusing". Yet, "Informational" items were not grouped into the corresponding scale. The eigenvalues of each factor from the principle component analysis was larger than one and an item with a factor loading of greater than 0.50 was retained from the instrument. Therefore, the initial 35 items were reduced to 25 items. A total of 76.56% variance was explained by these six scales. The reliability coefficients for these six scales were ranging from 0.75 to 0.93 and the overall reliability coefficient was 0.86, suggesting that these scales are adequately reliable to measure teachers' concerns of implementation of IBL. Teachers attained highest score on the "Consequence" scale (M = 4.01, S.D. = 0.81), followed by "Personal" (M = 3.89, S.D. = 0.89), "Collaboration" (M = 3.83, S.D. = 0.78), "Refocusing" (M = 3.46, S.D. = 0.84), "Awareness" (M =3.45, S.D. = 1.01), and "Management" (M = 2.56, S.D. = 0.84).

To clarify the structure of ISS instrument, the same procedures and methods were used. Thus, the initial 16 items were reduced to 14 items, with two factors: "Basic self-efficacy" and "Advanced self-efficacy." A total of 64.69% variance was explained by the two scales. The reliability coefficients for these factors were 0.86 and 0.92 respectively, and the overall alpha value was 0.90, indicating that these factors were sufficiently reliable for measuring teachers' perceived Internet self-efficacy. In addition, the teachers scored highest on the "Basic self-efficacy" factor (M = 4.69, S.D. = 0.47), followed by the other factor "Advanced self-efficacy" (M = 3.66, S.D. = 1.16).

3.2 Clustering teachers' stages of concern toward Internet-based learning

On the basis of teachers' scores for SoC questionnaire, a k-means clustering analysis method was employed to classify teachers into distinctive groups. The three-cluster solution was selected and yielded the significant distinctions in the six stages of concern among each group (F = 26.84~112.45, $p < 0.001$). As shown in Table 1, the number of participants and mean values of stages of concern toward IBL in each cluster. By comparing the mean score of each cluster with the total mean score of teachers via *t*-tests, the attributes of each cluster were identified.

Table 1. The clusters of teachers' SoC toward implementing IBL

Scales	Cluster 1 (Higher SoC) (n = 131) Mean (S.D.)	Cluster 2 (Lower SoC) (n = 25) Mean (S.D.)	Cluster 3 (Lowest SoC) (n = 78) Mean (S.D.)	F (ANOVA)
Awareness	3.80 (0.88) (+)	4.15 (0.79) (+)	2.64 (0.77) (-)	57.13^{***}
Personal	4.37 (0.54) (+)	2.43 (1.08) (-)	3.56 (0.60) (-)	112.45^{***}
Management	2.45 (0.83)	3.61 (0.73) (+)	2.40 (0.65) (-)	26.84^{***}
Consequence	4.38 (0.52) (+)	2.55 (0.79) (-)	3.86 (0.61) (-)	108.05^{***}
Collaboration	4.29 (0.47) (+)	3.02 (0.85) (-)	3.33 (0.66) (-)	90.34^{***}
Refocusing	3.86 (0.60) (+)	2.76 (0.78) (-)	3.02 (0.83) (-)	48.83^{***}

$^{***}p < 0.001$

Note: The sign (+) represents the mean was significant higher than total mean while the sign (-) represents the mean was significant lower than total mean.

The teachers in the cluster 1 (higher SoC) represents that their mean scores in all stages were significantly higher than the total mean scores (t = 4.62~11.06, $p < 0.001$) except the "Management" stage, which means that cluster 1 teachers expressed stronger concerns in most of the stages, particularly those higher stages such as "Consequence," "Collaboration," and "Refocusing" concerns. Next, in the cluster 2 (lower SoC), teachers' mean scores in the "Awareness," and "Management" stages were significantly higher than the total mean scores (t = 4.43, 7.20, respectively, $p < 0.001$). In addition, the mean scores in other stages including "Personal," "Consequence," "Collaboration," and "Refocusing" were significantly lower than the total mean scores (t = -9.23~ -4.49, $p < 0.001$), indicating that these teachers showed stronger concerns in the lower stages (i.e., "Awareness" and "Management"). Finally, teachers in the cluster 3 (lowest SoC), their mean scores on the each stage were significantly lower than the total mean scores (t = -9.28~ -2.12, $p < 0.05$), suggesting that the teachers in cluster 3 showed lowest concerns in all stages.

3.3 Teachers' Internet self-efficacy among different cluster groups

In this study, the relationship between teachers' stages of concern (divided into three clusters, as shown in Table 1) toward IBL and their Internet self-efficacy was explored. A series of ANOVA test analyses were employed to reveal the relationships between teachers' Internet self-efficacy and their stages of concern toward IBL. The results of the ANOVA analyses reveal that there are significant differences among the three clusters on the factors of "Basic self-efficacy" (F = 7.07, $p < 0.01$), and "Advanced self-efficacy" (F = 9.02, $p < 0.001$). A series of *post hoc* tests (Scheffe tests) were also conducted to make comparisons among the three clusters. In the scale of "Basic self-efficacy", the results indicated that teachers in cluster one (higher SoC) had a significant higher score than those in cluster three (lowest SoC) (4.76 versus 4.54, $p < 0.01$). In addition, teachers in the "lower SoC" cluster scored significant higher than those in the "lowest SoC" cluster (4.84 versus 4.54, $p < 0.05$). In the scale of "Advanced self-efficacy", the teachers in the "higher SoC" cluster also had a significantly higher score than those in the "lowest SoC" cluster

(3.89 versus 3.22, $p < 0.001$). Accordingly, teachers expressed stronger concerns in the lower stages (i.e., higher SoC and lower SoC clusters) might perceive themselves with higher basic Internet self-efficacy. Yet, only teachers showed stronger concerns in the higher stages (i.e., higher SoC cluster) might possess higher advanced Internet self-efficacy.

