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Work-in-Progress Poster (WIPP) Proceedings of the 20th International Conference on Computers in Education ICCE 2012

Editors

Jimmy LEE Doris CHOY Gautam BISWAS Lung-Hsiang WONG

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PREFACE

The Work-In-Progress Poster (WIPP) session was held in conjunction with the conference: 20th International Conference on Computers in Education (ICCE 2012) which took place during November 26 and 30, 2012, in Singapore. The aim of the WIPP session is to provide extra opportunities for poster presenters to showcase well-formulated, innovative on-going work and late-breaking results.

ICCE 2012 is comprised of seven theme-based sub-conferences as follows:
C1: ICCE Conference on Artificial Intelligence in Education/Intelligent Tutoring System (AIED/ITS) and Adaptive Learning
C2: ICCE Conference on Computer-supported Collaborative Learning (CSCL) and Learning Sciences
C3: ICCE Conference on Advanced Learning Technologies, Open Contents, and Standards
C4: ICCE Conference on Classroom, Ubiquitous, and Mobile Technologies Enhanced Learning (CUMTEL)
C5: ICCE Conference on Game and Toy Enhanced Learning and Society (GTEL&S)
C6: ICCE Conference on Technology-Enhanced Language Learning (TELL)
C7: ICCE Conference on Technology, Pedagogy and Education

This year, each of the seven theme-based sub-conferences set up its own program committee for selecting WIPP papers for their respective themes. All submissions for the WIPP presentations were reviewed by the program committees and 22 papers were accepted for presentation at the conference. The WIPP session provides a great opportunity for presenters and participants to refine their ideas and concepts through interactions with the community at large, and the conference attendees get to see some late breaking work generated by the ICCE community..

We are grateful to the authors of the papers, WIPP program committee members, and ICCE 2012 local organizers for their effort in organizing the session and to make this happen.

Poster Coordination Co-Chairs, ICCE 2012
Doris CHOY
Jimmy LEE

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Resource Organization System for Self-directed/Community-based Learning

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Abstract: The main topic addressed in this paper is how to find and organize learning resources in Web-based learning. In this paper, we propose a multi-layer map model which provides learners with structure of the resources explicitly and to share the suitable resources via the map representations. We also develop a system, based on the model proposed, enables not only individual learners can easily organize related learning resources as personal topic maps but also they can share a community topic map which merges the personal topic maps created by the individual self-directed learners.

Keywords: Web-based Learning, Resource Map, Self-directed Learning, Personal Topic Map, Community-based Learning, Community Topic Map

Introduction

With the rapid development of the internet, it has become possible to overcome the restrictions of time and place for self-directed learning. Such learning has been demonstrated to enhance the learning process [5], but often requires learners not only to navigate Web pages to find proper resources but also to control the navigation and knowledge construction processes [3]. As a result, Web-based self-directed learning has become an important research issues in the recent decade. Our approach to resolve this issue is to integrate self-directed learning into community-based learning in which the learners have informal community-centered communications [2]. Community-based learning also attracts much attention along with the fast development of the Web technology. However, it is difficult for the learners to get suitable learning resources to their learning process from community-based learning without suitable communication platform. In order to solve this problem, we propose a resource organization system which makes the connections between the actual Web contents to the learning topics by multi-layer map visualization. In this paper, we describe the design of the learning environment and the current research situation concerning the system development, which is aimed to provide supports in the process of self-directed learning and community-based learning seamlessly.

1. Issue Addressed

1.1 Difficulties in Self-directed Learning

In the process of web-based self-directed learning, learners can navigate a vast amount of Web-based learning resources to achieve their learning goals. Such resources usually

provide them with hyperspace so that they can navigate in a self-directed way by following links among the pages. However, the large amount of available information on the Web makes it very difficult for the learners to locate suitable resources about particular topics of interest. Secondly, it is difficult for them to organize the found ones. Beginners at self-directed learning sometimes lose sight of their learning goal because of the complexity of the hyperspace. Such navigation problems are major issues, and have been discussed regarding the developments of educational hypermedia/hypertext system [1].

1.2 Self-directed Learning and Community-based Learning

Community-based learning means a process of communication by the community members with the similar learning goals for the purpose of encouraging each self-directed learning activity, and makes it possible to conduct informal communication as feedbacks for the individual self-directed learning processes. Therefore, such features of community-based learning have possibilities for solving some problems in self-directed learning. Instead of searching on the web, it would be greatly helpful especially when it comes to locating suitable learning resources, the suitable ones might be already collected by other users. However, it is also difficult to integrate self-directed learning into community-based learning and be aware of the suitable ones collected by the other users. In order to solve this problem, Multi-layer Map Model is proposed in this paper.

2. Approach

Multi-layer Map Model [4] is the core of the learning environment proposed which is intended to perform as a GUI for self-directed and community-based learning. Figure 1 shows the four layers model with different functions dependent on the services provided by their nearest layers. The model provides the community members with communication basis via superposed map representations. It mainly focuses on visualizing the structure of learning contents in term of resource maps, and then enables learners to edit or reconstruct personal maps according to their learning processes. Moreover, this model includes community topic map where the personal topic maps are merged, viewed and used by other community members.

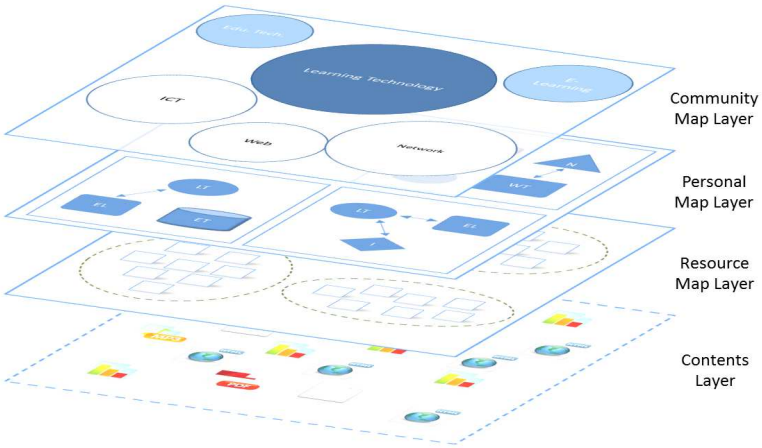

Figure 1 Multi-layer Map Model

3. System development

Figure 2 shows interfaces and workflows of the developed system. Learners can first use the embedded search engine API to select links with most relevance of their interest from the Web. Local crawler next gathers information from the chosen links to web pages in a much deeper level. And then the system generates spatial maps as the resource map automatically based on the results crawled by the local crawler. It shows the structure of the crawled URLs in form of nodes labeled with page titles. By clicking each node, the learners can access to the real contents behind it. Then, the system enables the learners to collect nodes by related topics, and learners can edit their personal topic maps simply by dragging and dropping selected nodes.

The system next merges necessary information (number of users under one topic, number of learning resources under one topic, and number of shared learning resources among topics) of the personal topic maps and presents it in the form of the community topic map. Relevance with learner's topic (Colors of bubbles), relevance among topics in the community topic maps (distance between bubbles) and the number of learning resources under one topic (size of each bubble) give the learners hints for making choices. After clicking selected bubble, learning resources will be represented with nodes labeled with title. Users create their personal maps by referencing the resource map and the community topic map. And on the contrary, the personal topic maps contribute to the community topic map too.

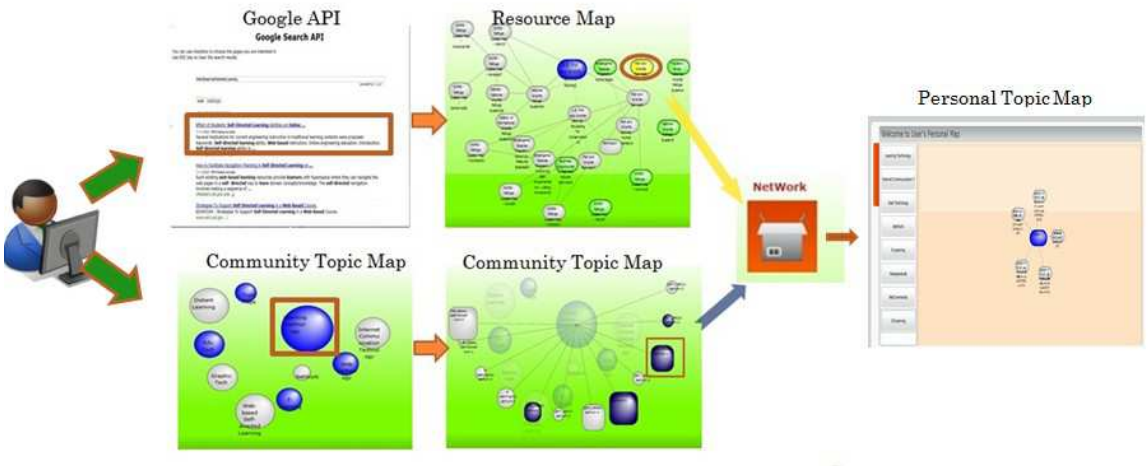

Figure 2 System Flow

4. Conclusions and Future Work

By using Microsoft .NET framework and Silverlight interface, the development is nearly finished. In the near future, we will conduct experimental case studies to analyze every step of the learning process when using this system.

Acknowledgements

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References

[1] Brusilovsky, P., (1996). Methods and Techniques of Adaptive Hypermedia, *Journal of User Modeling and User- Adapted Interaction*, 6, 87-129.

[2] Fujimoto, R., Hasegawa, S, Miura, M, & Kunifuji, S, (2006). Development of Community Based Learning System at a University, *Information and Creativity Support Systems (KICSS2006)*, 66-71,.

[3] Kashihara, A. & Hasegawa, S, (2005). A Model of Meta-Learning for Web-based Navigational Learning, *International Journal of Advanced Technology for Learning* (pp.198-206). Vol.2, No.4, ACTA Press,

[4] Li, H., & Hasegawa, S., (2010). Multi-layer Map-oriented Learning Environment for Self-directed &Community-based Learning, *International Workshop on Models, Methods, and Technologies for Learning with Web Resources (ICCE2010)*, 109-116.

[5] Thuering, M., Hannemann, J. & Haake, J. M., (1995). Hypermedia and cognition: Designing for comprehension. *Communication of the ACM*, Vol.38, (8), 57-66.

A Preliminary Study on Context-Aware Ubiquitous Learning Strategies Integrated Affective Tutoring System

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Abstract: Affective tutoring system (ATS) can enhance learner's motivation and effectiveness of learning in Digital Art courses. Past ATS researches and applications are developing on personal computer and in the classroom, but most learner look around Digital Art in gallery. The research of relating to ubiquitous learning is well-developed. In this research, we propose a conceptual model and system architecture on context-aware ubiquitous learning strategies integrated affective tutoring system (ULS-ATS) and a research design to test the system's usability for learner, learner's motivation and effectiveness of learning in Digital Art courses. We expect more new ubiquitous learning strategies of ULS-ATS and more different applications in the future.

Keywords: Affective Tutoring System, Ubiquitous Learning, Digital Art courses

Introduction

In Digital Art courses, researches verified that Affective Tutoring System (ATS) enhance learner's motivation and effectiveness of learning. The systems are developing on personal computer and in the classroom. If learner needs to leave the classroom to Digital Art gallery, existing ATS can't work without PC because of system compatibility. Mobile devices are smaller than PC and have diverse user interface design. In ubiquitous learning, teaching strategies have a lot of difference due to the sensor and environment. In this research we transplant ATS to mobile devices and design a new ATS user interface and integrate ubiquitous learning strategies, so its usability and effect of learners need to be verified.

1. Literature Review

1.1 Affective Tutoring System (ATS)

ATS is a system based on intelligent tutoring system and affective interface. Learners use computer to learn with affective agents. ATS can identify learner's emotion by many inputs like facial expressions, sounds, physiology information, and texts in real time. ATS will select different teaching strategies by learner's emotion (Lin, et al., 2012a, 2012b). Recently, some researches show that ATS can enhance learner's motivation and effectiveness of learning on Digital Arts courses (Huang, 2012). Lin, at el. (2011)

proposed a conceptual model and system architecture of Ontology-based affective tutoring system on Digital Arts and verified for good system usability. We will reference to Lin's affective interface design and transplant to mobile devices.

1.2 Strategies of Context-Aware Ubiquitous Learning

Ubiquitous learning is a learning environment built by mobile devices, wireless network and sensors at el. U-learning can enhance learner's effectiveness of learning (Chu, Hwang, Huang, & Wu, 2008; Hwang, Yang, Tsai, & Yang, 2009; as sited in Hsieh at el., 2010). Hwang et al. (2008) proposed 12 strategies of context-aware ubiquitous learning. Following are the strategies:

Table 1. Strategies of context-aware ubiquitous learning (Hwang et al., 2008)

1.Learning in the real world with online guidance	7.Identification of a real-world object
2.Learning in the real world with online support	8.Observations of the learning environment
3.Online test based on real-world object observations	9.Problem-solving via experiments
4.Real object observation	10.Real world observation with online data searching
5.Collect data in the real world via observations	11.Cooperative data collecting
6.Collect data in the real world via sensors	12.Cooperative problem solving

2. Research Methods

2.1 Research Subjects

Our objective research subjects are university students who attend Digital Art courses from Taiwan. We will design a teaching material using the strategies to students of context-aware ubiquitous learning.

2.2 Context-Aware Ubiquitous Learning Strategies Integrated Affective Tutoring System.

In order to integrate the strategies of context-aware ubiquitous learning (Hwang, G.-J. et al., 2008) and the affective tutoring system, we design a mobile system called ULS-ATS. When learner learns on ULS-ATS, the teaching agent will select different teaching strategies by learner's status like emotions, location, RFID, NFC tags and other sensors on the device. For example, if ULS-ATS find the learner feel bad, the agent will try to be funny and select a relatively-simple teaching material. Teacher can retrieve the learner's emotion on each course from ULS-ATS's server. Teacher also can adjust the teaching strategies which most people don't interest in and grasp much more learner's learning status instead of only scores.

2.3 Experimental Design

We will separate subjects into two groups: experimental group (ULS-ATS learner) and control group (normal learner). Before the course, subjects will finish a pretest. Then they learn Digital Art courses in public gallery. After the course, subjects will fill an exam and two questionnaires: System Usability Scale (Brooke, J. , 1996) and Motivated Strategies for Learning Questionnaire (Pintrich ,1993) to verify the effectiveness of learning, usability of ULS-ATS and learning motivation of learners.

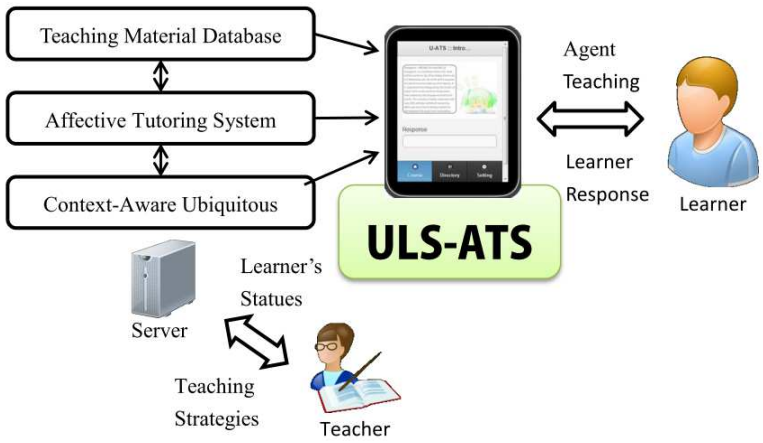

Figure 1. Conceptual model and system architecture of ULS-ATS

3. Conclusion and Future Work

We had already finished the prototype of teaching materials and ULS-ATS. Following are our future works:

(1) Based on integrating the strategies of context-aware ubiquitous learning to ULS-ATS, we need to develop more detail strategies of learner's emotion.

(2) For student, we'll evaluate the usability of ULS-ATS and apply to Digital Art courses. More, we'll design and evaluate more teaching agents for different populations like senior, junior, university students or maybe students want to design agents by themselves, we have to develop a mobile agent design tool for them.

(3) For teachers, they need a convenient teaching materials design tool and so on they can develop their own ULS-ATS courses.

(4) We'll try to use ULS-ATS with specific teaching strategies on different courses like nature, history.

References

[1] Ammar M. B., Neji M., Alimi A. M.,& Gouarderes G. (2010). The Affective Tutoring System. Expert Systems with Applications 37, 3013 – 3023.

[2] Bangor, A., Kortum, P., & Miller, J. (2008). An Empirical Evaluation of the System Usability Scale. International Journal of Human-Computer Interaction,24(6), 574-594

[3] Chu, H. C., Hwang, G. J., Huang, S. H., & Wu, T. T. (2008). A knowledge engineering approach to developing E-libraries for mobile learning. The Electronic Library, 26(3), 303–317.

[4] Hsieh Shengwen, Zhang Yurui, Chen, N. S, & Hwang, G.-J. (2010). Impacts of Adaptive reflect on questions mechanism for u-learning learners to reflect on the level. 2010 E-commerce Conference. 25-26.

[5] Huang, Tsu-Ching. (2012). Employing Multi-Modal Affective Computing Techniques to Design the Human-Computer Interface of an Intelligent Tutoring System – An Example on Digital Arts Learning. National Tainan University. Master's thesis. Tainan.

[6] Hwang, G. J., Yang, T. C., Tsai, C. C., & Yang, J. H. S. (2009). A context-aware ubiquitous learning environment for conducting complex experimental procedures. Computers &Education, 53(2), 402–413.

[7] Lin, H, C, K, Chen, N. S., Sun R. T., & Tsai, I. H. (2012). Usability of affective interfaces for a digital arts tutoring system, BIT, Behavior & Information Technology, DOI:10.1080/0144929X.2012.702356

[8] Lin, H, C, K, Hsieh, M. C., Loh, L. C., & Wang, C, H. (2012). An Emotion Recognition Mechanism Based on the Combination of Mutual Information and Semantic Clues, JAIHC, Special issues "Emotional Intelligence and Ambient Intelligence" of Journal of Ambient Intelligence & Humanized Computing, Volume 3, Issue 1, Page 19-29.

[9] Lin, H, C, K, Sun R. T., & Tsai, I. H. (2011). An Ontology-Based Affective Tutoring System on Digital Arts. Affective Computational Intelligence (WACI), 2011 IEEE Workshop on.
[10] Lin, Jin-Wei. (2012). Affective Computing Techniques with Intelligent Tutoring System - An Example on Digital Arts Course. National Tainan University. Master's thesis. Tainan.
[11] Pintrich, P.R., Smith, D.A.F., Garcia, T., & McKeachie, W.J. (1991). A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ). AnnArbor, MI: National Centre for Research to Improve Postsecondary Teaching and Learning, the University of Michigan.

Error-Based Simulation in Concept Mapping for Learning about Meaning of Class Structure

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Abstract: We describe development and evaluation of a learning support environment with error-based simulation functions using concept maps for class structure meaning. There are various relations between concepts in scientific domains, and understanding these relations is vital. Understanding class structure is particularly important. To that end, it is effective for learners to construct class structures by themselves. We develop a learning support environment using concept maps to aid the independent construction of structures by learners. The environment offers error-based simulation when learners make mistakes during construction. We report on implementation of the environment in a junior high school, and confirm that junior high school students can use the environment.

Keywords: Learning Support Environment, Concept Map, Error-based Simulation, Learning Science, Class Structure

Introduction

It is important for learners to understand the meaning of class structure in scientific domains. In such domains, important concepts are arranged using class structures. For example, sparrows belong to a 'birds' class, and the 'birds' and 'mammals' classes belong to a higher-ranked 'vertebrates' class. The class structure is composed of instances, classes, and properties. Instances are concrete concepts such as 'sparrow.' Classes are abstract concepts, such as 'birds,' which are constructed from instances or lower classes having common properties. Properties are features such as 'wings' or 'egg-laying.' Classes are differentiated by properties, which are passed down from higher classes to lower classes or instances. Understanding the meaning of a class structure corresponds to understanding these characteristics and to the ability to systematically arrange the various concepts. In the classroom, however, learners often blindly memorize class labels and properties.

Practical use of concept maps is effective in understanding class structures. Various studies of concept mapping have been conducted [4]. When learning with concept maps, correction activities are important [3]. This is a complex task, however, making computer-based correction support appealing. We developed a learning support environment with error-based simulation (EBS) [2] for concept maps. The purpose of this environment is to visualize learner errors when made, helping learners notice errors. This paper reports the results of deploying the environment in a junior high school.

1. Support Learning Environments using Concept Maps with Error-Based Simulation

Our learning support environment gives learners feedback regarding property inheritance and discrimination of classes by properties. Figure 1 shows an interface for constructing skeleton concept maps. Learners are required to link provided instance and property nodes to a partially constructed skeleton concept map. Lower classes or instances inherit properties from higher classes, so if learners can correctly link all relations, each instance will have the appropriate properties. Errors are thus apparent in each instance. EBS for concept maps generates strange behavior when there are differences between the instance properties of a correct map and a learner map. Figure 2 shows an example of EBS.

Figure 3 shows the architecture of our environment. Existing learning support environments diagnose differences between erroneous learner concept maps and correct ones, and give feedback based on the differences. Biswas [1] developed an environment that generates graduated hints using qualitative process theory. Our EBS generator specifies the differences of instance properties, and generates EBS using two databases. We describe behaviors by property in a property database, and when the behaviors are visualized in a process database.

This study focused on biology in junior high school. Figure 2 shows a visualization of 'pine.' In this case, though pine has a 'vascular bundle' property, the learner linked to the 'thallus' property (undifferentiated plant form). Our environment therefore visualized the pine growing like a moss.

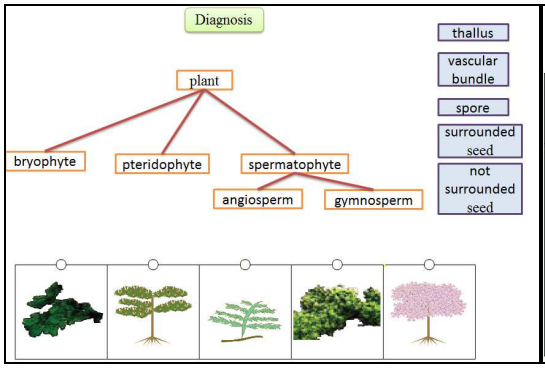

Fig. 1. Concept map interface

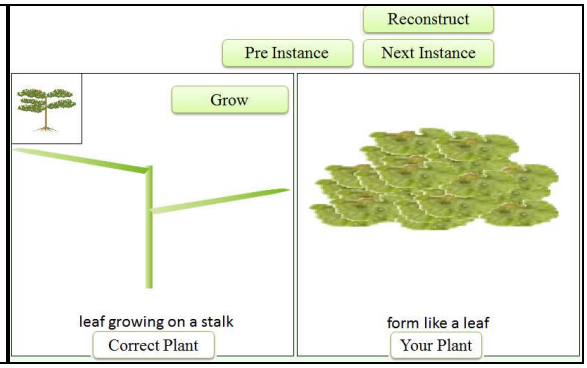

Fig. 2. An example of EBS

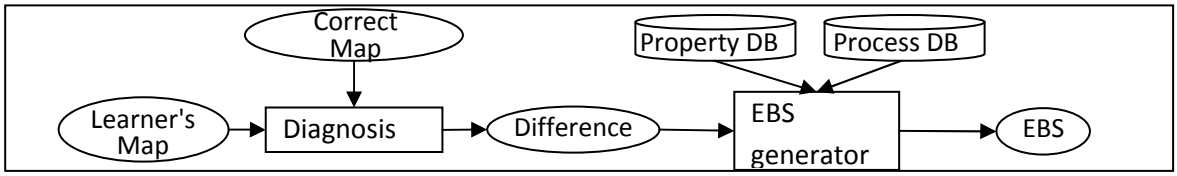

Fig. 3. Environment architecture

2. Evaluation

To evaluate whether using our learning environment promoted semantic understanding of class structure , we used the environment with 29 first-year and 31 second-year junior high school students, and investigated changes in results. The procedure was as follows:

1. Explanation of concept maps with examples (5 min)
2. Pre-test (10 min)
3. Use of the proposed environment (20 min)

4. Post-test (10 min)

Learners were required to construct concept maps about plants and animals. The pre- and post-test required the same tasks. The plant task, called the 'learning task,' was learned using our environment. The animal task, called the 'transfer task,' was not learned. No advice about constructing concept maps was given during system use, pre-testing, or post-testing.

Table 1 shows transition of the average number of correct properties for all instances of the learning and transfer tasks. Table 2 shows the results of analysis of variance with task (learning and transfer) and time (pre-test and post-test) as factors. Table 1 shows improving results from pre-test to post-test for all first and second year students. Table 2 shows that significant differences were acquired for the time factor, but not the task factor or interaction. The improvement between learning and transfer task scores suggests that learner knowledge of the domain and comprehension of class structure were promoted.

Table 1. Average scores (Max: 10)

	Learning Task (Plant)		Transfer Task (Animal)	
	Pre-Test	Post-Test	Pre-Test	Post-Test
First Year	4.0	7.2	4.8	6.0
Second Year	2.4	7.2	1.6	7.5

Table 2. Analysis of Variance

	Factor of Tasks	Factor of Tests	Interaction
First Year	$p < 0.01$	n. g.	n. g.
Second Year	$p < 0.01$	n. g.	n. g.

3. Conclusion

We developed and evaluated a learning environment that visualizes strange behavior resulting from learner errors in constructing concept maps. Implementation of our environment indicated that junior high school students improved their understanding of the meaning of class structure.

Acknowledgements

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References

[1] Biswas, G., Leelawong, K. Schwartz, D. and Bye, N.(2005) Learning by teaching: a new agent paradigm for educational software, *Applied Artificial Intelligence*, 19, 363-392.

[2] Hirashima, T., Imai, I. Horiguchi, T. and Toumoto, T. (2009). Error-based Simulation to Promote Awareness of Errors in Elementary Mechanics and Its Evaluation, *Proceedings of AIED'09*, 409-416.

[3] Novak, J. D. and Gowin, D. B.(1984). *Learning How to Learn*, Cambridge University Press.

[4] Tifi, A., Lombard, A.(2008) Collaborative concept mapping models, *Proceedings. of the Third Int. Conference on Concept Mapping*.

Exploring the effect of incorporating Facebook with project based learning activity on learners' creativity – A preliminary investigation

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Abstract: Social interaction is known to be one of the key elements in Computer-supported collaborative learning (CSCL). Through frequent social interaction, learners are expected to obtain heterogonous perspectives and develop divergent thinking, which could awake creativity, in the learning process. Facebook (FB), a popular social networking service, provides functions that allow people to interact with each other. Recently, educational researchers have looked into the potential of adapting FB in teaching activity. However, relative few attentions have been devoted to the relationship of the extent of engagement in online discussion using FB and the quality of learning outcome in collaborative learning. Therefore, this study incorporated FB with a group project teaching activity to explore the relationship between the extent of students' engagement in online discussion using FB and the quality of their project outcomes. Results showed that students' engagement is positively correlated to the completeness of the group project. Based on our preliminary findings, discussion and subsequent research are presented in this paper.

Keywords: Creativity, CSCL, Facebook, Project-based learning, social interaction

1. Introduction

Previous studies suggested that social interaction could be one of the key elements in Computer-supported collaborative learning (CSCL) [1][8]. Frequent social interaction is beneficial in forming positive climate for knowledge sharing and group member cohesion, which could contribute to effective learning and better learning outcome [6-7]. Meanwhile, by the productive discourses with peers, learner could be able to learn from heterogonous perspectives and experiences of peer learners [10]. In other words, a divergent thinking, which is helpful in triggering creativity, could be achieved during the social interaction [4].

In recent years, Facebook has shown exponential growth in the number of its users. Facebook (FB) created a social space for people to interact with each other. And, social interaction is known to be beneficial in achieving better learning outcomes [1]. In this manner, numerous educational researchers have explored the potential of incorporating FB into teaching activity (e.g. [5][9]). Despite many studies have addressed the applications of FB in education and learners' perceptions, However, in the context of CSCL, research that further investigate the relationship of the extent of learners' engagement in online

discussion using FB and the quality of their learning outcomes, e.g. creativity and completeness, is still quite limited.

To better understand this phenomenon, this study incorporated FB as an online discussion platform with a group project teaching activity in an electronic commerce course. The purpose of this study is to explore the relationship between the extent of students' engagement in online discussion using FB and the quality of their project outcomes in terms of creativity and completeness. As a preliminary investigation, discussion and future research are provided based on the findings of this study.

2. Research method

2.1 Participants and procedure

The participants of this study are 39 students from a university of northern Taiwan. Students were enrolled in the course – Electronic commerce. The purposes of this course are to introduce business models, the affordance of novel technologies, and successful case studies, etc. Students were divided into 7 groups to complete a required group project that incorporated Facebook discussion. In specific, each group was asked to collaboratively design a tablet as well as innovative services using the tablet they designed. Seven Facebook secret groups, i.e. closed discussion group, were created for each group to discuss their project. Students can only access the content of the secret group they belonged to. At the end of the semester, each group had to give oral presentation of the project in the class. In order to explore the interaction among students during and the content structure of the project discussions, this study retrieved messages that each group posted in the Facebook secret groups. A total of 1472 messages were retrieved for further analysis.

2.2 Data analysis

The assessment of creativity has not come to a universal agreement [3]. Various criteria for assessing creativity have been proposed, one commonly adopted approach is to evaluate the degree of creativity exhibited in one' work. Amabile (1996) suggested that the degree of creativity of a work can be assessed based on one's subjective and holistic evaluation of it [2]. Following this approach, the instructor of the course rated each group's final project proposal in terms of the degree of creativity. Meanwhile, one more dimension, i.e. completeness, was also adopted to assess the overall richness of elements include in the project. The instructor then scored each group project from 1 to 10 according to the two dimensions mentioned above. The number of messages retrieved as well as the scores of creativity and completeness for each group are available upon request.

In this preliminary report, we analyzed the relationship between the extent of students' engagement in online discussion, i.e. the number of post in each FB groups and the quality of their project outcomes in terms of creativity and completeness. Pearson correlation was conducted to analyze the relationship between the number of post in each FB groups and the creativity score as well as complete score. Results showed that the number of posts of each group is not significantly correlated with the creativity score ($r=0.495$, $p = .129$). On the other hand, the number of posts of each group is significantly correlated with the completeness score ($r=0.784$, $p = .018$).

3. Conclusion and subsequent research

This study provides a quick glimpse over the relationship of the extent that students engaged in online discussion and the learning outcome of their project. Our results showed that the extent of students' engaging in online discussion showed positive relationship with the completeness of their group project. In other words, the higher the level that students interact, in terms of the number of posted messages, in the Facebook secret groups, the higher the completeness score of their respective group project would be. Nonetheless, our initial data analysis showed no evidence of the relationship between the extent of engagement in online discussion and the creativity score. However, these results should be taken as tentative as the preliminary stage of this study is in. An elaborate quantitative content analysis (QCA) of students' posted messages in helpful in depicting a clearer picture of the pattern of students' interaction, the content structure, and the creative discourse during online discussion in FB.

In this brief report, we didn't address the individual differences issue, such as gender or personal style of creativity, in our research context. In the subsequent phases, this study is to extend the current results, by taking individual differences into account, to further explore the behavioral patterns and creative interaction in the context of online discussion using Facebook. Moreover, the relationship between students' behavioral patterns and the degree of creativity in the project outcomes can also be further addressed.

Acknowledgements

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References

[1] Abedin, B., Daneshgar, F., & D'Ambra, J. (2011). Enhancing Non-Task Sociability of Asynchronous CSCL Environments. *Computers & Education*, 57(4), 2535-2547.

[2] Amabile, T. (1996). Creativity in Context. Boulder, Colo.: Westview Press.

[3] Amabile, T. M. (1983). The Social Psychology of Creativity: A Componential Conceptualization. *Journal of Personality & Social Psychology*, 45(2), 357-376.

[4] Ashton-James, C. E., & Chartrand, T. L. (2009). Social Cues for Creativity: The Impact of Behavioral Mimicry on Convergent and Divergent Thinking. *Journal of Experimental Social Psychology*, 45(4), 1036-1040.

[5] Baran, B. (2010). Facebook as a Formal Instructional Environment. *British Journal of Educational Technology*, 41(6), E146-E149.

[6] Bock, G.-W., Zmud, R. W., Young-Gul, K., & Jae-Nam, L. (2005). Behavioral Intention Formation in Knowledge Sharing: Examining The Roles of Extrinsic Motivators, Social-Psychological Forces, and Organizational Climate. *MIS Quarterly*, 29(1), 87-111.

[7] Kirschner, P. A., & Van Bruggen, J. (2004). Learning and Understanding in Virtual Teams. *CyberPsychology & Behavior*, 7(2), 135-139.

[8] Kreijns, K., Kirschner, P. A., Jochems, W., & Van Buuren, H. (2004). Determining Sociability, Social Space, and Social Presence in (A)synchronous Collaborative Groups. *CyberPsychology & Behavior*, 7(2), 155-172.

[9] Madge, C., Meek, J., Wellens, J., & Hooley, T. (2009). Facebook, Social Integration and Informal Learning at University: 'It Is More For Socialising and Talking to Friends About Work Than For Actually Doing Work'. *Learning, Media and Technology*, 34(2), 141-155.

[10] Vass, E., Littleton, K., Miell, D., & Jones, A. (2008). The discourse of collaborative creative writing: Peer collaboration as a context for mutual inspiration. *Thinking Skills and Creativity*, 3(3), 192-202.

Development of Communication Tool for Informal Learning in Small Groups

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Abstract: Communication tools based on the Web, such as "Twitter" and "Facebook" have not only recently been methods of simple communication but also of managing and sharing information, or what is called "informal learning". We developed an asynchronous communication tool in this research, which means that we can access it at any time and from anywhere. This communication tool can also be used by small groups, such as those in research laboratories and class rooms, who can manage and share the information interactively.

Keywords: Web, informal learning, asynchronous communication, interactive

Introduction

Learning consists of two basic methods, the first is to learn what has been prepared in school, and the second is to learn spontaneously regardless of learning courses or learning methods that have been prepared in advance. We define the first method as formal learning and the second as informal learning. Searches on the Internet, social networking sites (SNSs), and chatting are kinds of informal learning. It is also defined non-formal learning in other study [1][2]. According to research by "Conner, Marcia L", informal learning is more effective than formal learning and it encompasses over 70% of learning opportunities [3]. In fact, we are in passive mode during formal learning when we learn what has been prepared, such as learning in schools. Informal learning, on the other hand, is spontaneous because we are in interactive mode. Informal learning becomes more effective as a result. Also, informal learning in small groups is more efficient than studying alone because we can share information interactively and can create new ideas based on conventional ones. Therefore, we would like to develop a new communication tool that enables informal learning in small groups.

1. Support of Informal Learning

Learning through communication, such as SNS chatting is interactive and effective for informal learning. If we can provide a better communication environment, we can become more interactive and learn more efficiently [4][5]. Informal learning based on the Web, such as Facebook and Lino, has recently been becoming popular. These tools are quite handy and easy for users to use. Facebook has group function. With this function, users can have various advantages which are that they can make public/closed groups and communicate and share files in them. Also Facebook has time-line interface that can

indicate messages in order of age. Lino is an online web sticky note service that can be used to post memos, to-do lists, ideas, and photos anywhere on an online web canvas.
Taking the advantage of Facebook and Lino, we developed a new communication tool that can:

1) Work based on the Web,
2) Be easy to use,
3) Work asynchronously,
4) Categorize similar messages in the same area, and
5) Display information based on a time-line.

2. Functions

2.1 Chatting Function

Users can attach messages to the virtual digital board with this function, which can be either text or images. User can respond to the each message. Each message on the board has two unique tags which are Time-stamp and author information. The time-stamp and author information is displayed in color to minimize the size of message (Fig. 1). Users can reallocate messages according to the time-line with time-line view (Fig. 2). They can place the messages wherever they want on the board so that they can categorize similar messages in the same area. However, it has a disadvantage in that users do not know which message was written first. As previously described, the messages have a unique tag that includes author information and a time-stamp. The time-line function utilizes the time-stamp information in the tag and reallocates messages according to the time-line.

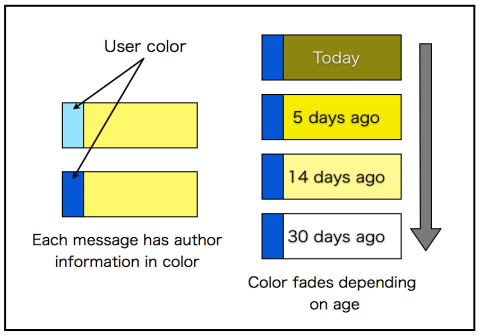

Fig. 1: Time-stamp and author information

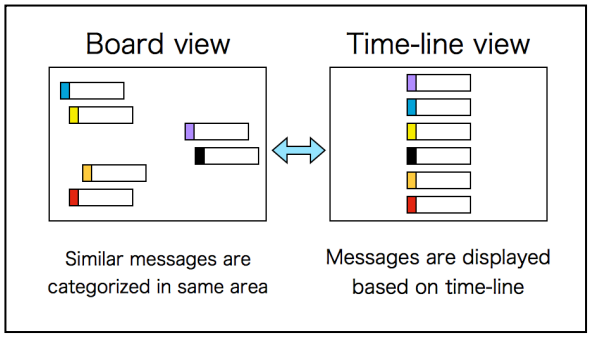

Fig. 2: Board view and time-line view

2.2 Paint Function

Users can draw figures with this function. Users can specify the color, width, and transparency of the drawing pen. They can draw figures with this pen and can remove them with the eraser. Multiple people can simultaneously access this system because it works in asynchronous mode. The system has a temporal layer for multiple people to access it simultaneously so that they can draw images on the temporal layer and save images from the layer when users utilize the “save” function.

3. Results

We will describe an example of how this virtual digital board was used. Fig. 3 shows how we used this board in small groups. The display area in the browser is board size. The

messages in the rectangles in yellow are what users were chatting about. They can chat in the rectangular boxes and place them wherever they like on the virtual digital board.

The colors in the rectangles have information that indicates how old the messages are. The colors in the rectangles will fade depending on age so that we can see how old this information is at a glance. Fig. 3 has an example of how we used the virtual digital board. The users managed and shared information about TeX. Fig. 4 shows messages that have been reallocated according to the time-line. Users can also see the details on the time-stamp and author information integrated with the messages.

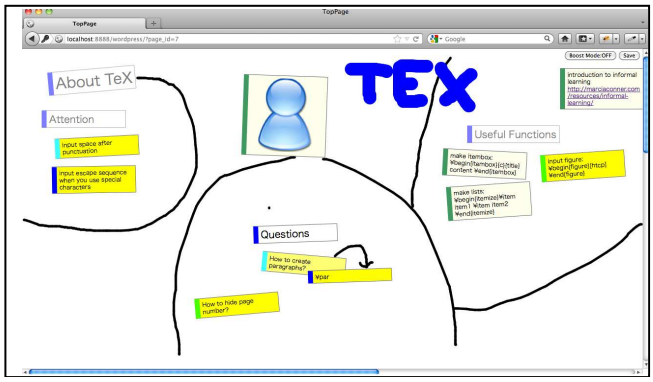

Fig. 3: How to use digital virtual board

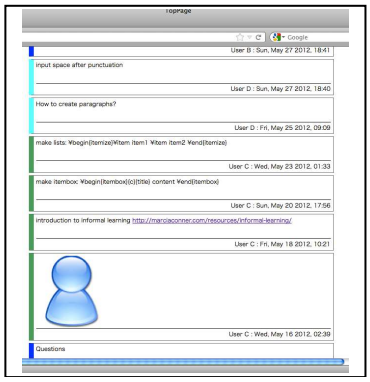

Fig. 4: Time-line view

4. Conclusion

We explained the usefulness of informal learning and we believe that informal learning by multiple people, such as those in SNS chats, is more effective than formal learning. Therefore, we developed a communication tool to support informal learning by small groups. We applied a whiteboard interface in the design process to make it easy for users to manage and share information. In addition, we adopted a time-line method to display and summarize information that users wrote. We believe that the tool we developed will promote communication by small groups and help to support informal learning. We intend to use this tool in experiments with small groups in the next process to ensure that this tool can become more effective for informal learning.