4. Conclusion and implication

This study aimed to explore teachers' concerns toward implementing IBL. The results show that not only it is reliable to assess junior high school teachers' concerns toward implementing IBL but also with a satisfied validity to assess and review teachers' concerns toward implementing IBL in a more effective way.

Moreover, in the current study, three distinct teacher clusters were found based on their SoC questionnaire scores. In general, teachers with higher Internet self-efficacy showed their concerns toward implementing IBL on higher stages. Furthermore, this study found teachers who concerned more in the lower stages tended to possess higher basic Internet self-efficacy. However, only those who concerned more in the higher stages showed higher advanced Internet self-efficacy. The results imply that teachers' perceived Internet self-efficacy including basic and advanced ones might influence their concerns toward IBL implementation. It is possible that the advanced Internet self-efficacy was the crucial factor to attain higher levels of concern whereas the basic Internet self-efficacy was essential for teachers to begin to familiarize IBL implementation in their classrooms.

The study was conducted using quantitative measures to reveal teachers' stages of concern toward implementing IBL, which may not be sufficient to provide more in-depth insights for explaining teachers' concerns regarding IBL implementation. Future studies might be needed to employ qualitative or mixed methods to gain a deeper understanding of teachers' concerns toward IBL implementation into their teaching practices. Moreover, the SoCQ used in this study was merely one of the dimensions of CBAM model. To acquire a better understanding of teachers' concerns toward implementing IBL, researchers are encouraged to undertake other dimensions of CBAM model such as Levels of Use (LoU) which describes the behaviors of individuals using the innovation.

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What make seniors feel more confident in learning Internet and computers? A case study

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Abstract: The purpose of this study was to investigate each aspect of the influential factors of seniors' confidence increase when learning Internet and computers. Factors included, seniors' motivation, obstacles solved due to support, and their coping strategies for obstacles when learning Internet and computers. A course was designed to support beginning-level seniors to learn knowledge and skills regarding usage of Internet and computers with teachers' and assistants' guidance. Content analysis was used to investigate each aspect of influential factors of confidence increase from the interview data. A sample of 30 middle and aged students was volunteered in this study. It is found that providing a course with content knowledge and skills that are interesting, enjoyable, useful, and sharable to seniors is important for motivating seniors, which in turns could increase their confidence. The findings also pinpointed the crucial role of assistants around students as most of them said that their increase of confidence was due to obstacles solved with the aid. In addition, asking for help was reported as one dominant coping strategy, which was used by seniors that can make them feel more confident.

Keywords: Internet and computers learning, Confidence increase, motivation, obstacles, coping strategies.

Introduction

Because of the rapid development of the Internet and communication technologies, the European committee raised a report, *Making a European Area of Lifelong Learning a Reality*, to enhance seniors' digital learning literacy [7]. Hence, seniors' abilities of operating computers and Internet to learn, communicate, and search for information are deemed as critical for life-long learners.

Most researchers have been interested in the investigation of computer self-efficacy and Internet self-efficacy [6, 13, 15]. According to Bandura [1], self-efficacy refers to a person's ability to self-assess one's capabilities of successfully performing specific tasks. Computer self-efficacy refers to the confidence one person has regarding his/her capabilities to perform various tasks using computers [5]. With the rapid growth of Internet, Internet self-efficacy has become a focus in the research field that probe a person's belief and confidence in one's Internet usage and whether he/she can successfully accomplish specific Internet tasks [14]. Actually, confidence and self-efficacy are highly related and intertwined. For instance, individual who has high computer self-efficacy would show higher confidence in specific tasks that he/she has to accomplish [5]. Studies also have been explored on related factors to confidence or self-efficacy. For instance, it is found that "confidence in one's abilities generally enhances motivation, making it a valuable asset for individuals with imperfect willpower [2]." In addition, low confidence is found to be one of many factors that inhibit students continuing learning [9]. Besides, providing computer aids to learners will improve their ability and in turn result in higher self-efficacy [5]. Even though many studies have been explored on confidence and self-efficacy, there is still limited research aimed to explore influential factors that make learners feel more confident with a more in-depth analysis. Therefore, the objectives of this study were to:

1. Design a training course with teachers' and assistants' guidance and support.
2. Use content analysis to investigate each aspect of the influential factors of seniors' confidence increase from the interview data. Categorized factors included, seniors' motivation, obstacles solved due to support, and coping strategies for obstacles when learning Internet and computers.
3. Investigate and compare results of pretest and posttest of seniors' self-efficacy toward Internet and computers utilizing two questionnaires.