References

[1] Ainsworth, Heather L. and Eaton, Sarah (2010). “Formal, Non-formal and Informal Learning in the Sciences”

[2] Schugurensky, D. “The Forms of Informal Learning: Towards a Conceptualization of the Field.” WALL Working Paper No.19, 2000

[3] Conner, Marcia L. “Informal Learning.” 1997-2009. ” http://marciaconner.com/resources/informal-learning/”

[4] Atsushi Washio. ”Improvement of Learning in Collaborative Learning in Music Field.” Takada Junior College Journal Vol.30(pp.55-66). [in Japanese.]

[5] Satoshi Goto. “Standardization of ICT Learning –Example coming from Active Learning Studio of Tokyo University-.” Yamagata University Graduate School Department of Practical Education Annual Report. [in Japanese.]

Developing an Online Map Mind-tool to Help College Students Learn Socio-Scientific Issues: An Example of Disaster Prevention Knowledge

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Abstract: This study aims to develop an online map mind tool to help college students learn about the socio-scientific issues regarding disaster prevention knowledge. This mind tool provides functions for location search, annotation, and data collection that can help the students to construct knowledge and knowledge combinations. Through empirical research, this study explores the students' learning effects and attitudes. Based on the preliminary research results, we find that this tool promotes the college students' learning about the socio-scientific issues around disaster prevention knowledge.

Keywords: Online Map, Mind tools, Socio-Scientific Issues

Introduction

Socio-scientific issues (SSIs) are related to both technology and society [1]. The application of SSIs to a science curriculum not only helps students to better understand the scientific content but also helps them to make decisions [2]. This study tried to adopt the issue of "urban disaster prevention planning" to promote college students' critical thinking skills and to explore how to apply the appropriate technology to assist in SSI learning. The mind tool, or cognitive tool, proposed by Jonassen [3] is a computer-based tool and learning environment whose function is to assist students in critical thinking and higher-level learning. Mind tools can help students to think deeply and extend what they have acquired; they can also promote students' ability to actively formulate a plan and make decisions while further enhancing their own knowledge database to construct the knowledge [4]. Therefore, this study develops a set of mind tools as the instructional technology to assist in the learning of SSI issues. SSIs include issues related to environmental science and geoscience such as disaster prevention, environmental protection, and energy development. All of these issues are related to location, so users must search maps to construct their knowledge. However, a quick, automatic search is not possible using static maps; thus, digital maps have been developed. Favier [5] noted that digital map tools allow students to visualize, create, manipulate, read, query, summarize, analyze, and present digital geographic data in a quick and flexible way. Digital maps can effectively improve the speed of geographic data processing and assist students in the construction of knowledge. Therefore, this study would like to develop an Online Map

Mind Tool for SSI learning (OMMT-SSI), which would include functions for location search, annotation, and data collection to assist users during SSI learning. Additionally, through an empirical study, this study explores the learning effects and attitudes of this online mind map tool on college students' learning about socio-scientific issues.

1. Method

1.1 Participants and Research tools

There were 15 junior and senior students from four college schools in Taiwan, including 8 males and 7 females, whose average age is 21. The content of the pre/post-test questions was designed according to the Handbook of Spatial System Planning for Urban Disasters Prevention, published by Taiwan government in 2007 [6]. There were 20 multiple choice questions and both the pretest and the post-test had the same questions.

1.2 Online Map Mind Tool for SSI learning (OMMT-SSI)

The OMMT-SSI was developed by this study. Users can search for the location and relevant information on the module of *Location Search* in the system. The search service adopts the 3rd edition LBS Location Search Service of Google Map. Users can search for the keyword to get the places near the center of the map and add the selected disaster prevention spot into *My Note* module to construct knowledge via managing and annotating the locations. On the page of *My Note*, those marked places are listed in tables, and also the locations of all places are displayed on the map. Users can know the distribution of the marked places and revise the content of each marked place to conduct information analysis (As shown in Figure 1.). The *Project Writing* module provides the service of a great deal of hyperlink/text editing. On this page, users can fill in the reasons why they choose each disaster prevention spot to reach the knowledge reflection, organization and expression.

Figure.1 *My Note* Page of Online Map Mind Tool for SSI learning (OMMT-SSI)

1.3 Research procedures

To test the degree of students' prior knowledge, we conducted a 5-minute pretest on the knowledge of disaster prevention and spent 5 minutes teaching them how to use OMMT-SSI. Then, we provided students a SSI project, and asked them to use the OMMT-SSI to write the project during a 30-minute period. The activity assumed that the participants were the planners of the disaster prevention refuge space, who came from four nearby universities in Taiwan. The participants' task was to try to find the proper location of each

disaster prevention spot. Within the last five minutes in class, students were asked to finish the post-test and an open-ended question. The purpose of the open-ended question is to understand students' experiences and attitudes toward the whole learning process.

2. Results

As shown in Table 1, there is a significant difference between the pretest and the post-test (t=-3.224, p=.006<0.01). The score of the post-test is much higher than the score of pretest, indicating that OMMT-SSI can effectively promote the learning effects of the SSI issues regarding disaster prevention knowledge.

Table 1 Paired sample t-test

	Mean	N	SD	*t*	*p*
Pretest	74.3333	15	10.32796	-3.224**	.006**
Post-test	81.3333	15	6.93507		

** p< 0.01

Based on students' attitudes in the open-ended question, many students mentioned that it's very interesting to use such a mind tool to learn. For example, some students said that this tool can arouse their learning interest. S5 said, *"Everything is fresh for me. I never feel bored in class. It really enhances my learning motivation."* S13 said, *"The use of this tool allows me to understand the surroundings around my life more. In case of disaster, I will know where to escape."* We found that the use of the mind tool can arouse students' learning interest and help them to understand their surroundings. However, many students reflected that that the time of operating the mind tool is too short to finish the assignment in time. We found about 20% of the participants did not finish the task. In addition, two students suggested that the system should combine (i.e., *Project Writing* and *My Note*.) The time reduction of switching these two pages may make users feel more convenient.

3. Conclusion and Suggestions

The OMMT-SSI developed in the study can improve college students' learning of SSI issues about disaster prevention knowledge. With the tool, college students may deeply realize the space of disaster prevention and enhance their abilities of estimation, selection, and decision-making in the process of selecting the proper location of disaster prevention.

Acknowledgments

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References

[1] Stradling, R. (1984). The teaching of controversial issues: An evaluation. *Educational Review*, *36*(2), 121-129.

[2] Sadler, T. D., Chambers, F. W., & Zeidler, D. L. (2004). Student conceptualizations of the nature of science in response to a socioscientific issue. *International Journal of Science Education, 26*(4), 387-409.
[3] Jonassen, D. H. (1996). *Computers in the classroom: Mindtools for critical thinking*. Englewood Cliffs, New Jersey Columbus, Ohio.
[4] Jonassen, D. H., Carr, C., & Yueh, H.-P. (1998). Computers as mindtools for engaging learners in critical thinking. *Techtrends, 43*(2), 24-32.
[5] Averill, D. S. (2005). Using mindtools in education. *T H E (Technological Horizons In Education) Journal, 32*(9), 30-32.
[6] Ho, M. C. (2007). *Handbook of spatial system planning for urban disasters preventio*n. Architecture and Building Research Institute, Taipei.

OnCampus: A Mobile Personal Assistant for College Students

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Abstract: Recent years have witnessed tremendous progress in mobile devices and wireless networks. Such technologies have become ubiquitous on college campuses. Meanwhile, mobile social networking software is attracting a lot of interest from college students. To explore the potential of recent technologies in higher education, this paper presents our ongoing work on design and implementation of a mobile personal assistant system for college students, namely OnCampus. This system is aimed to provide college students with a series of innovative mobile services that will be helpful especially in on-campus study. The system will also serve as a tool for college students, which improves the efficiency of campus life by making use of various campus resources.

Keywords: Personal assistant, mobile learning, location-based services, college study

Introduction

In recent years, smart mobile devices and wireless networks have become unprecedentedly popular on college campuses, which bring a wealth of new opportunities for innovative applications and services [1,2]. Mobile devices, especially smartphones, play an indispensable role for most college students, and are likely to be an access to as many resources as possible. However, although every college student owns a cellphone, it does not embody a useful system that gives suggestions and helps in their college lives. As a result, the potential of most of these information technologies (such as mobile devices, wireless networks, and social networks), which have recently become available on college campuses, has not been fully explored.

In this paper, the concept of a personal assistant on campus is proposed. To realize the potential of advanced technologies in college education, we will develop a mobile personal assistant for college students, namely OnCampus. The main contributions can be outlined in the following three aspects. Firstly, we propose to develop a mobile personal assistant software system based on modern smart mobile devices like smartphones, which will provide college students with a helpful tool for on-campus life and study. Secondly, we present the design of the OnCampus system, which will enable a number of innovative smart services including e.g. location-based messaging services, resource sharing, schedule management, and social networking for college students. Thirdly, a prototype of the OnCampus system will be developed and deployed for test.

1. OnCampus Design

The OnCampus system is designed to be a lightweight, smart, convenient platform with the C/S model. The considered major clients/users are college students, while the server is

responsible for data collection, information management, mobile device positioning (or user tracking), message sending, and other functions.

From an architecture perspective, OnCampus consists of four major modules: myMessages, myStudy, mySchedule, and myCircles, as shown in Fig. 1. In myMessages, the administrator can broadcast announcements and urgent notifications to students who locate within a certain physical area, while students can initiatively browse campus news and announcements. Messages will be well classified in this module, including out-of-date notices filtered and important ones highlighted. In myStudy, class schedule as well as class information can be found. A student can choose classes and make comments on every class he/has ever attended. What's more, a student can also sign up and take notes wherever he/she is. In mySchedule, students can record memos in different convenient ways. They can record things by e.g. inputting sentences, recording voice and taking photos. As the deadline approaches, the system will remind students of their schedule at right (sometimes pre-set) time points. In myCircles, students can share any information possible (especially those about their on-campus life and study) with friends in the same group.

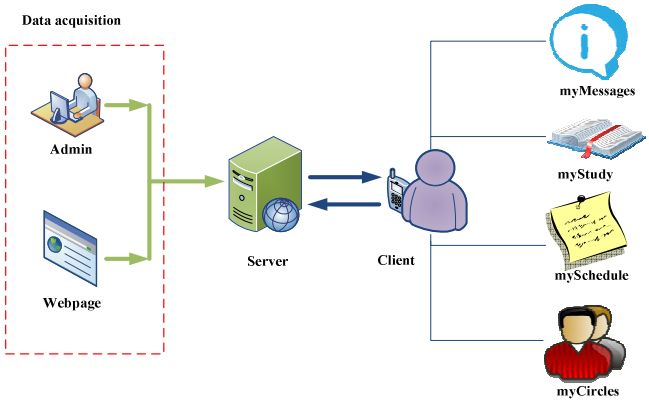

Figure 1: OnCampus System Structure

2. Prototype Implementation

A prototype of the OnCampus system has been implemented according to the above design. The server side is developed to be a control terminal in Java. It can run on Windows OS and Linux OS. The client uses Android to develop and can run on mobile devices supporting Android 2.1 or later versions. The server side uses Java Swing to complete a frame and control data interaction. The administrator can send, view and analyze data on server.

On the client, the above mentioned four modules work together. In myMessages, a location-based instant messaging system is implemented [3]. This module introduces the LM2C (Location Search Server and Message Sending Server To Client) service model. LSS (Location Search Server) is used to divide the service area by location. First, the client gets the attribute information of several service areas and recognizes which service area and MSS (Message Send Server) it belongs to. When a client moves in some extent, it can distinguish its service area without connecting to LSS [4]. MSS is used to supervise the clients in its own service area and collect data, store information and send messages to them. In message broadcast, we adopt a message push mechanism based on XMPP (Extensible Messaging and Presence Protocol). With the help of this module, the administrator can send instant messages to clients by selecting receivers according to physical locations.

In myStudy, students can choose classes in their class schedule and make comments on their classes. In this module, choosing classes becomes easier because it can be finished on mobile phones. When a semester ends, students can make comments on instructors/teachers of different courses. Students can also sign up when they come to (individual) study, which will be shown in myCircles.

In mySchedule, students can manage their (future) calendars and set reminders of tasks to come. The tasks can be added by the user manually or captured by the system automatically (e.g. from the class schedule). There are several different ways to remind the user of a coming task, including e.g. vibration, ring, and short message. Fig. 2 shows screenshots of the myStudy and mySchedule modules.

In myCircles, students can see friends' update (e.g. recent activities). If someone signs up in a classroom, for instance, his/her friends will see this information. There is also a chatting system in this module. Just as some general social networking systems, a user of OnCampus can join multiple circles, which may cover friends of different categories.

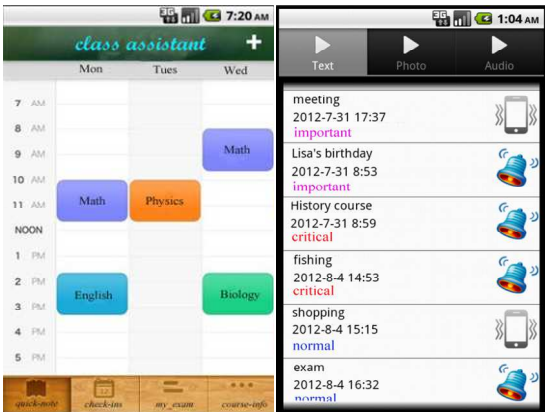

Figure 2: User Interfaces of myStudy and mySchedule

Conclusion

In this paper we have proposed to develop a mobile personal assistant for college students by taking advantage of ubiquitous mobile devices like smartphones. Some preliminary results on the design and implementation of our OnCampus system have been presented. A prototype system has been implemented based on current design, with several technical problems well addressed. A more powerful OnCampus is still under development. A full version of the system is expected to provide college students with a series of innovative services that help improve the quality of campus life.

Acknowledgements

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References

[1] Gill Clough (2010). Geolearners: Location-Based Informal Learning with Mobile and Social Technologies, *IEEE Transactions on Learning Technologies*, 3(1), 33-44.

[2] Rui Cheng, Zhuo Yang, and Feng Xia (2010). iZone: A Location-Based Mobile Social Networking System, *Third International Symposium on Parallel Architectures, Algorithms and Programming (PAAP)*, Dalian, China.
[3] Sheng Zhao, Feng Xia, Zhen Chen, Zhen Li, and Jianhua Ma (2012). MobiMsg: A Resource-Efficient Location-Based Mobile Instant Messaging System, *The 2nd International Conference on Social Computing and its Applications (SCA12)*, Xiangtan, China.
[4] Ananya, S., and Venkatalakshmi, B. (2011). Location Based Intelligent Mobile Organizer, *International Conference on Computer Science and Service System (CSSS)*, Nanjing, China.

Development and Evaluation of Presentation Support Software Using Mobile Device

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Abstract: Lectures can be conducted more efficiently by increasing the mobility and user interactivity of teacher-oriented software. We added features to existing PowerPoint remote presentation software, which enable users to prepare beforehand for the next slide by displaying a preview of the next slide at the bottom right of the screen, and insert pictures into the slides using the Android device's local memory. We describe the features and mention the results of an initial questionnaire as a way to validate our objective.

Keywords: Android, Mobile Device, Lectures, Interactivity, PowerPoint, Presentation

Introduction

A presentation is one of the means to communicate one's ideas where there is a potential of bi-directional flow of information between the presenter and the audience. Today, Microsoft PowerPoint is the most popular presentation software in various fields including academia. PowerPoint has many in-built features that greatly enhance its user-interface and help the presenters interact more with the listeners during the presentation. However, there are some features that could enhance the user-experience of the software for better productivity. For instance, the PowerPoint software can be connected to an Android client which, in turn, can use intuitive dynamic user operation modes to send remote control commands by leveraging various features of Android OS. The objective of this research is to improve the effectiveness of existing presentation software by adding features which are aimed at improving the user-interface for the lecturer which eventually leads to effective learning and better interaction between the lecturer and students.

1. Related Work

Presentation Support Software Using Mobile Device For Interactive Lectures [1]
In this research, a presentation tool with the following features was developed and evaluated. In our previous work [1], we developed a presentation software for mobile devices that supported the following features:

- Drawing annotations on slide
- Refer to slide notes
- Turn over pages from the mobile device
- Refer to thumbnails of the slide

[1] Kentaro UEDA currently works for Hitachi, Ltd.

- Taking pictures and incorporating them into the slide on the spot

Based on the results of a survey [1], three areas for improvement were found in the existing presentation software. In our present research, we focus on the following three new features:

- To be able to display a preview of the next slide
- Use a pointer to emphasize a specific part of the slide
- Upload pictures from the local memory of the mobile device

1.1 Design of a Smart Remote Controlled Framework based on Android Mobile Devices

In this research, the Android device acts as the client side of the proposed smart remote controller. The software uses intuitive dynamic user operation modes to send remote control commands to the controlled side by leveraging the multi-touch events, gesture recognition and hand gestures features of the Android device [2].

2. Software Description

2.1 Architecture

As described in [1], the software consists of server and client components. The server side is an add-in for PowerPoint 2007 and 2010. It is implemented in C#, and runs on .NET Framework 3.5 or later. The client software runs on mobile devices running Android platform 1.5 or later. They communicate with each other over TCP on a wireless network.

2.2 Features

Out of the three features stated above, two new features (explained below) have been added to the existing software.

2.2.1 Display preview of the next slide

This feature helps the lecturer to view the preview of the next slide at the bottom right of the screen. It helps him/her to have an idea about the next slide and prepare beforehand accordingly.

2.2.2 Upload picture from the device's memory

This feature enables the lecturer to upload pictures from the device's memory [3]. Previously, since this feature was absent, lecturers had to directly insert pictures taken with the device's camera. With this feature, they can simply take a picture, store it in the internal memory and use it later during the class to make learning more interactive.

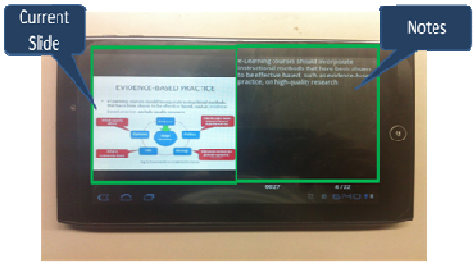

Figure 1: Without preview

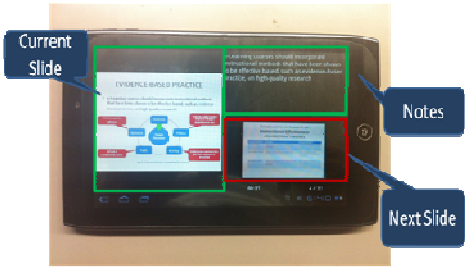

Figure 2: With preview

Figure 3: Uploading an image on-the-spot

Figure 4: Uploading pictures from the device's memory

3. Evaluation

10 Graduate students of Tokyo Institute of Technology participated in an evaluation of the new features of the software. The server side consisted of Windows XP with Microsoft PowerPoint 2007. The mobile device used was a Motorola MZ604 model with Android version 3.2. The questions were classified in a Likert scale from 1 to 5, with 5 being 'strongly agree' and 1 being 'strongly disagree'. Features like preview of next slide and incorporating slides directly from the device's memory received good evaluation. However, users found it difficult to understand the objective of a button just by looking at its icon and had to read the accompanying caption until they got used to it. We hope to increase the number of participants to evaluate the software in the near future.