Methodology

1. Participants

A sample of 30 middle and aged students (6 males and 24 females) with an average age being 58 was volunteered in this study. They were a group of students participated in a Buddhist organization in New Taipei city in Taiwan. According to their educational background, these students graduated with a high school degree in average.

2. Course introduction, Procedure, and Data analysis

The course design in this study was a series of instructional activities specifically designed based upon findings in the literature [4] as well as the interview data for beginning-level seniors to learn how to use Internet and computers. In addition, the ratio of assistants to students was 1:3. The course was given in three sessions during an eight week period (four hour per week). Participants met at the computer training lab of the Buddhist organization and each was assigned to a personal laptop. The course was divided into three major content areas: computer basic operations (typing and organizing files), communication applications (i.e. emails and msn), and searching skills (information, music and pictures).

Interviews were conducted on the third week, the sixth week, and the eighth week. Major interview questions included, 1) Why would you like to join this course? 2) What obstacles did you confront in learning computers and Internet? 3) Do you feel more or less confidence so far and why? Each of the interview session lasted within 30 minutes.

Content analysis was used to analyze students' responses to the interview questions. Those whose responses to the corresponding question were vague and/or uncompleted would be dropped out. The coders read all of the responses first, coded important keywords, and discussed and reached consensus in categories and criteria. Their inter-coder agreements for these analyses were assessed and reported as greater than 0.80.

3. Instrument

The measures were administered at both the beginning and end of the course. The time between pretest and posttest ranged from 8 to 9 weeks. The computers self-efficacy (CSE) questionnaire, which was developed and modified by Murphy et al. [11], was implemented with a bipolar statement in a six-point Likert mode, ranging from "strongly confident" to "strongly unconfident." Our study used 12 of the original 32-item instrument developed by Murphy et al. [11]. The loadings for the scales were ranged from 0.52 to 0.91, and the overall alpha was 0.96. A sample item of the basic ISS is "I feel confident of downloading pictures and films from the Website."

The Internet self-efficacy (ISE) questionnaire was mainly modified from Liang and Wu's [8] Internet self-efficacy scale (ISS) and added new items suitable for seniors. Therefore, in this study, the questionnaire has 22 items with a 6-point Likert scale ranging from 6 (very confident) to 1 (very unconfident). This ISS included two scales: basic Internet self-efficacy and advanced Internet self-efficacy. The alpha reliability coefficients for these two scales were 0.95 and 0.94, and the total alpha of this sample was 0.95 from Liang and Wu's [8] study. A sample item of the advanced ISS is "I feel confident of writing e-mail."

Results and Discussions

1. Influential factors of confidence increase when learning computers and Internet

Those 30 percent of seniors who considered motivation as an important factor that influences their confidence increase mentioned enjoyment, interest in learning, and sharing. For instance, student #s17 said, "*When other people ask me to help, I will be happy since I know it and I am available to help.*" As for obstacles solved due to support, 33 percent of male and 42 percent of female mentioned that there is sufficient support such as a number of assistants in the course. For instance, student #s01 said, "*You teacher and assistants spent a lot of time and energy to teach us. It's pretty nice that you have patience.*" Only 10 percent of students mentioned coping strategies, such as inner-directed exploration and asking for help as their reasons of confidence increase. For instance, student #s10 said, "*I explored on my own when the teacher is teaching a topic*."

Table 1. Frequency and percentage of influential factors of confidence increase

	Motivation	Obstacles solved due to support	Using coping strategies
male	0 (0%)	2 (33%)	0 (0%)
female	9 (38%)	10 (42%)	3 (13%)
total	9 (30%)	12 (40%)	3 (10%)

Note: n=30, (male=6; female=24)

2. Motivation toward learning computers and Internet

To investigate their motivation, the interview data were examined and compared with findings in the literature [3] and finally coded into two dimensions, which are, deficiency-oriented motivation (motives from the outside environment) and growth-oriented motivation (motives from inner-self or personal desire). There were 23 percent of students mentioning that they were motivated to catch up the trend in learning computers and Internet. For instance, student #s02 said, "*Using computers is a trend. When everybody knows it, you cannot leave yourself behind.*" There were both 17 percent of students mentioning encouragement by others and usefulness recognition as their motivation to learn. For example, student #s04 indicated, "*We were encouraged by masters in this organization to learn.*" Student #s18 mentioned, "*There are many things you have to use computers to handle with, such as searching information online, etc.*"

Table 2. Frequency and percentage of motivation toward learning computers and Internet

	Deficiency-oriented				Growth-oriented	
	Encouraged by others	Catch up the trend	Seize the opportunity	Afraid to be mocked	Recognize usefulness	Desire to learn more
male	1 (17%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)	1 (17%)
female	4 (17%)	7 (29%)	2 (8%)	1 (4%)	4 (17%)	0 (0%)
total	5 (17%)	7 (23%)	2 (7%)	1 (3%)	5 (17%)	1 (3%)

Note: n=30, (male=6; female=24)

3. Obstacles of learning computers and Internet

The study categorized two main aspects of obstacles faced by seniors based on interview data, which are, personal factors and contextual factors. It is found that 20 percent of seniors in this study needed to face some personal obstacles such as physical barriers. Very much similar to the previous findings [10, 12], most of seniors in this study mentioned bad memorization, slow typing, and eyes that are easily get tired. As for contextual factors, there were 17 percent of students mentioning insufficient resource, as well as instruction and assistance as obstacles they faced. For instance, student #s05 mentioned, "*We did buy computers at home, but those computers were took over by kids*." Even with the arrangement of the ratio of assistants and students as 3:1, there were 17 percent of students mentioned too many people resulted in their waiting for asking.