Table 1: Results of the questionnaire

Question	Mean	S.D.
1. Did the preview of next slide help you to prepare beforehand?	4.6	0.7
2. Did you view the notes as intended?	4.4	0.7
3. Did you find the layout of buttons (icons) appropriate?	3.8	0.9
4. Did you understand the meaning of button (icons) easily?	3.3	0.6
5. Did you find the feature of incorporating pictures directly from the device's memory helpful?	4.3	1.1
6. Did you learn the usage of this software easily?	3.8	0.8
7. Did you find this software useful?	4.6	0.5

4. Conclusion

We added news features suggested in the questionnaire of the previous research. The results of the evaluation show that the added features are effective in increasing the functionality of the software. In the future, we intend to add more features such as the pointer feature which will help to emphasize on a specific area of the slide and an

integrated web-browser feature to perform online search during class without having to exit the presentation.

Acknowledgement

This work was supported by JSPS KAKENHI Grant Number 24501130.

References

[1] Kentaro Ueda, Masao Murota (2010). Presentation Support Software Using Mobile Device For Interactive Lectures
[2] Hung-Ming Chen, Po-Hung Chen, Yong-Zan Liou, Zhi-Xiong Xu and Yeni Ouyang (2011). Design of a Smart Remote Controlled Framework based on Android Mobile Devices
[3] Android Developers Official website. http://developer.android.com/index.html

Analysis of C-Programming Iteration Type Courseware by Mahalanobis-Taguchi System

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Abstract: In this paper, it is proposed for the classification of the Mahalanobis distance of learning data in the C-programming iteration type courseware that a virtual teacher group is used as a standard space and that the membership function is used to convert learning time. Furthermore, a quantitative analysis method of the questions in the courseware is proposed by calculating the SN ratio allocating the Mahalanobis distance into the orthogonal arrays. The validity of the results by these proposed methods is confirmed by the measured values, and the causes for taking a long learning time are cleared.

Keywords: Mahalanobis distance, SN ratio, membership function, courseware

Introduction

Learning data, which consists of scores and learning time, is achieved by a learning management system from the answer of the courseware. Since every learner achieves the passing score in the iteration type courseware, learning time becomes the target of the analysis. In the past, the method by SP-chart or the Mahalanobis-Taguchi System have been reported for the analysis methods considering the cross correlation [1][2]. However, the estimation of learning time which consists of some questions in the courseware has not been reported in both methods. Especially, the later method has a feature that is able to calculate the quantitative value with some combined conditions, but has some problems. The 1st is that the classification of learning data depends on its standard space. The 2nd is that the Mahalanobis distance becomes great for it has an infinite learning time range. The 3rd is that the quantitative analysis method of questions in the courseware isn't known.

In this paper, it is proposed for the C-programming iteration type courseware that learning data of a virtual teacher group is used as a standard space and that the learning time is converted to a limited value by using a membership function, and the Mahalanobis distance of learning data is classified into 2 groups. Furthermore, an analysis method of questions in the courseware is proposed by calculating the SN ratio allocating the Mahalanobis distance into the orthogonal arrays. The validity of the results by these proposed methods is confirmed by the measured values, and the causes for taking a long learning time are cleared.

1. Analysis Methods

The Mahalanobis distance is calculated by the distance between two points: one is measured values and the other is a standard space. In this paper, the standard space is made at random by a virtual teacher group, who answers with a short learning time or high

score. The procedure of the analysis methods by the Mahalanobis-Taguchi System of learning time is shown as the step1~step3 and its score is as the step2~step3.

1.1 Step1: Preprocessing of Learning Time

When t_{ij} is the learning time for question No.j (=1, 2, ... , m) of learner-i (=1, 2, ... , n), t_{ij} is related to thinking time of the question, and takes the range $0 \leqq t_{ij} \leqq \infty$. Therefore, t_{ij} is converted to the value by the following equation using the membership function.

$$v_{ij}(t_{ij}) = \begin{cases} 1 & (t_{ij} \leqq t_{aj}) \\ \dfrac{t_{bj} - t_{ij}}{t_{bj} - t_{aj}} & (t_{aj} < t_{ij} \leqq t_{bj}) \\ 0 & (t_{ij} > t_{bj}) \end{cases} \quad (1)$$

Where, t_{aj} is the smallest learning time of the question No.j in the standard space, and t_{bj} is equal to 2.2 times of the average learning time [1].

1.2 Step2: Calculation of Mahalanobis Distance

When a_{jk} is the reciprocal of the Peason product-moment correlation coefficient between the questions, Mahalanobis distance of learner-i (D_i^2) is calculated by the following equation.

$$D_i^2 = \frac{1}{m} \sum_{j=1}^{m} \sum_{k=1}^{m} a_{jk} V_{ij} V_{ik} \quad (2)$$

Where, V_{ij} is the normalized v_{ij} by the average value of learning data and its standard deviation. The average value of V_j is 0. The average value of D_i^2 is 1.0, which means that the distance from the standard space becomes greater as the value gets bigger.

1.3 Step3: Calculation of SN Ratio

The Mahalanobis distances are allocated as trying the evaluation of learner-i in a courseware into each line of the 2 levels' orthogonal arrays. Where, level-1 and level-2 correspond to “use the question in the courseware” in the orthogonal arrays, and “take it off,” respectively. When the SN ratio (η_j) indicating the smaller is the better response is used for trying the evaluation, it is calculated by the following equation.

$$\eta_j = -10 \log\left(\frac{1}{n} \sum_{i=1}^{n} D_i^2\right) \quad \textbf{(3)}$$

The graph of factorial effect can be made by allocating η_j into the orthogonal arrays.

2. Analysis Results

2.1 Analysis of Learning Data by Mahalanobis Distance

Every leaner answers a question which consist of the fundamental questions (No.A~No.D) and the advanced questions (No.E~No.I) in the C-programming course until he/she achieves the passing score (more than 80%) in each question by using a learning management system [1]. The number of total questions is m=9, the number of virtual teachers is 27 (=3×m), and the number of learners is n=54.

Fig.1 shows the Mahalanobis distances of learning time and scores. The score in each question is calculated by (the sum of score in iteration numbers) / (iteration numbers). The dashed lines show the boundary of the classification by cluster analysis. A short learning

time group is 31%, and they are in the high score group. On the other hand, a long learning time group is 69%, 2/3rd of them take a few iteration numbers with a long learning time, and the rest 1/3rd takes many iteration numbers with a short learning time. Since some learners take the value of more than 2000 in the Mahalanobis distances of learning time, it means that the valid result is obtained using the approximation by Eq.(1).

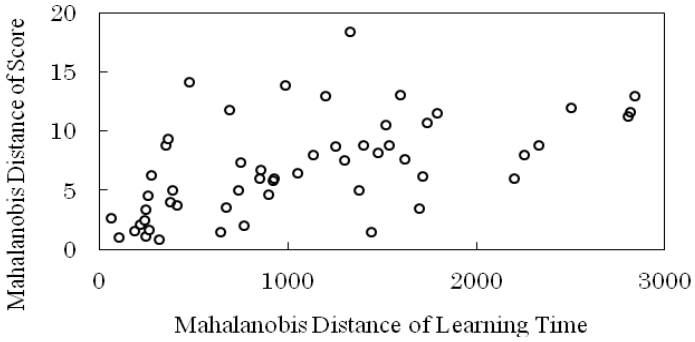

Fig.1: Mahalanobis distances of learning time and scores

2.2 Evaluation of Courseware by Graphs of Factorial Effect

Fig.2 shows the graph of the factorial effect of learning time. It shows that the left side (● mark) is the level-1 in the 2 levels' L_{12} orthogonal arrays, and that the right side (○ mark) is in its level-2. The SN ratio of this courseware is μ_{all}^{1}=-29.6db. This value is almost equal to -30.0db calculated by the average value (1004) from the Mahalanobis distance of learning time in Fig.1 and Eq.(3). The SN ratio of the optimum condition, which consists of the questions No.A, C, H in level-2, and the other questions No. in level-1, is calculated as μ_{opt}^{1}= -25.6db, and the gain is μ_{opt}^{1}-μ_{all}^{1}=+4.0db. The factor of the long learning time's group in Fig.1 is the fundamental questions, since the sum of SN ratio in its level-1 is smaller than that of advanced questions. Furthermore, the graph of the factorial effect of score shows that low-score questions are the questions No.C, G.

Table 1 shows the average learning time in each question No. When the question No. of the SN ratio in Fig.2 is downward to the left, the average learning time of all learners is more than 7 times the one of virtual teachers in Table 1. The cross correlation in Table 1 isn't considered as it is in Fig.2, but the results are almost valid. No.A(hex) takes a long learning time for it is the first question in the courseware. No.C(while) takes a long learning time for they take many iterations within a short time. No.H(pointer) needs a long thinking time, but they don't take many iterations.

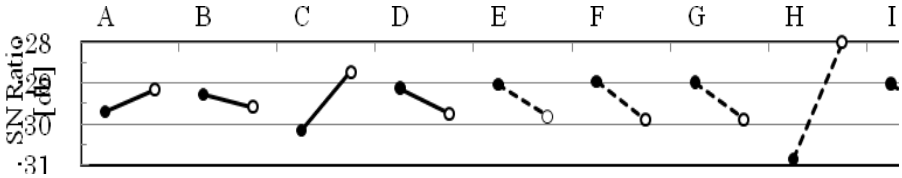

Fig.2: Graph of the factorial effect of learning time

Table 1: Average learning time in each question No. [sec]

Question No.	A	B	C	D	E	F	G	H	I
All learners/Virtual teachers	198/28	168/25	172/13	105/21	134/23	83/21	60/15	263/33	78/24

3. Conclusions

For the analysis of learning data of the C-programming iteration type courseware by the Mahalanobis-Taguchi System, it was proposed that the methods where a virtual teacher group is used as a standard space, and learning time is converted into a limited value by a membership function. The quantitative analysis method that the questions influence in the courseware was proposed by allocating the SN ratio into the orthogonal arrays. By these methods, the SN ratio which consists of many questions in the courseware was able to be estimated, and the causes for taking a long learning time were cleared.

References

[1] Hiroyuki, W., & Katsuhiro, K. (1999). An analysis of response time distribution for CAI courseware. *ICCE*, 2, 125-132. Chiba, Japan.

[2] Elizabeth, A. C. et al. (2007). An evaluation Mahalanobis-Taguchi System and neural network for multivariate pattern recognition. *Journal of Industrial and Systems Engineering*, 1(2), 139-150.

Development of an HTML5 Presentation Software with Camera and Web Sharing Functions

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Abstract: We developed an HTML5 presentation software with camera and sharing functions. This software is based on W3C HTML Slidy. To implement these functions, this software uses the APIs of "media capture and streams", which enable it to handle the camera hardware in the HTML document. Users are able to capture snapshots and then add a slide alongside the picture. The user is also able to add some comments in the slide. The edited slides can be uploaded to a web server and be accessed on the web.

Keywords: Presentation Software, Mobile Device, Camera in Lecture, HTML5

1. Introduction

1.1 Background

In the field of education, many kinds of presentation software and devices have been used and developed. For example, CodEx (Kaminishi and Murota, 2011) has been used for teaching programming lectures.

In order to make a lecture more interactive and effective, Kikan-Shido (Between Desks Instruction) is very important (Clarke, 2004). However, when a teacher uses PowerPoint software, the teacher tends to stay in front of the computer where the presentation software is running. This is not preferable for both the teacher and students. Ueda and Murota(2012) developed a software tool (Remote Presentation Controller, RPC) to support PowerPoint presentations with Android mobile devices. The software enables teachers to control the presentation from a mobile device. In addition, the teacher can also take a picture and insert it on a new slide. This function benefits the teacher, as it lets the teacher show students' works as they make it. It is considered to be important to share their own answers and know various and sometimes exemplary answers by student.

However, RPC is not designed for students' use. It is considered to be beneficial in showing and sharing their work in cooperative learning situations with many kinds of devices, such as Desktop PC, Tablet PC and other mobile devices.

1.2 Purpose of This Study

The purpose of this study is to develop presentation software which has functions for both students and teachers; taking a pictures, incorporating pictures into slides, and sharing

these presentations on the web. Especially, to be available in various kind of devices, the software is implemented by using HTML5 technology.

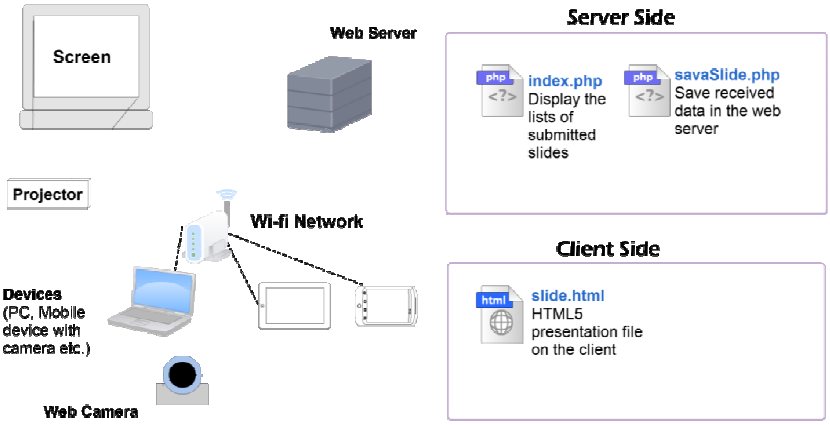

Figure 1. Overview of the system

2. Development

2.1 Overview

This presentation software is based on W3C HTML Slidy (Ragett, 2005). When a user presents, the user downloads the presentation file from a web server. The presentation file cannot be edited by the presenter. In this research, we added functions for editing and uploading to the web server.

For editing, we added functions to insert new slides to the presentation, to add pictures taken with a camera to slides, and to write simple comments. The edited slides can be uploaded to the server and can be accessed from the web.

An overview of the system is shown in Figure 1. Devices such as a PC or tablet can show the presentation slide. This slide can be downloaded from the web server. The user can see the real-time feed from the camera and can also take a snapshot. If the user does so, a new slide with the snapshot will be inserted. Users (teachers or students) can submit a slide file, which is edited during the lecture. This function is not implemented in the original version of Slidy. Some of these functions are available using HTML5 technology, especially the handling of the camera on the HTML document.

2.2 Implementation of the camera/picture function

To use the camera and picture function, we adopt video element and canvas element in HTML5. We also use the “getUserMedia()” method in JavaScript. This method is one of the APIs of “media capture and streams”, which allow local media, including audio and video, to be requested from a platform (Burnett and Narayanan, 2012). With these APIs, the HTML slide can capture the camera stream, get snapshots for the canvas element and make a PNG image file.

Though these APIs are in draft form and therefore only the newest browsers support them, it is expected to be useable in various browsers and devices in the near future. At the present moment, we verified that this software runs on Opera 12 (both desktop and mobile) and Firefox 17 (only desktop).

2.3 Functions of the slide

The sequence of the presentation slides are shown in Figure 2. This presentation includes title slide, normal slide (without camera function), and some slides with camera movie. Teacher may prepare the presentation slides before the lecture. On the slide with the camera movie, the stream of the camera which is connected to the client device is displayed. Users can capture snapshots of the movie and convert it to the image files or new slides with editable comment. If the user captures a screenshot, the picture will be saved in a permanent image file, but the user can discard it and re-set the camera movie.

Users can save the edited slides by submitting to the web server. The submitted presentation will be accessed on the web and referred to by any other users who are permitted to access the server.

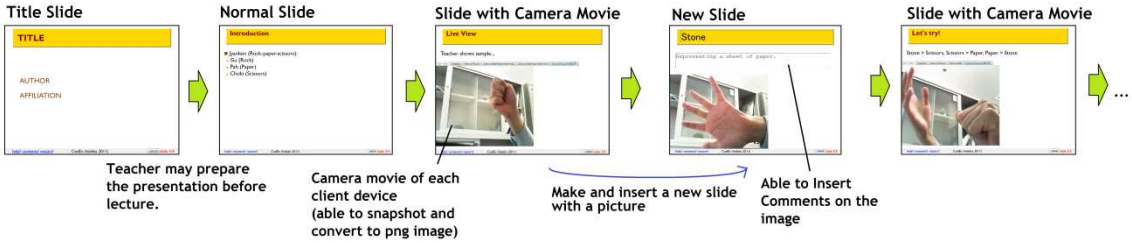

Figure 2. The sequence of the presentation slides. The fourth slide is added by user.

3. Expected usage in education

We expect this software to be usable in these situations (but not limited to these cases):

- To share students' various answers of mathematical problems: It is considered to be important to share their own answers and know various and sometimes exemplary answers by student.
- To show the manipulation in the anatomy training: students can also take a picture of the organs. This is useful in sharing knowledge with colleagues and in reviewing what they did when they studied other courses.
- To share pictures of outside field work: It is easy to know what the other members do in real time during field work because students can make and submit presentations anywhere the wireless network is available. In addition, it is also easy to report in class after it.

4. Summary

We developed an HTML5 presentation software with camera and sharing functions. This software is based on W3C HTML Slidy. To implement these functions, this software uses APIs of "media capture and streams", which enable it to handle the camera hardware in the HTML document. Users are able to capture snapshots and then add a slide by the picture and comment in the slide. This software is expected to be used in various educational situations like mathematics, anatomy or fieldwork. In the next study, we plan to use this software in those lectures and evaluate its usability and impact.

References

[1] Burnett, D., C. & Narayanan, A. (2012). Media Capture and Streams. *W3C Editor's Draft 25 June 2012* , from http://dev.w3.org/2011/webrtc/editor/getusermedia.html (reffered on Aug. 8, 2012)

[2] Clarke, D. J. (2004). Kikan-Shido - Between Desks Instruction. *Annual Meeting of the American Mathematical Research Association*, from http://extranet.edfac.unimelb.edu.au/ DSME/lps/assets/Clarke_Kikan-shido.pdf (referred on Aug. 6, 2012)

[3] Kaminishi, H. & Murota, M. (2011). Development and evaluation of a new presentation software program (CodEx) for teaching programming code. *Research and Practice in Technology Enhanced Learning*, 6(2), 83-106.

[4] Raggett, D. (2005). HTML Slidy: Slide shows in HTML and XHTML. from http://www.w3.org/Talks/Tools/Slidy2/ (referred on Aug. 8, 2012)

[5] Ueda, K., & Murota, M. (2012). Development of software tool to support Powerpoint presentations using Android ,mobile device for teachers. *Proceedings of Ed-Media 2012* (pp.1459-1464). Denver, Colorado.

Exploring the Technology Acceptance and Flow State of a Chamber Escape Game - Escape the Lab© for Learning Electromagnet Concept

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Abstract: Utilizing digital games to assist students with simulation manipulation and problem-solving may help them deeply explore and construct scientific concept and relevant procedural knowledge. The chamber escape games are the game type of problem-solving, involving challenges, adventures, and uncertainty elements. This study developed a chamber escape game-*Escape the Lab*© to assist in learning the concepts of electromagnet and electromagnet assembly skills. We empirically explored 100 high school students' technology acceptance of this game and the differences of flow state between different genders. This study discovered that students have a high degree of acceptance toward this game, and the males have higher flow experience during playing this game.

Keywords: Chamber-escape game, Game-based learning, Science education

1. Introduction

In recent years, the development, application, and research of digital educational games are gradually emphasized. To promote the learning of scientific concepts and experimental skills, utilizing digital games to assist students with simulation manipulation and problem-solving may help them deeply explore and construct scientific concept and relevant procedural knowledge. Learners can reflect and adjust their problem-solving strategies to reach more effective learning during the problem-solving process in the game tasks [1] [2]. Besides, to promote learners' learning motivation, it's quite important to embed the game elements such as suitable challenges, adventures, and uncertainty in an educational game [3]. The chamber escape games are the game type of problem-solving, involving challenges and adventures, and uncertainty elements. The application of chamber escape games to the learning of scientific concepts is worth researching. Also, to evaluate chamber escape educational game, learners' acceptance of the games and their flow states [4] are important indicators. Therefore, the objectives of this study are to develop a chamber escape game-*Escape the Lab*© to assist in learning the concepts of electromagnet and electromagnet assembly skills, and to understand learners' technology acceptance and the differences of flow states between different genders.