Table 3. Frequency and percentage of seniors' obstacles of learning computers and Internet

	Personal factors		Contextual factors	
	Physical barriers	Insufficient skills	Insufficient resource	Insufficient instruction & assistance
male	1 (17%)	1 (17%)	1 (17%)	1 (17%)
female	5 (21%)	0 (0%)	3 (13%)	4 (17%)
total	6 (20%)	1 (3%)	4 (13%)	5 (17%)

Note: n=30, (male=6; female=24)

4. Coping strategies for obstacles encountered in learning computers and Internet

Among 63 percent of students who chose to ask for help, there were 67 percent of female and 3 percent of male asked for help. Uniquely, two females among all students mentioned that they study on their own, which shows inner-directed coping strategies. For example, student #s15 said, "*Sometimes during short breaks, I will try to explore and practice by myself frequently.*"It is almost the same situation when it is out of the class.

Table 4. Frequency and percentage of seniors' coping strategies for obstacles

	In-class		Out of the class		
	Asking for help	Inner-directed	Libraries	Family	Other experts
male	3 (50%)	0 (0%)	0 (0%)	0 (0%)	2 (33%)
female	16 (67%)	2 (8%)	1 (4%)	5 (21%)	6 (25%)
total	19 (63%)	2 (7%)	1 (3%)	5 (17%)	8 (27%)

Note: n=30, (male=6; female=24)

5. Comparison among seniors' confidence increase, CSE, and ISE

After examining influential factors of confidence increase in-depth, this study further analyzed the trend of seniors' confidence change with time passing by. It is found that there were 30 percent of students described their confidence chance as low-middle-high with time change. Only 7 percent of students regarded their confidence change as decrease. This finding can be further supported by the findings as shown in Table 5. The t-test result showed that seniors perceived higher computer self-efficacy and Internet self-efficacy both on general and advanced aspects in the posttest when comparing with the pre-test.

Table 5. Pre-post comparison in seniors' responses to CSE and ISE

	Pre-test mean (S.D.)	Posttest mean (S.D)	*t*-test
CSE	3.12 (1.00)	4.35 (0.60)	-6.87**
ISE-General	3.82 (1.05)	4.42 (0.47)	-3.39**
ISE-Advanced	2.84 (1.25)	4.02 (0.58)	-5.72**

Note: $^{*}p<.05$, $^{**}p<.01$

Conclusions

This paper was intended to examine the influential factors of seniors' confidence increase and further query the aspects categorized from their reasons of confidence increase. It is found that most of the students who mentioned confidence increase mainly because of obstacles solved with the aid pinpointed the crucial role of assistants around them. In addition, students could be motivated when they were able to share with or help others. As a result, designing instructional strategies that provide enough assistants and opportunities for students to help each other is suggested. For instance, arranging students' sitting places based on the level of skills and knowledge may be an option for educators who have interests in teaching seniors about computers and Internet. Besides, with the encouragement of and support from outside resource, seniors seemed more likely to have confidence in learning. However, only a small proportion mentioned using coping strategies such as studying in libraries or trying and practicing on their own. It is also found that most of online learners don't know how to fight for available resource from outside [6]. As a result, teachers and assistants may encourage students to possess abilities in using active coping strategies to solve problems.

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Information commitments and Internet attitudes of nutritional science students and in-service dietitians in Taiwan

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Abstract: This study aimed to explore nutritional science students' and in-service dietitians' information commitments and Internet attitudes toward online nutritional information. The subjects were 340 nutritional science students and in-service dietitians in Taiwan. Two instruments, Information Commitments Survey (ICS) and Internet Attitude Scale (IAS), were used in this study. Results of the study showed that, although students and dietitians with more Internet experience perceived more positively toward Internet's usefulness, they tended to utilize less advanced information commitment standards and less advanced online information searching strategy. No gender difference was found in this study. Significant relations were found between information commitments and attitudes toward Internet. Finally, the in-service dietitians demonstrated more 'Technical' standard and 'Elaboration' searching strategy than did the nutritional science students.

Keywords: Information commitments, Internet attitudes, nutritional science

1. Introduction

Internet technology has become not only an integral part in our life but also used in learning of education for decades [1]. It is common that learners use the Internet to search relevant information and resources to complete their learning tasks. They have been found to use different types of searching strategies to get information from the Internet [2]. They may also set different evaluation standards to assess the accuracy and usefulness of online information [3]. Tsai proposed a theoretical framework describing Internet users' information commitments based on three dimensions: standards for accuracy, standards for usefulness and searching strategies [4]. Wu and Tsai then utilized this framework to assess students' information commitments in Web-based learning environments [3]. Their study found that students' evaluative standards of Web information had a significant effect on their information searching strategies in online learning environment. These two variables seemed to be critical factors for learning in Web-based learning environments.

In addition, Internet attitude is another important factor for online learning. Students with different Internet using experience tended to hold different attitudes toward the Internet [5]. Specifically, students with more Internet experience tended to hole more positive attitude than those with less experience. Tsai, Lin and Tsai [5] developed an instrument, the Internet Attitude Scale (IAS), to assess learners' affection, perceived usefulness, perceived control and behavior of using the Internet. Further research indicated that holding a positive attitude toward the Internet benefits for successful Internet-based learning, as it affects learners' learning motivation, interests and outcomes [6] [7].

It is also very common for future citizens to search information about health and nutrition via the Internet. People may need advanced information commitments and positive Internet attitudes in order to make reasonable judgments and decisions after reading various online nutritional information. However, very limited studies have been conducted to this issue, especially for those who are or will be dieticians. Therefore, this study tried to investigate the information commitments and internet attitudes of those who have nutritional science backgrounds, including students who majored in nutritional science (i.e. pre-service dieticians) and in-service dieticians. To be more specific, the following questions were investigated:

- What are the information commitments and Internet attitudes of nutritional science major students and dieticians?
- What is the role of Internet experience played in their information commitments and Internet attitudes?
- What are the relationships between their information commitments and Internet attitudes?

2. Methodology

2.1 Subjects

Subjects of this study were 340 volunteers, including 289 nutritional science students and 51 in-service dietitians in Taiwan.

2.2 Instruments

To assess nutritional science students' and in-service dietitians' Information commitments and Internet attitudes in web-based environments, two instruments were employed in this study. One is the Information Commitments Survey (ICS) developed by Wu and Tsai [8] and the other is the Internet Attitude Scale (IAS) developed by Tsai et al. [5].

First, ICS had three aspects: standards for accuracy, standards for usefulness and searching strategy, each of which consist two scales. Therefore, the ICS included six scales, named respectively 'multiple sources as accuracy' , 'authority as accuracy' , 'content as usefulness' , 'technical issues as usefulness' , 'elaboration as searching strategy' , and 'match as searching strategy'. All six scales were measured by a six-point Likert scale, ranging from 'strongly agree', 'agree', 'somewhat agree', 'somewhat disagree', 'disagree' to 'strongly disagree'. Overall alpha was 0.80 and these factors accounted for 65.30% of variance. Sample items of the six scales were as follows:

- Multiple sources as accuracy scale (Multiple sources): *"I will discuss with teachers or peers, and then to judge whether the nutritional information which was received from the Internet is correct."*
- Authority as accuracy scale (Authority): *"I will believe in its correctness if the nutritional information appears in government websites."*
- Content as usefulness scale (Content): *"If its content fits my searching goal, I will think the nutritional information is useful to me."*
- Technical issues as usefulness scale (Technical): *"If it does not take much time to be*

retrieved, the nutritional information is useful to me."
- Elaboration as searching strategy scale (Elaboration): *"I can use some acquired information for advanced search to find the most-fit nutritional information."*
- Match as searching strategy scale (Match): *"If I find the first relevant nutritional website, I will not search others."*

Second, the IAS had 18 items which included four subscales: perceived usefulness, affection, perceived control and behavior. All four scales were presented in a six-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. Overall alpha was 0.81 and these factors accounted for 53.81% of variance. Sample items of the four subscales were as follows:
- Perceived usefulness: "*The Internet helps me acquire relevant information I need.*"
- Affection: *"The Internet helps me acquire relevant information I need."*
- Perceived control: *"I need an experienced person nearby when I use the Internet."*
- Behavior: *"I only use the Internet at schools when told to."*

3. Results

3.1 Factor analysis

To clarify the structure, this study used the exploratory factor analysis (EFA) by principle component method as a validation for the ICS. The results of factor analysis revealed that nutritional science students' and the dieticians' responses on the instrument could be analyzed based on the six factors: 'Multiple source', 'Authority', 'Content', 'Technical', 'Elaboration' and 'Match', i.e. all six factors exactly the same as Wu and Tsai`s study [8]. The total variance of the factors was 57.65%. All eigen-values of the six factors amount were greater than one. The reliability coefficients (alpha) of the scales respectively were 0.83, 0.64, 0.71, 0.60, 0.81 and 0.67 (overall alpha is 0.79). These supported the validity and reliability of the six factor surveys as a mean to assess the subjects' nutritional information commitments.

In addition, to validate the instrument of their attitudes toward internet, this study also examined subjects' IAS scores by an EFA. The results also demonstrated good validities and reliabilities under the following four factors: 'Perceived usefulness', 'Affection', 'Perceived control' and 'Behavior', provided in Tsai, Lin and Tsai`s study [5]. The total variance explained by the factors was 58.26%. The overall reliability alpha for IAS was 0.82 and were 0.77, 0.65, 0.61 and 0.62 for subscales respectively.