2. Escape the Lab©

Escape the Lab© is an educational chamber escape game, developed by our research team-NTUST MEG (Mini-Educational Game development Group in E-learning Research Center in National Taiwan University of Science and Technology). The scenario in this game: a researcher is poisoned by his colleague who is also a member of a criminal group, and is stuck in her own lab. The player has to observe and search for the useful objects (shown as Figure1) in the lab before the researcher is poisoned to death. Also, based on electromagnetism concepts, the player has to assemble an electromagnet correctly (shown as Figure2), utilize magnetism to pick up the key from the hole in a secret cabinet, and then escape the room. This game provides not only nervous but adventurous problem-solving tasks which allow learners to observe and explore, and simulate and manipulate to reach the learning objectives.

Figure. 1 Screenshot of Escape the Lab©: Search for the environment and cues

Figure. 2 Screenshot of Escape the Lab©: Simulation manipulation and Feedbacks

3. Method

There were 100 senior high school students participated in this study, including 50 males and 50 females. The average age of the participants was 16. All the students finished the electromagnet course before this study. This paper referred to the technology acceptance model [5] and the elements of digital instructional games [3, 6] to make a preliminary evaluation of learner's attitudes toward perceived usefulness, perceived ease-of-use and game elements. The questionnaire was scored on a 4-point Likert scale (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree). To evaluate the flow state when learner play the game, this paper also referred to Killi's Flow Scale for Game [4] (translated to Chinese by this study). The questionnaire was scored on a 5-point Likert scale (5 = agree, 1 = disagree). The student were asked to play *Escape the Lab*© (10 minutes) once, and then fill out the above two questionnaires.

4. Results

This study conducted a preliminary descriptive statistical analysis. We discovered that 75% of the students agree or strongly agree that this game can help them understand the concept of the electromagnet; 73% of the students agree or strongly agree that this game can help them understand the procedures of assembling electromagnet; 74% of the students agree or strongly agree that this game helps them understand the concept of the electromagnet more than paper textbooks; 54% of the students agree or strongly agree that

the operation of this game is easy; 74% of the students agree or strongly agree that the story of the game is easy to understand; 54% of the students agree or strongly agree that the operating process of this game is smooth without any errors; 83% of the students agree or strongly agree that the game is entertaining; 93% of the students agree or strongly agree that the game is challenging; 88% of the students agree or strongly agree that they feel the uncertainty of adventure and fantasy when they play the game; 49% of the students agree or strongly agree that the design of the mechanism of the interactive rules this game is appropriate.

Table 1 Evaluation questionnaire on the technology acceptance and game elements

Dimension	Item#	Item	strongly agree (%)	agree (%)	disgree (%)	strongly disagree (%)	References
Perceived usefulness	T1	This game can help you understand the concept of the electromagnet?	13.0	62.0	23.0	2.0	Davis (1989)
	T2	This game can help you understand the procedures of assembling electromagnet?	11.0	62.0	24.0	3.0	
	T3	Compared with the paper textbooks, you think this game helps you understand the concept of the electromagnet more.	13.0	61.0	23.0	3.0	
Perceived ease of use	T4	The operation of this game is easy.	22.0	32.0	37.0	9.0	
	T5	The story of the game is easy to understand.	26.0	48.0	22.0	4.0	
	T6	The operating process of this game is smooth without any errors.	10.0	44.0	30.0	16.0	
Game elements	T7	The game is entertaining.	25.0	58.0	11.0	6.0	Prensky & Thiagarajan (2007); Alessi & Trollip (2001)
	T8	The game is challenging.	40.0	53.0	5.0	2.0	
	T9	When you play the game, you feel the uncertainty of adventure and fantasy.	29.0	59.0	9.0	3.0	
	T10	The design of the mechanism of the interactive rules this game is appropriate.	6.0	43.0	36.0	15.0	

In addition, this study conducted an independent t-test to explore the gender differences of the flow state base on the collected data. We discovered that males had more flow experience than females when they play this game (t=2.46, p<.05), but there is no significant difference in the phase of flow antecedents.

Table 2 Gender independent T-test

	Gender				
	Male (n=50)		Female (n=50)		
Flow state (Kiili, 2006)	M	SD	M	SD	t
Flow Antecedents	3.75	.79	3.49	.75	1.66
Flow Experience	4.10	.62	3.79	.65	2.46 *

* p <.05

5. Discussions and Conclusion

The research results showed that most students have highly positive attitudes toward perceived usefulness of this game, indicating that learners confirm this game has the utility of electromagnet-related knowledge instruction. However, in terms of perceived ease of use, there's still room for improvements in this game (e.g., interactive mechanism and user interface). As for flow, the males can get more flow experiences in this game, indicating that this game helps the males' learning engagement more. By analyzing learners' behavioral patterns more deeply (e.g., [7]), this study expects to explore and understand their problem-solving processes in the future and improve the ease of use of *Escape the Lab*©.

Acknowledgments

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References

[1] Kiili, K. (2007). Foundation for problem-based gaming. *British Journal of Educational Technology, 38(3),* 394-404.
[2] Lee, C. Y. & Chen, M. P. (2009). A computer game as a context for non-routinemathematical problem solving: The effects of type of question prompt and level of prior knowledge. *Computers & Education, 52* (3), 530-542.
[3] Prensky, M., & Thiagarajan, S. (2007). Digital game-based learning (Paragon Houseed.). St. Paul, MN: Paragon House.
[4] Kiili, K. (2006). Evaluations of an experiential gaming model. *Human Technology, 2*(2), 187-201.
[5] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13 (3), 318-340.
[6] Alessi, S. M. & Trollip, S. R. (2001). *Multimedia for learning: Methods and development*. MA: Allyn and Bacon.
[7] Hou, H. T. (2012). Exploring the behavioral patterns of learners in an educational massively multiple online role-playing game (MMORPG), *Computers and Education, 58,* 4, 1225-1233.

Fishing Master: An Educational Game for Number Sense of Mathematics Arithmetic for Elementary Students

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Abstract: Number sense, the basis of mathematical ability is the important goal of elementary mathematics curriculum. Previous studies have indicated that number sense may make student have the feeling of using numbers. It may help students understand the relationship of numbers more and judge the reasonableness of an answer. It can also enhance their ability of analysis. Students with better number sense can use various strategies to solve a problem. This study therefore designs a digital game, named Fishing Master, for facilitating students' number sense of addition. In order to win the game, students have to use appropriate strategies, which the system can scaffold them to use if they are not familiar with the strategies. In the future, the game should be improved and can be applied to multiplication and division for verifying its effects by a rigorous experiment.

Keywords: number sense, strategy use, game-based learning

Introduction

Number sense is an ability to recognize the meaning of numbers and to sense the relationship between numbers (Dehaene, 1997; NCTM, 1989; Stoddard, 1994; Thompson, & Rathmell, 1989). Previous research has demonstrated that even babies have such an ability (Dehaene, 1997), suggesting that number sense is inherent. However, although students have to deal with quantities in their daily life, they barely encounter abstract numbers, not to mention the relationships between numbers (Stoddard, 1994). Without number sense, students may find difficulties with effectively and efficiently solving problems, and even learning other subjects (Burton, 1993; Reys, 1991). For this reason, the main goal of mathematics education in primary schools should develop students' number sense.

In order to develop number sense, students need to practice seeing relationships between numbers, and to convert numbers into simpler forms (Stoddard, 1994). For the former, students can learn the properties of numbers. Ten's complement, for instance, may help them to do addition and subtraction more efficiently. For the latter, students can learn transforming numbers fluently. For instance, if a student can view 99 as 100-1, he/she may quickly calculate 273+99 by seeing 273+100-1, which are 372. Therefore, this paper aims to develop a mathematical game to facilitate students' number sense.

1. System design

This paper develops an educational game, called Fishing Master, for facilitating number sense. In this game, a student plays the role of a fisherman. He/she has to overcome all of urgent challenges in limited time. This game is implemented in HyperText Markup Language 5.0 with physics engine. In this game, the number of fishes determines the difficulty and the time required by the student. Previous research has showed that controlling the balance between the level of difficulty and the student's ability may arouse flow Experience, which may happen when people are totally absorbed in an activity (Csikszentmihalyi, 1990).

Figure 1. Interface of the game

1.1 Game rules

The game provides instructions. When the game starts, an arithmetic question appears at the top of the screen as shown in Figure 1. A student needs to calculate it and get the answer first. Then he/she as a fisherman has to catch some fishes with numbers which may assemble the answer as a shoal of fish. When the student becomes an experience fisherman, if fishes find someone wants to catch them, they may change their swimming directions and speed up in latter game levels. The game thus becomes more difficult catch in limited time. When a student passes one level, he/she may unlock one kind of fish (i.e. one number). Although he/she get one new option of assembling his/her answer, there are relatively more kinds of fish, which may hinder the student from catching his/her targets. For example, when the system detects the player becomes more capable, the bigger fish may obscure the smaller one because of their positions, making the game and calculation more difficult and challenging.

1.2 System architecture

Figure 2 illustrates the system architecture of the game. When a student enters a game level, the system may analyze the strategies that he/she used in previous levels. More specifically, the system classifies his/her strategies into several types, as shown in Table 1. If the student only uses a fixed or even inappropriate strategy, the system should scaffold him/her to use various and appropriate strategies for learning others number relationship

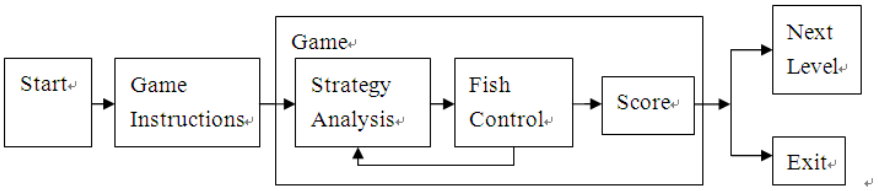

Figure 2. System architecture

Table 1 further shows the scaffolding that the system provides in order to facilitate number sense. The system may control the numbers on fishes to help player to learn and strengthen new strategies when detecting a student's strategy in his/her learning portfolios. For example, if the system detects that a student does not use grouping strategy, the system may provide a set of the same numbers (e.g. 5), and prompt the first three of them.

Table 1. Number sense strategy and system scaffolding

Strategy types	Definition	Scaffolding	Challenges
Ten's complement	Catching two numbers for making ten	(1) Providing more number pairs of 10 (2) Prompting the first pair	a. Providing 100's complement b. Providing near-10 number pairs (e.g. 5+6=11)
Grouping	Grouping the same numbers for approaching the answer	(1) Providing more same numbers (2) Prompting the first three same numbers	Providing more sets of the same numbers
Maximum first	Catching the maximum number first	Prompting the maximum number	N/A

2. Conclusion

This paper develops an educational game for facilitating number sense, which may help students understand numbers relationship, improve their problem-solving ability, as well as enhance their motivation. In this game, player plays a fisherman who uses various strategies to catch fishes with target numbers. However, this study is still in a preliminary stage, and need a rigorous experiment to verify the advantages mentioned above. From the perspective of games, the game can be improved by enhancing its freedom and flexibility to increase the playability in the future. From the perspective of learning, the game can be applied to multiplication and division to increase the diversity of learning.

Acknowledgements

The authors would like to thank the National Science Council of the Republic of China, Taiwan, for financial support (NSC 101-2811-S-008-009, NSC 101-2631-S-008-003, NSC 100-2511-S-008-013-MY3, & NSC 99-2511-S-008-002-MY3), and Research Center for Science and Technology for Learning, National Central University, Taiwan.

References

[1] Stoddard, E. (1994). Speed Mathematics Simplified. New York: Dover Publications.
[2] Dehance, S. (1997). The Number Sense. New York: Oxford University Press.
[3] NCTM. (1989). Curriculum and Evaluation Standards for School Mathematics.
[4] Csikszentmihalyi, M. (1990). Flow: The Psychology of optimal experience. New York: Harper & Row.
[5] Thompson, C. S. & Rathmell, E. C. (1989). By way of introduction. Arithmetic Teacher, 36(6), 2-3.Burton, G. M. (1993). Number sense and operations: Addenda series, grades K-6. Reston, VA: National Council of Teachers of Mathematics.
[6] Reys, B. J. (1991). Developing number sense: Addenda series, grades 5-8. Reston, VA: National Council of Teachers of Mathematics.

Improving graduate students' reading comprehension and summary writing in CSCL

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Abstract: Since the process of summary writing is internal and unobservable in onsite instruction, graduate students have few opportunities to provide their peers with feedback for improving summaries. This study reports on the design of a computer-supported collaborative learning (CSCL) system to investigate the effects of online peer collaboration and feedback on graduate students' summary writings while reading academic texts. The results of this study reveal that the graduate students made more significant progress through using CSCL rather than through onsite instruction alone. The regression analysis and the open-ended questionnaire also show that the graduate students who actively engaged in peer collaboration and feedback made more revisions and progress in their academic reading and summary writings than those of students who passively participated.

Keywords: Collaborative learning; Peer feedback; Interactive learning environment; Learning communities; Improving classroom teaching

1. Introduction

Graduate students, in general, are expected to grasp the main ideas after reading a large amount of new information from lectures and research articles (Friend, 2000). For graduate students who learn English as a Foreign Language (EFL), the level of inability to sum up paragraphs into a summary is high. Summary writing is hard to learn because the gist of a passage is often not present in the surface structure (the exact wordings) of the text (Friend, 2001) and the cognitive process which converts surface structure to the gist of a text is internal and unobservable in onsite instruction (Alfassi, 2004). To externalize, visualize, and record the process of summary writing, a computer-supported collaborative learning (CSCL) system was developed in this study to investigate the effects of online peer collaboration and feedback on the graduate students' summary writings and reading comprehension.

Roschelle and Teasley (1995) propose that collaboration may be seen "as the mutual engagement of participants in a coordinated effort to solve the problem together" (p.70). Peers, however, are not domain experts, as opposed to teachers because peer advice or judgment may be correct, fully incorrect or misleading. In addition to this advantage, it is possible for students to provide peers with new perspectives when they try to evaluate whether or not they will accept or reject peers' comments.

There have been problems found in the previous studies in terms of peer collaboration, reading comprehension, and summary writing. First, teachers did not provide graduate students with explicit and strategic instruction to write summaries. As such, graduate students have difficulties on main idea identification and paraphrase it into

a summary writing in onsite instruction (Friend, 2001). Second, graduate students have less interaction with their peers and teachers in traditional classroom setting due to very limited instructional hours (Chi, 2001). As a result, graduate students are unable to share their knowledge and deepen their thinking. Third, few studies have investigated the relationships among peer collaboration, reading comprehension, and summary writing. Finally, the process of writing summaries is hardly observed in onsite instruction. That is, graduate students have few opportunities to compare their own summaries with those of proficient ones.

This study reports on using computer-supported collaborative learning (CSCL) system to support peer collaboration and feedback on graduate students' reading comprehension and summary writing. Three research questions were addressed in this study:(1) What are the relationships among peer feedback, summary writing, and reading comprehension?, (2) What are the effects of peer feedback on graduate students' reading comprehension and summary writing in CSCL?, and (3) What are students' perceptions toward their progress on summary writing and reading comprehension in CSCL?

2. Method

There were 24 graduate students participate in this study at a university of science and technology in central Taiwan. Before the instruction began, they were asked to take the reading section of a standardized test such as Test of English as International Communication (TOEIC) as the pre-test to identify their English language proficiency. The maximum score in reading on this version of the TOEIC is 495. The mean and standard deviation of these 24 graduate students in reading section of TOEIC are 385.45 and 45.95 in the pre-test. The onsite instruction incorporated with the CSCL system lasted for 18 weeks (including the pre- and post-tests). In summary writing, the graduate students' original and final drafts were first compared after peer feedback and further identified by the P-density. The high rate of the P-density indicates the high quality of the graduate students' summaries. The reliability of the P-density is reported to be 0.97 (Brown, Snodgrass, Kemper, Hermen, & Covington, 2008).

3. Results

3.1 The graduate students' reading progress on summary writing

In CSCL, paired-sample *t*-test is conducted to investigate the graduate students' reading progress between the pre- and post-tests after the instructional intervention of summary writing. The results indicate that the mean of the reading score for the 24 graduate students in the TOEIC post-test (407.55) is greater than that of the pre-test (385.45) and there is a statistically significant difference between the pre- and post-tests in reading (t = -3.026, p< .01).

3.2 The effects of online peer collaboration and feedback on summary writing

To externalize, visualize and compare the graduate students' summary writing process, two participants were randomly selected from the 24 graduate students to show their different summary writings. Student A is a sample case to show more revisions of her final draft after receiving peer feedback online. Student B is another example who made almost no revisions after receiving online peer feedback. The log files recorded in the CSCL

system were shown to indicate the interactive actions between these two students with their peers. From the log files, student A actively participated in collaborative interactions with her peers such as reading peers' summaries and providing peers with her suggestions (Fig. 1). By comparing student A's summary writing cycle, student B was a participant who made almost no revisions after receiving peer feedback. Students B did not actively participated in collaborative interactions with his peers for summary writing (Fig. 2).

3.3 The graduate students' perceptions toward summary writing and reading comprehension in CSCL

According to the open-ended questionnaire, all participants agreed that summary writing is an important skill since it helps them to read and write academic texts. Fifteen participants (63%) believed that practicing summary writings helped them identify the main ideas easily and quickly while reading academic texts. Almost all participants (92%) liked to receive online feedback from peers while writing summaries. They preferred to provide feedback to their peers in the CSCL system because they could learn from each other by reading other peers' summaries and comments to improve their own ones.

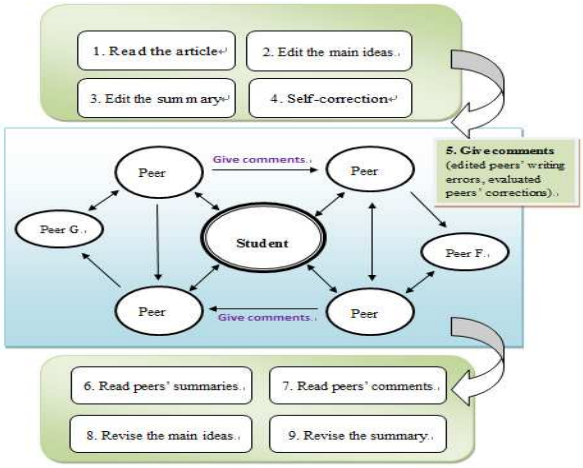

Fig.1 Student A's interactions in the summary writing cycle

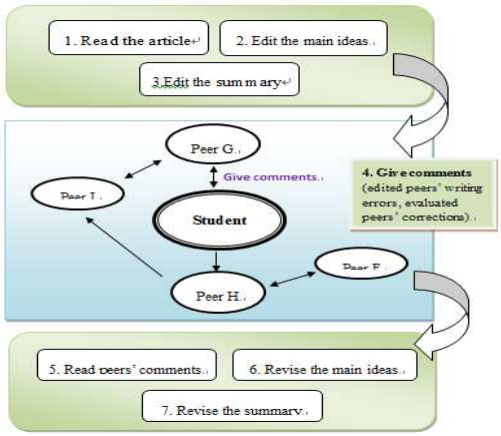

Fig.2 Student B's interactions in the summary writing cycle

4. Discussion and conclusion

Whether or not a graduate student accepted peers' suggestions and corrections, every single social activity of sharing knowledge and acquiring new information in CSCL would lead to a progress in summary revision. The effects of peer feedback on the graduate students' reading comprehension and summary writing are confirmed in this study. The more the graduate students engaged in peer feedback, the more they improved their reading comprehension and summary writing.