3.2 Correlation between subjects' background and ICS

In this study, an interesting finding was found regarding the correlations between subjects' Internet experience and their information commitments. it was found that the students' and the dieticians' Internet experience had significantly negatively correlated with 'Multiple sources' ($r= -0.12$, $p < .05$) and 'Elaboration'($r= -0.17$, $p < .01$). This indicated that students and the dieticians with higher Internet experiences tended not to utilize advanced evaluative standards, such as 'Multiple sources' as standards for judging online nutritional information and 'Elaboration,' the advanced searching strategy, to search online nutritional information. It also found that their 'Confidence' for learning nutritional science was negatively correlated with ‘Authority’ (r= - 0.14, p < .05). This indicated that, though they had high ‘Confidence’ for learning nutritional science, they tended not to utilize advanced standard for usefulness, such as ‘Content’ information commitment. However, their ‘Interest’ for learning nutritional science had not any significant correlation with all the ICS scales.

3.3 Correlation between subjects’ background and IAS

This study also found a positive correlation between subjects' Internet experience and their Internet attitude regarding perceived usefulness. The students and in-service dieticians with higher Internet experience for learning nutritional science had higher scores in their responses on ‘Perceived usefulness’ of IAS (r=0.12, p < .05). This means that students and in-service dieticians with higher Internet experience tended to perceive the online nutritional information was useful. Also, it was found that their ‘Confidence’ for learning nutritional science was positively correlated to ‘Perceived usefulness’ of IAS (r=0.12, p < .05). It indicated that students and in-service dieticians with higher confidence in learning nutritional science perceived more about the usefulness of online nutritional information. However, their ‘Interest’ for learning nutritional science had no significant correlation with all the IAS scales.

3.4 Correlation between ICS and IAS

Table 1 shows the results of correlations between ICS and IAS scores. First, all sub-scores in IAS were significantly positive correlated with Elaboration strategy and significantly negative correlate with Match strategy. This means that the subjects with better Internet attitudes tended to use better strategies to search online information. Second, there were significantly positive correlation between all IAS sub-scores and Content score of ICS. This indicated that subjects with better Internet attitudes tended to evaluate online nutritional information's usefulness majorly by content. Third, regarding the accuracy standards, the subjects with higher usefulness and behavior scores of IAS tended to judge online nutritional information based on both multiple sources and authority. However, the ones with higher affections of Internet tended to judge information by only authority; and the ones with higher perceived control of Internet tended to use multiple sources for evaluation standards.

Table 1: The correlation between subjects’ scores on the ICS and IAS (N=340)

	Multiple sources	Authority	Content	Technical	Elaboration	Match
Perceived usefulness	0.36***	0.32***	0.42***	0.21***	0.37***	-0.22***
Affection	0.08	0.13*	0.19***	0.05	0.11*	-0.25***
Perceived control	0.32***	0.07	0.21***	0.02	0.39***	-0.36***
Behavior	0.13*	0.16*	0.24***	0.01**	0.20***	-0.39***

p* < .05, ** *p* < .01, * *p* < .01

3.5 Comparisons between pre-service and in-service dieticians

Comparisons between students and the dieticians in this study showed significant differences in terms of their scores on the 'Technical' (t = -3.83, p<0.01) and 'Elaboration' (t = -3.85, p<0.01). It indicated that in-service dieticians were more oriented to use the 'Technical' standard and 'Elaboration' strategy than pre-service dieticians when searching nutritional information on the Internet. Besides, there was no significant gender difference on the scales of the ICS and IAS with all of their responses scores. This indicated that male and female students or in-service dieticians had similar on-line nutritional information commitments and the Internet attitudes.

4. Conclusion

This study used two instruments to assess nutritional science students' and in-service dietitians' information commitments and Internet attitudes. By exploratory factor analysis, the ICS and IAS are deemed to be sufficiently reliable in assessing subjects' information commitments and Internet attitudes. Liang and Tsai found that medical students with more Internet experience tended to use 'Elaboration' searching strategy while inclining towards utilizing quite 'mixed' standards for judging online information [1]. However, this study revealed that the nutritional science students' and in-service dietitians' Internet experience were negatively related to 'Multiple sources' scale and 'Elaboration' scale of the ICS, and positively related to 'Perceived usefulness' scale of the IAS. This means that respondents with more Internet experience tended to utilize less advanced standards for correctness and searching strategy, but tended to have positive Perceived usefulness about the Internet attitudes. Their confidence for learning nutritional science was negatively related to 'Authority' of the ICS, and tended to have more "Perceived usefulness" of Internet attitudes. It also found that the nutritional science students and in-service dietitians with better Internet attitudes tended to use advanced online information search strategy, to perceive Internet's usefulness majorly according to the content provided on the Internet, and to judge online nutritional information on a mix standard (based on both multiple resources and authorities). Furthermore, there were some differences regarding ICS between in-service and pre-service dietitians. That is, the in-service dietitians tended to use 'Technical' standard for usefulness and 'Elaboration' searching strategy more than did the nutritional science students. Finally, future studies can be conducted to compare the information commitments about online nutritional information and Internet attitudes between students with and without nutritional backgrounds.

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Applying Recommendation System to Facilitate Exploratory Online Learning - An Empirical Study at Graduate Level

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Abstract: Information exploration has become an essential part of exploratory learning that encourages students to acquire new knowledge and solve problems. However, conducting web search is complex and challenging, and learners may fail to acquire valuable information they really need. Recommendation systems have been proposed as a potential means to facilitate learner's web search. Nevertheless, few recommendation systems were developed to help learners obtain more suitable keywords toward a specific field. In this paper, an empirical study was conducted to examine the effectiveness of a proposed recommendation system in facilitating learners to specify keywords more precisely for searching.