References

[1] Alfassi, M. (2004).Reading to learn: Effects of combined strategy instruction on high school students. *Journal of Educational Research, 97*, 171–184.2

[2] Brown, C., Snodgrass, T., Kemper, S.J., Herman, R., & Covington, M.A. (2008). Automatic measurement of propositional idea density from part-of-speech tagging. Behavior Research Methods, 40(2), 540–545.

[3] Chi, F. M. (2001). The role of small-group text talk in EFL reading: A thematic analysis. Taiwan: The Crane Publishing Co., LTD.
[4] Friend, R. (2000). Teaching summarization as a content area reading strategy. *Journal of Adolescent and Adult Literary*, 44(4), 320-329
[5] Friend, R. (2001). Effects of Strategy Instruction on Summary Writing of College Students.*Contemporary Educational Psychology*, 26(1), 3-24.
[6] Roschelle, J., & Teasley, S. D. (1995). Construction of shared knowledge in collaborative problem solving. In C. O'Malley (Ed.), Computer supported collaborative learning (pp. 69– 97). Berlin/New York: Springer Verlag.

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Kanji Learning Strategies: Acquisition of Motor Skills

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Abstract: This paper describes the effective strategy in learning kanji. This strategy is acquisition of motor skills, and it is a learning method to memorize kanji. In this strategy, learners practice writing kanji repeatedly using a digital pen for a few weeks. This writing motion is complex motor skill, and is developed through repeated writing kanji. We then analyze performance of kanji writing and compare results of pretests and posttests.

Keywords: Repeated writing kanji, acquisition of motor skills, strategies of learning, digital pen, handwriting

Introduction

The focus of this study is on kanji learning strategies. Kanji is a logographic script adopted from the Chinese language. Kanji characters express meanings. Also, one kanji can have many readings. Furthermore, kanji character forms are more complicated. The 1006 kanjis that primary school students need to learn have an average number of 12 writing strokes, indicating that many of them are complicated kanjis. Therefore, since (1) kanjis have different ways to read, (2) there are many types of characters, and (3) glyph is complicated, learning kanji has been considered as very difficult. In particular, students from non-kanji cultures find it especially difficult to learn kanji. In this research, we studied strategy of learning Japanese kanji.

1. Research on Learning Strategies and memorization Related to Kanji Study

1.1 Theoretical Background

Many studies in cognitive psychology related to kanji study have been made so far. Nozaki and Ichikawa (1997) have pointed out that facilitation of writing motions and understanding of kanjis' pattern structure are helpful. This article focuses on the facilitation of writing motions pointed out by Nozaki and others. Studies on effects of writing motions on memory indicate that to repeat writing serves as a visual rehearsal to facilitate memorization. In addition, memorization by writing allows one to acquire representation of motor skills different from visual memory and thus facilitates studying.
"Kusho" is defined as the "writing-like finger movements without any physical or visible trace." A studies have shown that (1) "kusho" behavior facilitates character-recall in adults from kanji cultures, and (2) "kusho" writing on paper is better at promoting character-

recall than writing in the air (Sasaki, 1982, 1984). These results show that the imagery derived from these writing-like movements is useful in remembering kanji characters.
Onose (1987) classified writing motions into tracing, copying (writing while looking at an example), and spontaneous writing (writing after the example is put away) to study methods of teaching how to write kanjis. In addition, to repeat writing motions is one of effective strategies to acquire kanji for those who understood common rules in kanji scripts. Such common rules include the following: horizontal bars are written left to right; vertical bars are written top to bottom.

2. Position of the Study

As mentioned in the previous section, repeatedly writing the characters enables creating a movement-derived imagery of the characters, which facilitates their memorization. Recognizing the effectiveness of writing motions in learning kanji as pointed out in previous research, we integrated them into the learning method used in this study. In our support in Kanji study, we encourage children to repeat writing using a digital pen so as to facilitate their writing motions, intending to facilitate their learning accompanied with motor skills.

The use of the digital pen has the following advantages: (1) Scripts and figures written on paper by a student can be recorded with the original brushstrokes; (2) Records of scripts and figures of all the students can be saved so that their thoughts and opinions can be easily classified; (3) Brushstrokes can be reproduced stroke by stroke so that stroke orders of Kanjis can be checked; and (4) Since scripting processes of students can be saved and their orders can be reproduced, false steps in the process of thoughts and their factors can be found and educational guidance can be evaluated. In addition, the use of the digital pen in studying at home has the following advantages: (1) Data can be saved in a connected PC so that even parents busy in working or child-rearing can check their children's learning status when they have time; and (2) Learning using an unusual means can increase motivation for learning.

3. Kanji Study Support for Japanese Children

3.1 Method

Target: One fourth-year female student, she is not very good at studying kanji
Supporting Period: Prior interview, pretest conducted once, study support for seven days in total, and posttest conducted once
Materials Used for Study: A personal computer, a digital pen, and a dedicated notebook for the digital pen
Place of Supporting: The home of the target (One of the authors visited her home to provide the individual educational guidance)

3.2 Procedure of Study Support

At first we conduct a pretest to see how many kanjis she has acquired, how her errors in stroke orders are characterized, and so on. Then, we create learning materials based on the results analyzed over the pretest. The target drills kanjis using the learning materials, the digital pen, and the dedicated notebook. The supporter points out what noticed as it arises.

In the end we conduct a posttest to analyze the result and compare with the result of the pretest.

3.3 Result of Kanji Test

Table 1 shows the results of kanji dictation and stroke order questions. Since the pretest (1) contains many familiar kanjis with small numbers of strokes, the percentages of correct answers in dictation were high. On the other hand, since the pretest (3) contains many difficult kanjis with large numbers of strokes, the percentages of correct answers in dictation were low. We conducted the posttest with the same questions as in the pretest. In the posttest, overall percentages of correct answers were high. In the posttest, overall percentages of correct answers were high. The percentages of correct answers of all the items in the posttest were higher than those in the pretest. In particular, the percentages are significantly improved in the following items: Kanji dictation questions of pre-posttest (2) from 71% to 92% and stroke order questions of pre-posttest (1) from 50% to 100% .

Table 1. Percentages of Correct Answers in Pretest and Posttest

	Pretest(1)	Posttest(1)	Pretest(2)	Posttest(2)	Pretest(3)	Posttest(3)
Kanji Dictation Questions	96%	100%	71%	92%	57%	89%
Stroke Order Questions	50%	100%	63%	75%	42%	42%

4. Related Research

In this section, we will introduce a kanji learning system partly developed by the authors. The “Java Kanji Flashcard 500” (JFK 500) is a kanji learning system developed under the leadership of Chikamatsu(1998). The authors collaborated in the development of the system. JFK 500 has the following features: (1) it enables learning the 500 kanjis most commonly used in Japanese newspapers, (2) it shows a stroke order animation. It can be accessed through the following URL: http://nuthatch.com/kanjicards/.

5. Conclusions

In this study, we conducted an experiment of helping a Japanese student who has difficulty in reading and writing kanji to learn kanji using a digital pen. The student was asked to practice writing kanji repeatedly using a digital pen for seven days. This improved the student’s kanji test scores, indicating that this learning strategy is effective. However, since our support was too short this time, there are still many kanji yet to be acquired.
Repeated writing kanji is an effective learning strategy. In the future, we would like to continue providing Japanese students with adequate support for learning kanji. In this study, however, only one student was used as subject for evaluating the above kanji learning method. There is thus a need to increase the number of subjects and properly assess the effectiveness of learning through the method used in the study.

Acknowledgements

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References

[1] H. Nozaki and S. Ichikawa (1997). *Kanji gakushu shien shisutemu no kaihatsu* [Development of a Computer-Assisted Kanji Learning System: Understanding Pattern Structure and Acquisition of Motor Skills], *Japan Journal of Educational Technology*, *21*(1), 25-35.

[2] N.Chikamatsu, S. Yokoyama, H. Nozaki, et al. (2000). A Japanese logographic character frequency list for cognitive science research, *Behavior Research Methods, Instructions, & Computers*,*32*(3), 482-500.

[3] M. Onose (1987). *Youji jidou ni okeru nazori oyobi shisya no renshuu ga syoji ginou no shutoku ni oyobosu kouka* [The effect of tracing and copying practice on handwriting skills of Japanese letters in preschool and first grade children], *Jap. J. of Educ. Psychol*, *35*, 9-16.

[4] M. Sasaki et al. (1983). *KUSHO kouduo no shutsugen to kinou* [An experimental study of spontaneous writing-like behaviour ("KUSHO") in Japanese], *Jap. J. of Educ. Psychol*, *31*(4), 1983, 273-282.

[5] S. W. Ryner, Jr., N.Chikamatsu, H. Nozaki, S. Yokoyama, S. Fukuda(1998). Java Kanji Flashcard 500: Kanji, Java, and the World Wide Web, 12th International Unicode Conference, part2, 1-7.

The Design of a Synchronized Multimedia-based English Self-Study System for Elementary Students

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Abstract: In this paper, we describe the development of a Synchronized Multimedia-based English Self-Study (SMESS) system for elementary students in Taiwan. Three major functions for fundamental English learning are designed in the SMESS system: (1) synchronized multimedia reading guidance, (2) online dictionary and (3) four types of self-assessment tools- sentence translations, fill in the blank questions, grammar error corrections and spelling exercises. Lessons covered in the current system include a total of 85 essays in two levels (primary (40 essays) and intermediate (45 essays)). In order to increase the flexibility of content, we also developed a content management component for providing an easy-to-use interface to manage all related materials.

Keywords: Synchronized multimedia, English learning, self-study, self-assessment, content management

Introduction

Second language (L2) acquisition is generally thought to be enhanced a great deal by information technology and multimedia networking for their functions that provide practice, interaction, and feedback in learning [1, 4, 6]. Web-based writing programs have been developed to provide instructors and students with writing instruction and assessment of English essays [5, 7]. Due to the constraints of EFL learning environment in Taiwan, English learning has conventionally been taught through lecture-based drills and paper-based practice. Some foundation and important issues such as vocabulary retention, grammatical cognition and reading comprehension are highly related to learning effectiveness of other subjects in particular to the stage of college or looking for jobs. However, these issues are usually lack of practice in the classroom due to the limitation of class time. Thus most of Taiwanese students have to spend much time and money to hire tutors or go to cram school after class. Therefore, in this paper, we describe the development of a Synchronized Multimedia-based English Self-Study (SMESS) system for elementary students, which is helpful to learn fundamentals of English. Three major functions are designed in the SMESS system: (1) synchronized multimedia reading guidance, (2) online dictionary and (3) four types of self-assessment tools- sentence translations, fill in the blank questions, grammar error corrections and spelling exercises. Lessons covered in the current system include a total of 85 essays in two levels (primary (40 essays) and intermediate (45 essays)). To increase the flexibility and extensibility of

content, we also developed a content management component to manage all related materials by an easy-to-use interface. The system has been served free online for a while (http://mlab.cs.pu.edu.tw/boyo) and promoted by a charity, Boyo Social Welfare Foundation, which is a famous organization on its free remedial programs for under-achievers in Taiwan.

Figure 1. Reading guidance of SMESS

Table 1. Four types of exercise

Types	Examples
Translation	(1) What do you do after school? 放學後你都做什麼？ 你放學後都做什麼？
Fill in the blank	(1) 他沒有一台電腦。 He doesn't has a computer. (1) 他沒有一台電腦。 He doesn't have a computer.
Correction	(1) What does Ben doing now? do does → is
Spelling	(1) 新的 _ ew new ✓ (2) 刺激的 e _ _ i _ i _ _ exciting

Note: Each type of exercise except translation practice has an automatically answering check mechanism. The red texts in the above examples show the automatic checking results.

1. Overview of SMESS

1.1 Synchronized Multimedia-based Presentation for Learners

Figure 1 shows the functions provided in our system for learners. The reading guidance includes a short essay and its corresponding oral reading recording by a native speaker. When oral reading plays, the sentence corresponding to its audio clip will be highlighted. That will help learners to concentrate on text accompany with playing of the sound. Learners can randomly access oral reading clips by clicking any sentence. All vocabularies appeared in the essay will be parsed automatically and displayed by red color. Moreover, online dictionary is a useful tool when learners are reading. Each lesson consists of four types of self-assessment, as Table 1 shows. Each type of exercise except translation practice has an automatically answering check mechanism. For elementary students, the designed functions or tools will be helpful for their pronunciation, intonation, vocabulary retention, grammatical cognition and reading comprehension.

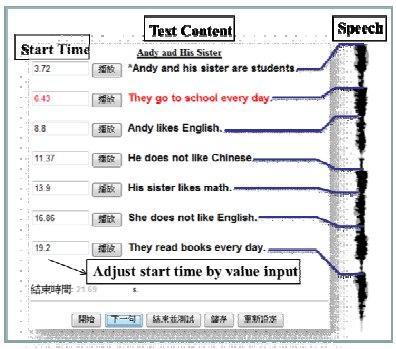

Figure 2. Speech-Text alignment

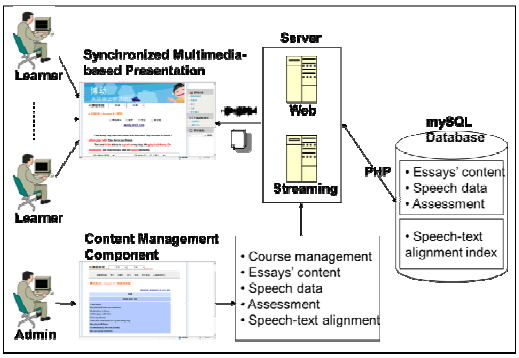

Figure 3. SMESS system architecture

1.2 Easy-to-Use Content Management Component for Instructors

Content management is not a new concept for web-based applications. The design of our system keeps this feature to manage all materials represented to learners. An instructor can use this tool to create a new lesson, use pre-defined characters to format a short essay, edit self-assessment exercises and determine the timestamp between each sentence and its corresponding oral reading clip. Figure 2 shows an example of operations for determining the timestamp of each sentence. When starting to play oral reading, the instructor can click a button to retrieve the current playing time and set it as the starting time of a sentence. After completing this process, he/she can test the alignment results and adjust the timestamp value for each sentence. This process provides important clues for synchronized presentation of reading guidance and random access.

2. System Architecture

Figure 3 shows the architecture of SMESS system. It consists of two major parts: (1) synchronized multimedia-based presentation mechanism and (2) content management component. The former applies the multimedia synchronization concept used for web-based language learning system which proposed on [2] and [3]. The latter provides variety of editing tools for learning content management. All related data will be stored on a MySQL database. In this architecture, server plays an import role to provide web and streaming services. Network streaming facilitates the access of oral reading or pronunciation of vocabulary speech data which usually has larger file sizes.

3. Conclusion and Future Work

In this paper, we proposed the SMESS system for fundamental English learning on pronunciation, intonation, vocabulary retention, grammatical cognition and reading comprehension. Learners can access all of online lessons through Internet for their self-studies. We believe that the use of our system will enhance learners' English ability in some degree. Therefore in the future, we will invite students who are studying in an elementary school to use this system for empirical study and evaluating the performance and effectiveness on English learning.

References

[1] Abraham L. B. (2008). Computer-mediated glosses in second language reading comprehension and vocabulary learning: A meta-analysis. *Computer Assisted Language Learning*, *21*(3), 199-226.

[2] Chen H.Y. & Li S.W. (2007). Exploring Many-to-one Speech-to-Text Correlation for Web-based Language Learning, *ACM Transactions on Multimedia Computing, Communications, and Application*, *3*(3), Article No. 13.

[3] Chen H.Y. & Liu K.Y. (2009), WMA: A Marking-Based Synchronized Multimedia Tutoring System for English Composition Studies, *IEEE Transactions on Multimedia*, *11*(2), 324-332.

[4] Lan Y.-J. (2009). The Essential Components of a Language-Learning-Centered Study of Technology Enhanced Foreign Language Learning. *The Technology Enhanced Learning Conference 2009*. Taipei, Taiwan.

[5] Lee, C., Wong, K., Cheung, W., Lee, F. (2009). Web-based essay critiquing system and EFL students' writing: A quantitative and qualitative investigation. *Computer Assisted Language Learning*, *22*(1), 57-72.

[6] Wong, L.-H., Gao, P., Chai, C.-S., & Chin, C.-K. (2011). Where research, practice and authority meet: A collaborative inquiry for development of technology-enhanced Chinese language curricula. *The Turkish Online Journal of Educational Technology*, *10*(1), 232-243.

[7] Wu Y.-L., Wu W.-M., Kung C.-Y., Hsieh, M.-Y. (2011). The Effect of Web-Based Instruction on English Writing for College Students. *Intelligent Decision Technologies*, *10*(II), 597-604.

Corpus-based online common error detector

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Abstract: In this paper the theoretical underpinnings and the practical construction of a corpus-based online common error detector are described. The selection of errors for inclusion was based on analysis of published accounts of common errors in the writing of Japanese learners of English, which were confirmed through statistical corpus analysis. Harnessing the concept of regular expressions and utilizing a MySQL database, the online error detector provides instant feedback on common errors in academic discourse that standard spell and grammar checker programs do not detect.

Keywords: error detection, Japanese learners, research articles, learner corpora

1. Introduction

The *raison d'être* for this common error detector is to provide automated feedback on drafts of research articles and abstracts written by Japanese researchers. The feedback is designed to provide easy-to-understand actionable advice that will improve the grammatical accuracy and formality of their drafts.

The inspiration for this project was the Common Error Detector, a JavaScript program created by Andy Morrall [1] at the Hong Kong Polytechnic University. His program searches for common errors made by Chinese speakers of English in academic essays using regular expressions (regexp).

The novelty of our error detector is twofold: firstly, the data set is tailored for Japanese researchers; and secondly, the error database is based on an extensive literature review and statistical analysis of large collections of texts (corpora). Our regexp data set includes phrases and words that are commonly misused, such as the noun *researches*. If this regexp is matched to the submitted text, the feedback message *research is an uncountable noun* is displayed. What is particularly useful about this detector is that it finds errors that standard spelling and grammar checkers cannot. This is first documented online error detector tailored for Japanese writers of English research documents.

2. Project overview

The project was divided into two key phases, namely: preparation and creation. The preparation phase involved reviewing the literature on error analysis and learner corpora, and designing the technical specifications. The creation phase comprised the creation of the web interface and a MySQL database, data input and analysis of the efficacy and accuracy of regexp using various corpora.

3. Preparation phase

3.1 Error analysis

Having analyzed a corpus of 2 million words, Izumi *et al* [2] noted the three most common errors in the spoken English of Japanese learners were related to articles (e.g. *the*), number (e.g. *–s*) and prepositions (e.g. *in*). These were closely followed by a variety of verb errors. Focusing on research articles drafted by Japanese academics, Orr and Yamazaki [3] proposed a set of twenty common problems. This was based on their analysis of a corpus of approximately 200,000 words of academic text written in English by Japanese researchers. The problems they identified are classified in Table 1. Regexp can be used to identify many of these errors at phrase level; but, with a few exceptions, cannot identify discourse-level errors.

Table 1: Twenty problems frequently found in research articles authored by Japanese

Noun phrase	Verb phrase	Discourse	
articles	copula - be	collocations	authorship
number	modality*	summarizing	consistency
quantification	transitivity	discussion	citation relevance
prepositions*	time, tense & aspect	communication authenticity	lexical richness
titles and labels	voice		density & complexity
	phrasal verbs		

* placed in these categories for pedagogical purposes

3.2 Learner corpora

A two-fold approach was adopted. First, having assessed the available corpora of Japanese learners of English, the Japanese sub-corpora of around 170,000 words from the 2010 beta Corpus of English Essays written by Asian University Students [4] was selected as being the most relevant. Second, the variables of the ideal corpus were established [5]. Following those parameters, a preliminary corpus of 250,000 words was created using texts from research articles in the fields of information, materials and knowledge science. All the texts were written in English and published in domestic conference proceedings or journals by Japanese researchers.

3.3 Technical details

A MySQL database, housing a live and a test version, is hosted on the university server. A student input interface was designed in which users submit text that is searched for regexp and feedback given for each error that is discovered within the error set. A subsidiary aim is also to harvest the submitted text and add it to a learner corpus which can be accessed when checking the efficacy of regexp. A teacher input interface was also needed to input the regexp and associated data as well as accessing both the live and test versions.

4. Creation phase

4.1 Creation of interface and database

The beta version of the database and web-interfaces was created. A website designer was consulted to identify ways to make the student interface more user-friendly.

4.2 Data input

Common errors made by Japanese learners of English were collated from four published sources [6] [7] [8] [9]. These were inputted into the database. These errors were further subdivided, and regular expressions were identified for each case. After testing, feedback was worded for each error and trialed with focus groups of Japanese researchers. This gave rise to numerous issues. For example, the initial example of researches may actually be correct when research is used as a verb in the present simple tense with a third-person subject, but in research documents the noun is much more frequently used. Feedback messages were assigned a priority, namely: warning or advice. Warnings include those regexp which would be incorrect in all situations, such as these researches. Advice includes regexp that would often be incorrect such as lots of, which is rather informal for research documents, but in some situations could be appropriate.

4.3 Statistical analysis

The regular expressions were systematically tested on the Japanese learner corpora using Antconc3.2.4w [10], a concordance program. Items that were not able to identify errors accurately were discarded from the database.

5. Further development

To enable more refined searches of errors, we plan to assigned parts of speech to both the submitted text and the preliminary corpus using a part-of-speech tag set and an automatic tagger, which will enable word-category disambiguation.

References

[1] Morral, A. (2010). Common Error Detector. <http://www2.elc.polyu.edu.hk/cill/errordetector.htm>

[2] Izumi, E., Uchimoto, K., Saiga, T., Supnithi, T. and Isahara, H. (2003). Automatic Error Detection in the Japanese Learners' English Spoken Data, *Procedings of ACL*, Sapporo, Japan.

[3] Orr, T., and Yamazaki, A. K. (2004, Sept 24 – Oct 1). Twenty problems frequently found in English research papers authored by Japanese researchers. *(pp. 23-35), Professional Communication Conference Proceedings, International, 2004.* doi. 10.1109/IPCC.2004.1375270

[4] Ishikawa, S. (2008). *Eigo koupasu to eigo kyouiku: deeta toshiteno tekusuto. [Engish corpus and language education: Text as data]*. Tokyo: Taishukanshoten.

[5] Atkins, S., Clear, J., and Ostler, N. (1992). Corpus design criteria, *Literary and Linguistic Computing, 7:* 1-16.

[6] Thompson, I. (2001). Japanese speakers. In M. Swan and B. Smith (Eds.) *Learner English: A teacher`s guide to interference and other problems.* Cambridge: Cambridge University.

[7] Barker, D. (2003). *Eigo to Nakanaori Dekiru Hon* [The book for becoming friends again with English]. Tokyo: Aruku.

[8] Webb, J. H. M. (2006). *151 common mistakes of Japanese students of English*. Tokyo: The Japan Times.

[9] Barker, D. (2008). *An A - Z of Common English Errors for Japanese Learners (Japanese version).* Tokyo: BTB Press.

[10] Anthony, L. (2012). *AntConc (Version 3.2.4) [Computer Software]*. Tokyo, Japan: Waseda University. Available from http://www.antlab.sci.waseda.ac.jp/

A Test Method of Background Questionnaire in Programme for the International Assessment of Adult Competences (PIAAC)

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Abstract: PIAAC is new international assessment by OECD, and targeted for adults from 15-year-old to 65. PIAAC assesses Numeracy, Literacy, Problem Solving in Technology-rich Environments, and Background Questionnaires (BQ). BQ is an important position among the survey data in PIAAC. Each participates country does not miss the actual test, for loss of data is not allowed. Therefore test pattern will be reduced with the technique of the combinatorial test; none of all combinations but all pairs of the variables. Applying this method, in the first half there are 30 patterns and the latter half there are 17 patterns, comparatively. The combination inclusion rate between two choices becomes 100%. Time required for the BQ test was to shorten by one person for five hours.

Keywords: OECD-PIAAC, information literacy, test method, combinatorial test

Introduction

PIAAC (Programme for the International Assessment of Adult Competences) [1] is new international assessment by OECD. PIAAC is targeted for adults from 15-year-old to 65 whereas OECD-PISA is targeted for 15-year-old student. PIAAC is the most comprehensive international survey of adult skills ever undertaken. PIAAC will measure the skills and competencies needed for individuals to participate in society and for economies to prosper.

The International Consortium which mainly on the American ETS summarizes develops the concrete investigation method and means of PIAAC and Deutsches Institut für Internationale Pädagogische Forschung (DIPF) is in charge of the assessment system.
PIAAC assesses Numeracy, Literacy, Problem Solving in Technology-rich Environments, and Background Questionnaires (BQ). Most of the survey use laptop computer. In BQ part of the investigation, the investigator enters the PC hearing target audience's answer. Other three areas, the target audience oneself enter the answer to the PC to bring the subject of an investigator. If the target audience is difficult on a PC, he or she can also answer in writing.

1. The place of BQ in PIAAC

To include BQ in PIAAC is because to assess the relationship of adult competencies with economic and social outcomes is believed to underlie both personal and societal success (e.g., earnings, employment, educational attainment, participation in further learning) and optionally with additional outcomes or processes at the individual level (e.g., health, social

capital) or workplace level, and with transitions at key points over the lifespan, such as school-to-work and possibly other stages [2].

BQ contains following 7 areas [3]: General Information (Age, Sex), Education and Training (Highest level of formal education, Field of study highest qualification), Current status and Work history, Current or recent work, Skill Use Literacy (Numeracy and ICT: Reading skill use, Writing skill use), Personal Traits (self-discipline, Locus of control), and Background information (Household composition, Children). BQ system in computer is implemented by two parts: the first half is General Information, Education and Training, and Current status and Work history. The latter half is Current or recent work, Skill Use Literacy, Personal Traits, and Background information.

2. Test Method about BQ system

As mentioned above, BQ is an important position among the survey data in PIAAC. Although the system will create and test of the International Consortium in charge, each participates country does not miss the actual test. There is a part of investigators to enter the data, for loss of data is not allowed, it is necessary to perform the test reliably.
As for the number of the items of BQ is 500 and choices is 13 in maximum, the number of the divergence is 24. Effective inspection is necessary because test pattern emits when test as it is. Before mentioned, BQ system consists of two parts, but still there is much test pattern. In addition, as for the part, as for the part, it is 6*5*4*3 = 360 patterns in the first half, and 310*29 = 30233088 patterns in latter half even if the equivalent division by the combination of simple round robins.

Therefore test pattern will be reduced with the technique of the combinatorial test; none of all combinations but all pairs of the variables. It is thought that it is effective when the combinatorial number of tests is very big like BQ. Specifically, a combination list is made by the standard collection method after divided equivalently an individual choice and reduced the number of the standards. The bug between all 2 factors must detect it. And the combination of multiple factors (more than 3 factors) bug has rarely occurred.[4] If bug detection rate is p, bug detection rate between 2 factors is p^2 and that between n factors is p^n. For example, if p = 0.004, detection rate between 2 factors is (0.004)^2 and 3 factors is 0.000016, 0.000000064, comparatively.

Table 1: Test of All Combination (Round-Robin Test)

	P1	P2	P3	P4
Test Case 1	0	0	0	0
Test Case 2	0	0	0	1
Test Case 3	0	0	0	2
Test Case 4	0	0	1	0
Test Case 5	0	0	1	1
Test Case 6	0	0	1	2
Test Case 7	0	0	2	0
Test Case 81	2	2	2	2

Table2: Combinational Test Table

	P1	P2	P3	P4
Test Case 1	0	0	0	0
Test Case 2	1	1	1	0
Test Case 3	2	2	2	0
Test Case 4	0	1	2	1
Test Case 5	1	2	0	1
Test Case 6	2	0	1	1
Test Case 7	0	2	1	2
Test Case 8	1	0	2	2
Test Case 9	2	1	0	2

If test item = 4(P1/P2/P3/P4) and standard = 3(0/1/2) (See Table 1), test pattern is 3^4 = 81 with all combination, 9 with orthogonal array (combinatorial test; Table 2). The test result is provided 100% inclusion rates between 2-pair factors in a one-ninth test item,

approximately equal to all combinations test. Figure 1 shows the transition of the equivalent division (State Transition Diagram).Each state (ellipse) represents one question in BQ. For example, BQ_01aJP is one question item, ”What is your educational background ?”

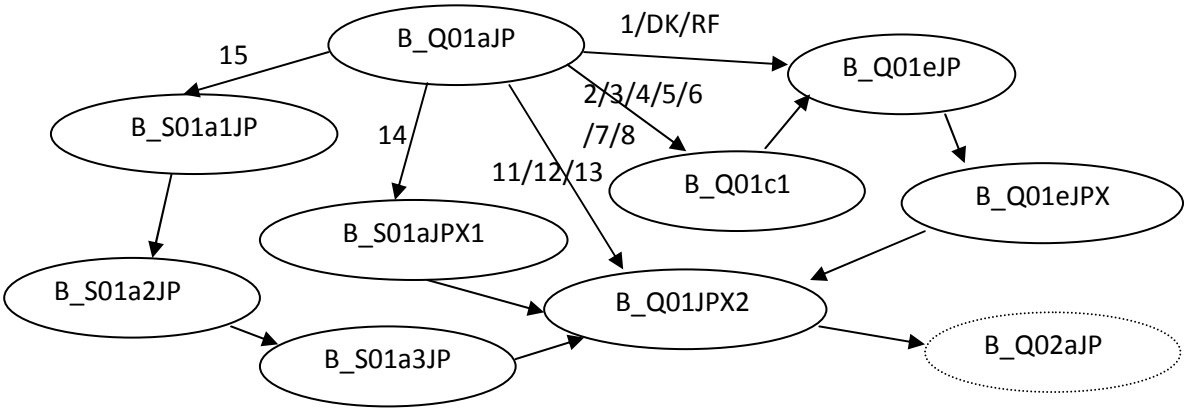

Figure 1: The State Transition Diagram rewritten by computer.
Item No. B_Q 01aJP may has range of 1/2/3/4/5/6/7/8/9/10/11/12/13/14/15/DK(Don’t Know)/RF (Refused).

First, BQ items were divided equivalently an individual choice and reduced the number of the standards. As for the number of the standards in each the divergence, in the first half, there are one of 6 standard, one of 5 standard, one of 4 standard, and one of 2 standard and in the latter half ten of 3 standard, nine of 2 standard. Second, a combination list is made by the standard collection method by ALLPAIRS [5]. Applying this method, in the first half there are 30 patterns and the latter half there are 17 patterns, comparatively. The combination inclusion rate between two choices becomes 100%. To make a standard collection was used ALLPAIRS, which was free software. Time required for the BQ test was to shorten by one person for five hours. Without this technique, 6*5*4*3 = 360 patterns in the first half, and 310*29 = 30233088 patterns in latter half must be tested by the combination of simple round robins. It would be impossible.

3. Conclusion

PIAAC BQ is an important position among the survey data in PIAAC. Each participates country does not miss the actual test, for loss of data is not allowed. Therefore test pattern will be reduced with the technique of the combinatorial test; none of all combinations but all pairs of the variables. Applying this method, in the first half there are 30 patterns and the latter half there are 17 patterns, comparatively. The combination inclusion rate between two choices becomes 100%. Time required for the BQ test was to shorten by one person for five hours. 2nd PIAAC survey is under consideration by OECD Bulletin Board.

References

[1] OECD (2005). International Assessment of Adult Skills: Proposed Strategy, Doc. Ref.:COM/DELSA/EDU(2005)/REV1, OECD, Paris.

[2] Thorn, W. (2009). International Adult Literacy and Basic Skills Surveys in the OECD Region, OECD Education Working Papers(26). OECD Publishing.

[3] OECD(2009). PIAAC-NPM（2009_02_01）BQ V.5.0 Conceptual Framework, doc（working paper） http://www.oecd.org/dataoecd/52/28/48865373.pdf

[4] Black, Rex (2007). Pragmatic Software Testing: Becoming an Effective and Efficient Test Professional, New York: Wiley. p. 240. ISBN 978-0-470-12790-2.
[5] ALLPAIRS. http://www.satisfice.com/tools.shtml

Multimedia Motivational Agent: The Impact on the Middle School Students' Science Learning and Motivation

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Abstract: This study examined the effects of motivational agent (present and absent) and different formats of instructional content (text narrative and animated narrative) on student learning and motivation. The provision of motivational agent was found to significantly interact with the format of instructional content on student performance. The provision of motivational agent affected student performance when reading animated narrative content. However, the provision of motivational agent did not affect student motivation when reading either text or animated narrative contents. The implications of current study extends what we know about the benefits of motivational agent in learning and offers important insights on how to better design or integrate motivational agent in the instructional content to enhance performance and motivation to learn.

Keywords: Motivational agent; formats of instructional content; performance; motivation; physics learning

1. Introduction

The pressure of credentializationism in Taiwan has caused many school teachers placing heavily attention on the aspect of keeping up with course schedule than students' motivation to learn. With the purpose of promoting students' science literacy and sustaining their interest and motivation in science learning or science-related activities, the design of web-based science learning environments have emphasized on how to enhance and complement students' deficiencies in motivation. This study proposes the use of learning agent as motivational mechanism that can provide direction for students to use appropriate learning strategy, sustain their motivation in learning, and facilitate their learning outcomes. Content delivered in the web-based learning environments generally through different formats or representations such as text, animation, narrative, audio, video, etc. Several researchers have found that certain instructional content delivered through computer can enhance the relation between abstract and concrete concepts, in which learners can explore the underlying principles by using different presentation modes [1, 2, 3, 4]. As new technologies emerge, the availability of teachers can be alternated by virtual humans [5]. Implementing virtual humans such that the assistance given to students is tailored to their individual needs is a new and promising direction of research. Accordingly, virtual humans are as pedagogical agents, and they not only serve to delivery knowledge, but play as communicative and interactive bridge with students [6]. Since many researchers have explored the roles (i.e., appearance, facial expression) of agents on student's learning. Moreno et al. [7] found that students had more positive attitudes and better achievement when the lesson was taught by an agent rather than by on-screen text.

Atkinson [8] also found that narrative embodied agent was more effective at fostering learning than a text-based learning environment. Currently, there are a number of pedagogical agents used in a variety of computer-based multimedia learning environments. For instance, Herman the Bug, a talkative agent, provides students real time advice intended to focus on botanical anatomy [9]. Peedy the Parrot, an animated agent, would fly across the screen and use gesture or gaze to help the learners associate verbal information with visual information [8].

2. Methods

2.1 Participants and design

A total of 139 7th grade students from four classes were recruited to participate in this study, and the average age of the participants was 14. The participants had not learned what the instruction would be covered in this study. Students were randomly assigned to four groups. A 2 (text narrative and animated narrative) x 2 (with and without motivational agent) factorial design was used to study the effects of different formats of instructional content and motivational agent.

2.2 Instruments

The instruments used in this experiment were: an assessment for learning and instructional materials motivation survey. An assessment for learning was used prior to the study and after the completion of the study. The assessment consisted of 21 multiple-choice items with four response options each, which is the regular type of assessment for the course in which the assessment was administered. The instructional materials motivation survey assesses the motivational effects of instructional situations. The survey was constructed according to the ARCS model with four respective subscales, namely Attention, Relevance, Confidence, and Satisfaction. Reliabilities of the measures for each subscale were Cronbach's alpha .89, .76, .88, and .82 respectively.

2.3 Procedure

Four web-based learning modules were created. Data were collected twice with one week apart. Each session lasted 45 minutes. Participants were first randomly assigned to one of the four conditions (as shown in Table 1) and given a code to use throughout the study to login to the website. The website started with an overall description of the site, the purpose, and the tasks for the participants. Then the participants were asked to fill out a demographic questionnaire and a pre-test. After the pre-test, the website instructed participants to read a series of instructional passages about force and motion. One week later, participants returned for the second session of the study. In the second session, participants went back to the website and the website directed them to read the instructional passages as shown and to complete a post-test.

Table 1. Experimental groups

Motivational agent	Formats of instructional content	
	Text narrative	Animated narrative
Present	Group A	Group B
Absent	Group C	Group D

2.4 Data analysis

A multivariate analysis of variance (MANOVA) was employed to analyze whether there was a main effect on students' post-tests and motivation. The treatment groups were independent variables. Dependent variables were students' post-tests and motivation. The effect size was calculated using the eta squared statistic and interpretation was based on the thresholds of .01 for a small effect, .06 for a moderate effect, and .14 for a large effect (Cohen, 1977). The assumption of equal variance was met at the .05 alpha level as shown by the results from the Leven's Test.

3. Results and Conclusions

The results showed that the provision of motivational agent was found to significantly interact with the format of instructional content on student post-test. The provision of motivational agent affected student performance when reading animation narrative content. However, the provision of motivational agent did not affect student motivation when reading either text or animated narrative contents. Differed from previous studies, this study did not find positive effects of present or absence of the agent [10, 11]. One reason might be the design of the motivational agent appearance or its purpose did not meet the needs of the students. Another reason is that the instructional contents were new to these students, therefore much cognitive capacity was focused on the understanding of the content itself, fewer attention can be split to other tasks. In digital age, emerging technologies have changed the formats of instructional content can be presented; however the design of instruction is still perceived as an important component in determining the effectiveness of digitized learning methodology on student learning. This study found the provision of motivational agent embedded with different formats of instructional content (text or animation) seemed to have an impact on learners' processing different formats of instructional content.

References

[1] Akbulut, Y. (2008). Predictors of foreign language reading comprehension in a hypermedia reading environment. *Journal of Educational Computing Research, 39*(1), 37-50.

[2] Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review, 3*(3), 149-210.

[3] Moreno, R., & Mayer, R. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of Educational Psychology, 91*, 358-368.

[4] Paivio, A. (1986). Mental representation: A dual coding approach. Oxford, England: Oxford University Press.

[5] Kim, Y., Baylor, A. L., & Group, P. (2006). Pedagogical agents as learning companions: The role of agent competency and type of interaction. *Educational Technology Research & Development, 54*(3), 223-243.

[6] Baylor, A. L., & Kim, S. (2009). Designing nonverbal communication for pedagogical agents: When less is more. *Computers in Human Behavior, 25*, 450-457.

[7] Moreno, R., Mayer, R. E., Spires, H., & Lester, J. (2001). The case for social agency in computer-based teaching: Do students learn more deeply when they interact with animated pedagogical agents? *Cognition and Instruction, 19*, 177-213.

[8] Atkinson, R. (2002). Optimizing learning from examples using animated pedagogical agents. *Journal of Educational Psychology, 94*, 416-427.

[9] Moreno, R., Mayer, R. E., Spires, H., & Lester, J. (2001). The case for social agency in computer-based teaching: Do students learn more deeply when they interact with animated pedagogical agents? . *Cognition and Instruction, 19*, 177-213.

[10] Lester, J., Towns, S., Callaway, C., Voerman, J., & FitzGerald, P. (2000). Deictic and emotive communication in animated pedagogical agents. In J. Cassell, J. Sullivan, S. Prevost & E. Churchill (Eds.), *Embodied conversational characters* (pp. 123-154). Cambridge, MA: MIT Press.
[11] Mumm, J., & Mutlu, B. (2011). Designing motivational agents: The role of praise, social comparison, and embodiment in computer feedback. *Computers in Human Behavior*.