Keywords: Recommendation Systems, Exploratory learning, Information searching strategies, concept association techniques

1. Introduction

With the rapid development of information technologies, World Wide Web has become an important information repository involving varieties of resources [6]. Learners often search for and collect information what they desire on the specific sites or academic databases, such as Google, Yahoo, Wikipedia, ISI Web of knowledge. These sites do not only provide alternative opportunity for learners to explore specific domain knowledge, but also build the relationship among information to form a Web of knowledge to help learners expand the scope of knowledge.

However, a number of studies showed that learners often face difficulties, such as information evaluation [4] and disorientation [5][6]. The difficulties might increase learners' cognitive load and impede their exploratory learning on the web. More specifically, they do not know how to query appropriate keywords and are unfamiliar with the specific domain. To address the difficulties above, numerous recommendation mechanisms have been proposed, such as content-based filtering [3] and collaborative filtering [1]. The former applied the Term Frequency-Inverse Document Frequency of information retrieval technique to extract important keywords from collected documents, and then recommend the suitable information based on learner's past experience. The latter used the association rule mining of data mining technique to discover the relationship among a group of learners who have similar experience, and then recommend relevant information based on collaborative filtering to help learners.

With the advantages of the two filtering mechanisms, the recommendation system with the concept association techniques was proposed by previous study [2], which demonstrated the technique is an efficient approach to facilitating learners to exploratory learning. However, the previous study only evaluated learners' exploratory performance. There is still a lack of strong evidences to demonstrate the effect of the concept association techniques on exploratory learning. Several factors have been identified might influence learners on seeking information on the web. For example, Tasi and Tasi's study found that learners with low self-efficacy might not use high-level searching strategies [6]. In addition, Tu et al. study indicated that learners with high metacognitive skill had better searching outcome [7]. Therefore, it is necessary to understand learners' perceptions toward using the concept association techniques in exploratory learning

The purpose of this study was to supplement the findings of previous study [2]. It is similar to the previous study which focuses on the effect of the concept association techniques on learners' searching behavior. It differs from previous study, however, in the way learners' perceptions toward the techniques is evaluated. To this end, this study conducted an empirical experiment to evaluate how the concept association techniques influence learners' behaviors and perceptions of information searching.

2. Method

2.1 Participants and activity

This study conducted an experiment to investigate the effect of the concept association techniques on exploratory learning. The participants of this study were 30 graduated students in Taiwan. All of them participated in two exploratory learning activities, and each activity lasted 90 minutes. Participants had to search for information on the ISI database to perform the assigned task in two different settings. The task is open-ended questions related to the digital technologies learning domain.

2.2 Research instruments

2.2.1 The exploratory learning of two settings

The participants were asked to use database provided by ISI web of knowledge to seek information in the first exploratory learning activity. The ISI provided basic and advanced query function and also provided the refined function to re-query based on additional criteria from the searched results. Participants used these functions to search relevant information and organized collected papers to complete their reports.In the second activity, participants only used the recommendation system with concept association techniques provided by previous study [2]. The system is providing keywords recommendation function in light of the keywords identified by participants and providing the search interface made of concept map tool to assist learners in organizing information.During exploratory learning activity, participants' searching behaviors on screen were captured by Camtasia application for further analysis. After each activity, each participant was asked to fill out a questionnaire about their perceptions toward their information seeking strategies.

2.2.2 Onscreen searching behaviors

In order to better understand how learners search for information in the two different settings, the onscreen searching process were analyzed to gain in-depth behavioral attributes. A total of six searching behavioral attributes were identified. The attributes are described in detail as follows:

- Frequency of keyword searching: The number of times keyword searches were queried by the learners to search for information.
- Number of keywords: The number of keywords shows that the number of distinct keywords that a student used to search for information. All keywords identified by a student are similar that were considered as the same keyword.
- Frequency of logical searching: This attribute indicates the number of times that learners used logical expressions to query database in light to multiple criteria.
- Frequency of repeated search: The learners may repeat using the same keyword to search for information. The frequency of repeated search reveals the number of times that the students performed such repeated searches.
- Number of papers downloaded: This attribute reveals the quantity of information that learners considered useful during searching information process.
- Number of papers cited in reports: This attribute displays the valid impact of the information seeking activity on learning as the students may have used only a small portion of the papers they found to complete their reports.

2.2.3 Questionnaire

A questionnaire was used to examine how learners perceived their information searching strategies in the two different sittings. Therefore, this study adapted the Online Information Searching Strategies Inventory (OISSI) proposed by Tsai [5] to understand the learners' perception of information searching. The questionnaire provides a well framework, and presents good validity and reliability (.91). Thus, the questionnaire is a suitable instrument to assess the learners' perceptions toward applying information searching strategies in two settings. To meet the context of this study, the questions items of OISSI were moderately revised by this study. The Cronbach's alpha value of adapted questionnaire is .913, which serve as a reliable instrument.

2.3 Data analysis

To answer the questions concerning difference of the two different setting toward exploratory learning, the method of paired t-test was used to analyze participants' responses to the questionnaire on the five parts. Furthermore, participants' exploratory learning activities were extracted searching behavioral attributes. These behavioral attributes were also analyzed with the dependent t-test to understand the difference of the two different settings. By way of t-test analysis, we gain a better understanding of how the concept association techniques might facilitate learners' information searching behaviors and searching strategies.

3. Results and discussion

3.1 Information searching behaviors

It is shown that the learners demonstrated different searching behavior in the two settings, as shown in Table 1. The learners used higher frequency of keyword searching in the recommendation setting than they did in the ISI setting ($t = -2.65$, $p < .05$). In addition, the learners significantly cited more useful information in their reports in the recommendation setting than they did in the ISI setting ($t = -3.36$, $p < .01$). Although the frequency of logical searching behavior has no significant difference between the two settings, the behavior p value is .56 which almost approaches significant difference. It may be indicated that the learners used fewer logical searching behavior in the recommendation setting than they did in the ISI setting. There are no significant differences between the two settings for the number of keywords, frequency of repeated search and number of papers downloaded.

The results revealed that the recommendation setting with the concept association techniques may influence learners' searching behaviors. More specifically, the recommended techniques provide more appropriate keywords for learners to expand effectively their searching directions. Moreover, the techniques alleviated their cognitive overload on orchestrating different keywords to seek the correlation between different keywords. In particular, increasing rate of cited papers in their reports demonstrated that the supporting of recommendation with the concept association techniques can greatly assist them in seeking relevant papers.

Table 1. The results of information searching behaviors in the two settings

Behavioral attributes	Settings	N	Mean	SD	t-value
Frequency of keyword searching	ISI web of knowledge	30	8.87	4.41	-2.65*
	Recommendation system	30	12.53	5.78	
Number of keywords	ISI web of knowledge	30	4.33	4.16	-.73
	Recommendation system	30	5.03	3.48	
Frequency of logical searching	ISI web of knowledge	30	6.10	6.41	1.99
	Recommendation system	30	3.87	3.44	
Frequency of repeated search	ISI web of knowledge	30	1.47	2.60	1.60
	Recommendation system	30	0.73	1.08	
Number of papers downloaded	ISI web of knowledge	30	4.53	1.61	-.64
	Recommendation system	30	4.83	1.88	
Number of papers cited in reports	ISI web of knowledge	30	2.33	1.16	-3.36**
	Recommendation system	30	3.67	1.58	

*p <.05; **p< .01

3.2 Perception of information searching strategies

The learners' responses to the question items were averaged to obtain an overall understanding as shown in Table 2. The results showed that there are significant differences between the two different settings for the dimensions of system control ($t= -7.01$, $p < .001$), disorientation ($t= 3.72$, $p < .01$), problem-solving strategies ($t= -2.84$, $p < .01$), purposeful thinking ($t= -7.9$, $p <. 001$) and evaluation ($t= -8.62$, $p < .001$). However, there was no significant difference between the settings for problem solving strategies ($t= -1.987$, $p<.05$). Overall, the results reveal positive effects of using recommendation system with concept association techniques on information searching strategies. Learners intended to consider that the searching interface of the recommendation system is easier to use than the ISI setting. Moreover, they perceived their disorientation problem decrease obviously in the recommendation system setting. That is, the recommendation system can effectively alleviate their cognitive load due to suggesting the searching direction. In addition, they felt that the recommendation system help them apply the searching strategies to solve problem. It could be supposed that the recommendation system provided appropriate keywords and clear association between concepts. The learners agreed strongly that the recommendation system can facilitate self-monitoring fit for searching purpose.

The interface with concept map tool may provide visual searching history to support their searching process since they were instantly aware of what they search status for the moment. In addition, the relationships between concepts and information were represented with linking form on the concept map in which they were easy to evaluate collected papers.

Table 2. The questionnaire results of learners perceptions toward information searching

Dimensions	Settings	N	Mean	SD	t-value
System control	ISI web of knowledge	30	3.64	0.88	-7.01***
	Recommendation system	30	4.73	0.58	
Disorientation	ISI web of knowledge	30	2.85	1.07	3.72**
	Recommendation system	30	2.14	0.65	
Problem-solving strategies	ISI web of knowledge	30	4.25	0.68	-2.84**
	Recommendation system	30	4.67	0.59	
Purposeful thinking	ISI web of knowledge	30	3.07	0.69	-7.90***
	Recommendation system	30	4.71	0.72	
Evaluation	ISI web of knowledge	30	3.17	0.81	-8.62***
	Recommendation system	30	4.72	0.54	

*p <.05; **p< .01; ***p< .001

4. Conclusion

The study administrated an empirical experiment to investigate the effects of the recommendation system with concept association techniques on learners' information searching strategies and their perceptions. The results shown in this study demonstrated that the recommendation system with concept association techniques is a useful approach to facilitate learners' searching direction and expand the scope of domain knowledge. Moreover, they perceived the recommendation system can help them to reflect upon the status of their searching and solve searching difficulties in disorientation and information evaluation. However, this study was a small-scale investigation. Further work is needed to conduct a large sample to support the findings of the study. In particular, the participants of the study are graduated students. It would be interesting to see the effects of the concept association techniques on the different ages of learners.

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