Evaluation of pre-service teachers' technology acceptance of a mobile social networking App for teachers' professional development

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Abstract: Our research group has implemented a professional development platform for teachers, WIDEKM (Web-based Instructional Design Environment with Knowledge Management modules) since 2006. WIDEKM was mainly a blog-based professional development environment that, in a recent count, had approximately twenty thousand members, but the social interaction between teachers was still limited. Therefore, the purpose of this study was to evaluate the technology acceptance and usage motivation of the pre-service teachers after they operated a mobile social networking application (WIDEKM App) that was developed by our research group in 2012 to promote interaction between the teachers. There were 10 participants in this pilot study. The results of technology acceptance showed that most participants expressed positive attitudes toward most WIDEKM App functions.

Keywords: Social Network Services, Mobile Application Platform, Professional Development

Introduction

Using social networking services (SNSs), people can communicate learning-related knowledge with their friends in a highly interactive way [1]. People have more opportunities to learn because their homepage is always full of posts provided by friends. However, teachers seldom consistently make use of their current professional development platforms to learn with others because of a lack of time and incentives during the semester [2, 3]. Currently, the social networking characteristic is insufficiently present in most teachers' professional development platforms. Since the WIDE-KM platform was implemented in Taiwan by our research group in 2006 [4, 5], twenty thousand teachers have registered in total. Teachers could effectively discuss their instruction, instructional design and the problems that they faced in class. Although teachers could effectively exchange knowledge and experiences, the usage and interaction rates were still low. Therefore, we [6] developed a mobile professional development application, *WIDE-KM App*, which was combined with a series of mobile social networking functions. Through the functions, we expect to enhance the teachers' usage motivation and the social interaction between teachers. There were 10 participants (pre-service teachers) in this pilot study, and two primary research questions are proposed in this study (1) after the pre-service teachers manipulated the WIDEKM App, what was their technology acceptance attitude of the entire platform? (2) After the pre-service teachers manipulated the WIDEKM App, what was their technology acceptance attitude of each function?

1. Method

This study included 10 qualified pre-service teachers as participants. The research tool, *WIDEKM App* was designed and implemented by our research group [6]. Following the original functions of WIDEKM, we developed the app (i.e., WIDEKM App, as shown in Figure 1) and combined social networking with mobile portability to the original platform based on some social networking concepts such as "Openness" and "Active State" [1]. Social networking functions were combined with our platform to provide teachers with more opportunities to interact and have discussions with other teachers, especially unfamiliar teachers to them. Moreover, by combining the instant dynamic function of social networking, our platform could increase knowledge sharing among teachers. For example, whenever users logged into our platform, they could observe plenty of content posed by other teachers [1].

Figure 1 Screenshot of *WIDEKM App*

We also designed a questionnaire based on Technology Acceptance Model (TAM) [7] to assess pre-service teachers' satisfaction after using our platform. There were 19 questions regarding the technology acceptance of the entire platform (α=.660). Moreover, the technology acceptance of each function was evaluated by two questionnaires: a perceived usefulness questionnaire and a perceived ease of use questionnaire. In the perceived usefulness questionnaire, there were 21 questions (α=.719). In the perceived ease of use questionnaire, 21 questions were included (α=.872). All of the teachers were asked to use our new mobile social networking platform, the *WIDEKM App*, approximately 30 minutes in the experimental process to allow them to understand whether this platform would meet their needs. Next, all of the teachers completed the TAM technology acceptance questionnaire to express their perception and satisfaction regarding our platform.

2. Results and Discussion

We referred to TAM to implement percentile statistic and a five-point scale questionnaire to evaluate pre-service teachers' attitudes and behavior toward our system. The score of each question was above 3.7, and the average score was 3.963, indicating that these teachers had positive technology acceptance towards of the entire platform. Here, we list the questions of top five high scores (as shown in Table 1).

Table 1 Technology acceptance of entire platform

Rank	Item	Mean	SD
1	I think that the function of WIDEKM App is clear and understandable.	4.30	.483
2	I think that the interface design of App's blog system is ease-of-use.	4.30	.675
3	I think that WIDEKM App can help me obtain high-quality teaching materials more easily.	4.20	.632
4	I like to use WIDEKM App to obtain other teachers' teaching materials and information.	4.10	.568
5	I think that the function of WIDEKM App can help me know other teachers' latest information rapidly.	4.10	.568

Regarding the questionnaire regarding the perceived ease-of-use, the scores for the questions regarding all of the function dimensions were above 3.9, indicating that the WIDEKM App was suitable for teachers' use. Regarding the perceived usefulness, the scores of the 19 questions were positive and over 3.6, indicating that the pre-service teachers had positive technology acceptance toward each function's perceived usefulness. Here we list the top five high-score questions (i.e. functions) (as shown in Table 2).

Table 2 Technology acceptance of each function

Rank	Item	Mean	SD
1	Preview high-quality teaching material.	4.50	.527
2	Read latest blog articles.	4.40	.516
3	Download high-quality teaching material.	4.30	.483
4	Read friends' blog articles.	4.30	.483
5	Reply peers' blog articles.	4.20	.422

3. Conclusions

Social networking characteristics may improve teachers' interaction and usage motivation (e.g., [1]). Thus we designed a professional development platform, WIDEKM App. The results of technology acceptance in this pilot study showed that most pre-service teachers expressed positive attitudes toward most WIDEKM App functions, especially the functions of accessing high-quality teaching materials and blog interactions. However, this study did not analyze the interaction in the teachers' actual use. Thus, we will proceed with further interaction pattern analysis for providing further references to improve the system.

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References

[1] Yu, E. (2009, Oct.). *A study on attributes of interaction of a social network service on the web.* Paper presented at IASDR 2009 Conference, Seoul, Korea.

[2] Slotwinski, J. (2011). Online communication as a mode of professional development among student teachers in music education. In M. J. Koehler, & P. Mishra (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2011* (pp. 3353-3361), Chesapeake, VA: AACE.

[3] Wang, X., & Fang, Y. (2010, June). *Online learning community for mathematics teachers in*

Singapore: Online facilitation. Paper presented at the 2nd International Conference on Education Technology and Computer (ICETC 2010), Shanghai, China.

[4] Chang, K. E., Sung, Y. T., & Hou, H. T. (2006). Web-based tools for designing and developing teaching materials for integration of information technology into instruction. *Educational Technology & Society*, *9*(4), 139-149.

[5] Chen, T. Y. (2009). *Integrating tagging system into teacher knowledge management system: Implementation and behavioral analysis.* Unpublished master thesis, National Taiwan Normal University, Department of Information and Computer Education, Taipei City, ROC.

[6] Li, C. Y., Hou, H. T., & Chang, K. E. (2012). *Impact of mobile social network platform (WIDEKM App) on professional development of teachers.* Paper presented at International Conference on Internet, E-Learning and Education Technologies, Taipei, Taiwan.

[7] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly 13*(3), 319-340.

Visualization of Chemical Reactions for Teaching Material Based on Quantum Calculation – Thermochemical Handling about NaCl

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Abstract: Original Born-Haber cycle about sodium chloride NaCl is proposed as a teaching material based on the calculation result by the quantum calculation with MOPAC MP6 Hamiltonian level. Enthalpy changes of the corresponding processes *via* NaCl-related substances on the basis of the formation energies are depicted in the cycle. Furthermore, the intelligible diagram about dissolution phenomenon is carried out by the thermodynamic changes of enthalpy, entropy and Gibbs function for student to understand meaning of the thermodynamic changes in the phenomenon.

Keywords: Visualization, quantum calculation, thermochemistry, teaching material Born-Haber cycle of NaCl

Introduction

The learning on the basis of students' enthusiastic activities on imaginative thinking and behaving would be of great importance to understand science. Student's attitude being enthusiastic toward the possibilities of their own abilities with their own images would enhance the understanding of objectives. Dividing the lecture stage into the three thinking levels is mentioned by Tasker *et al* [1]. Visualization as a key of representation of images is great help for student to have images of phenomena, chemical concepts, and molecular world, and then the visualization enables student to realize images of them. Visualization of chemical abstract concepts on CG graphics helps us greatly to realize images of them, and the visualization is one of effective methodologies for making teaching material [2]. The visualization needs to be more appealing for students from the stand point of a useful teaching material. It is our aim to produce a teaching material in accordance with this manner [3, 4].

Born-Haber cycle related with sodium chloride NaCl is well known thermodynamic procedure for student's learning of theromochemistry [5]. An understanding of thermodynamics tends to be unclear and tends to have misunderstanding. For example, if the dissolution phenomenon of salt is taken, the dissolution will take place spontaneously thermodynamically with a value positive in enthalpy change, and then an understanding of a relation with entropy change will become ambiguous easily. This paper reports the study on thermochemical teaching material by quantum calculation in which original Born-Haber cycle related with sodium chloride NaCl is established for student to understand meaning of the thermodynamic changes in the phenomenon.

1. Procedure

The semi-empirical molecular orbital calculation software *MOPAC* in the *CAChe Work System for Windows ver. 5.04* (Fujitsu, Inc.) with PM6 Hamiltonian was used in calculations for optimization of heat of formation ΔE_f as origin. The ΔE_f was calculated on the basis of the definition of heat of formation ($E_{elect} + E_{nuc} - E_{isol} + E_{atom}$) [6].
Enthalpy changes ΔH of the corresponding processes were calculated on the basis of the ΔE_f. ΔH_{dissol} of the dissolution process of NaCl(s) → NaCl(aq) was estimated by our practical data from the experiment of NaCl dissolution in water at 298 K.

2. Results and Discussion

2.1 Born-Haber Cycle

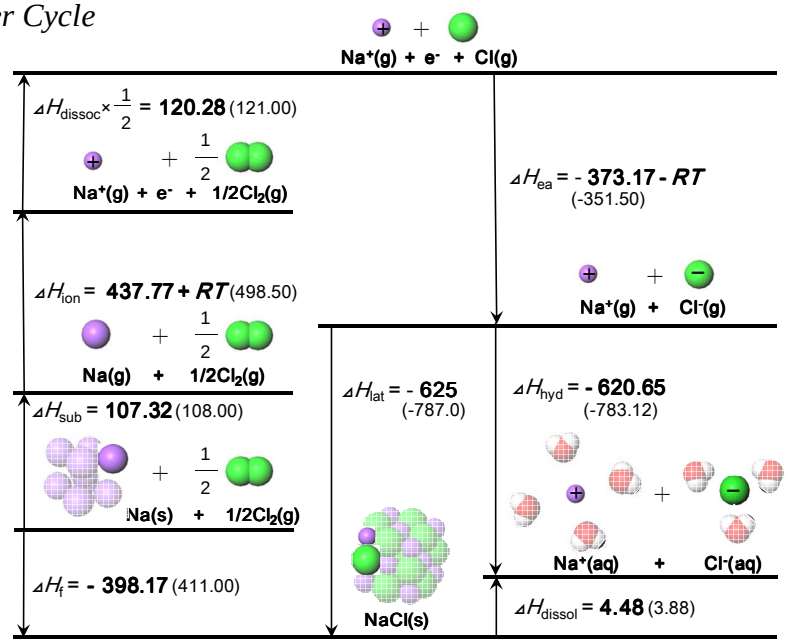

Fig. 1. Born-Haber cycle[a]

[a] ΔH / kJmol^{-1} is calculated from ΔE_f; ΔH_{dissol} was estimated from our experiment of NaCl dissolution in water at 298 K. Vales inside of a parenthesis are cited in the reference [7].

Calculated heat of formation ΔE_f / kJmol^{-1} as an original of NaCl-related species were as follows; –206.67 as NaCl(g), 107.32 as Na(g), 121.15 as Cl(g), 545.09 as Na^+(g), –252.02 as Cl^- (g), –1.74 as Cl_2(g), and –331.98 as NaCl(s). Enthalpy changes ΔH among steps in the reaction process related with NaCl are able to find out from the combination of ΔE_f.
Calculated ΔH is represented in Fig. 1 as an original Born-Haber cycle, with definition of subscription of f: formation, sub: sublimation, ion: ionization, dissoc: dissociation, ea: electron affinity, hyd: hydration, dissol: dissolution, lat: lattice with reference value inside of a parenthesis [7]. For the purpose of clear stoichiometry, state of molecule with relative size is represented. We should use the ionization enthalpy, $\Delta H_{ion} + RT$, $\Delta \nu_{gas} = +1$ and enthalpy of electron affinity, $\Delta H_{ea} + RT$, $\Delta \nu_{gas} = -1$; but not only is the difference small (RT = 2.5 kJmol^{-1} at 298 K), the RT is in fact cancelled by a similar term mentioned above.

2.2 Dissolution

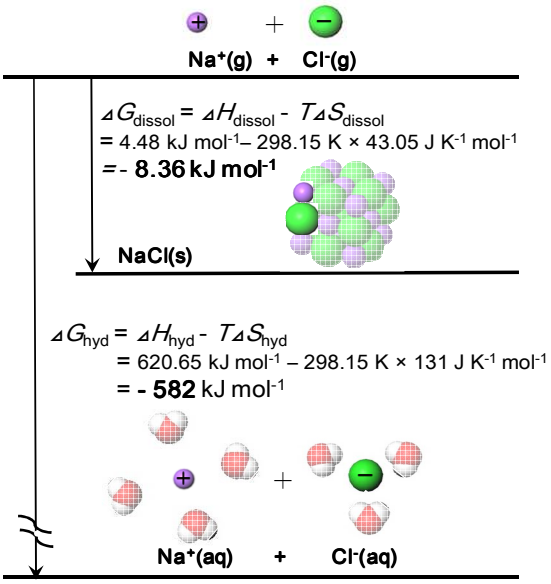

Fig. 2. Dissolution

An intelligible diagram about dissolution phenomenon is advocated in Fig. 2 with the thermodynamic changes of enthalpy, entropy and Gibbs function in order that student may understand the meaning of thermodynamic changes in the phenomenon and treat thermochemical procedure with calculation by thermodynamic quantities. It is clear that dissolution phenomenon proceeds spontaneously even with the plus value of ΔH_{dissol} besides with plus value of ΔS_{dissol}, totally with minus value of ΔG_{dissol}. The visualization based on outcomes from the calculation would have strong possibility for teaching material to a smooth understanding for student to realize the whereabouts of the reaction.

References

[1] Tasker R. and Dalton R. (2006). Research into practice: visualization of the molecular world using animations, Chem. Educ. Res. Pract., 7, 141-159.

[2] Gilbert, J. K., Reiner M., Nakhleh M. (eds), (2008). Visualization: Theory and Practice in Science Education, Springer.

[3] Ogawa, H., Ikuo, A., & Yoshinaga, Y., (2010). Development of teaching materials by CG visualization of chemical reactions for realizing the reaction mechanisms, Holbrook J. et al. (eds), "Innovation in Science and Technology Education: Research, Policy, Practice", University Tartu, 251-253 (2010).

[4] Ikuo, A., Ikarashi, Y., Shishido, T., & Ogawa, H., (2006). User-friendly CG visualization with animation of chemical reaction - Esterification of acetic acid and ethyl alcohol and survey of textbooks of high school chemistry-, *Journal of Science Education*, **30** (4), 210-215.

[5] For example, P. W. Atkins, "Physical Chemistry", 3th Ed, Oxford University Press (1988) pp. 91-92; P. W. Atkins, M. J. Clugston, "Buturi-Kagaku no Kiso", Tokyo Kagaku Dojin (1986) p188 (in Japanese).

[6] http://openmopac.net/manual/SCF_calc_hof.html.

[7] Peter Atkins, Julio de Paula, "Physical Chemistry", 8th Ed, Oxford University Press (2006) p. 719, 1000; P. W. Atkins, M. J. Clugston, "Buturi-Kagaku no Kiso", Tokyo Kagaku Dojin (1986) p189, 156 (in Japanese).

Tapping Technology to give Formative Feedback for Practical Learning in Medicine

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Abstract: Effective feedback has been singularly highlighted as a significant, powerful tool for reinforcing student learning. Indeed, even highly motivated and academically geared medical students are no exception and expect regular feedback during various stages of their learning, including the basic medical/pre-clinical sciences. In this paper, we describe the use of technology enhancements and multimedia support to incorporate formative feedback on a regular basis for large student cohorts (up to 130 students) during and after practical learning such as that required in studying human anatomy.

Keywords: Feedback, formative assessment, practical learning in anatomy, basic medical sciences, educational technology

Introduction

Effective feedback (Hattie & Timperley, 2007) has been singularly highlighted as a significant and powerful tool for reinforcing student learning (Hattie, 2009). Indeed, even highly motivated and academically geared medical students are no exception and expect regular consistent feedback during various stages of their learning, including formative assessment for basic medical sciences (Ogilvie et al, 1999).

1. Developing a new practical strategy

Over five years ago, as a new medical school with a non-traditional integrated curriculum, alternative strategies were sought to teach core competencies in gross anatomy together with clinical practice applications. Anatomy, a cornerstone in medical education, requires understanding the complex three-dimensional structure and organisation of the body. Cadaveric dissection was not an option due to shortage of cadavers and cultural/religious taboos. We initially faced major challenges shifting away from a traditional dissection-based curriculum and opting for a novel learning space; a 'dry' laboratory-cum-resource centre supported with computers, audio-visual equipment and multimedia technology (Ogilvie et al, 1999). An innovative practical strategy was designed for tech savvy medical students to replace conventional dissection classes in 3-stages:

1) Guided Collaborative Learning (GCL) :This included weekly learning by Year 1 and 2 student peer groups through combination of their independent pre-class preparation and in-class group discussion of structured practical tasks, uploaded on the institution's online learning portal (Rosenberg et al, 2006). Medical students had full access to available laboratory resources and engaged hands-on with anatomy models and plastinated specimens, peer volunteers for living anatomy and interactive multimedia technology and anatomy software. Tutors - either clinically qualified or practising clinicians -facilitated this session.

2) Peer Teaching Demonstration (PTD): Weekly presentation of selected practical tasks by student groups was broadcast to the whole cohort (up to 130 students) via audio-visual technology and actively moderated by clinician tutors. Technology savvy students utilised hands-free headset microphones, real time high resolution web cameras, a visualizer and internet-enabled desktop computers with high resolution LCD projection in the Anatomy Laboratory to demonstrate models, plastinated specimens, consenting peers for surface anatomy and X-ray images.
3) Objective Structured Clinical Anatomy Review (OSCAR): The OSCAR was developed as an interactive formative assessment incorporating multimedia technology & available anatomy resources. Held at mid- or end-semester, the OSCAR served to reinforce anatomy practical skills learning and pre-exam revision. Stations were set up based on anatomy-focused questions uploaded on computers within the technology-enhanced Anatomy Laboratory. Students rotated through timed stations (Fig.1) and assessed on clinical anatomy correlation, procedural/surgical anatomy and digital radiograph interpretation. Tutor feedback/debriefing immediately followed with an interactive question and answer session. Appraisal of student knowledge and feedback on their learning inadequacies still remains a challenge as current medical education methods often lack focus on improving practical anatomy skills through reflective practice. Hence, multiple levels/ mechanisms of formative feedback were incorporated in our overall practical strategy.

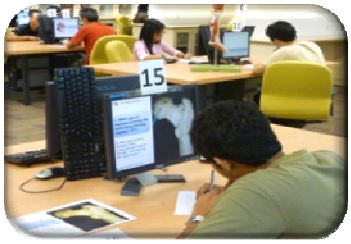

Figure 1: Station testing clinical anatomy

2. Inclusion of formative feedback in practical strategy

2.1 Peer and tutor verbal feedback during GCL and PTD

During group discussions of practical tasks, students utilise their experience in problem-based learning to readily discuss the topic at hand in a constructive manner. The clinician tutors, whilst listening in on the group discussions, are able to provide direct and immediate verbal feedback to correct student misconceptions or recognise their difficulties in practical anatomy identification skills.

Table 1: Peer group assessment of peer demonstration (n=9 groups)

Items of Student peer assessment	Mean score (max 5)
Accuracy of the content of presentation	4.1
Cohesiveness and smooth flow of presentation	3.7
Use of specimens and models	4.4
Integration of anatomy with clinical correlation	3.8
Use of audiovisual aids (microphones, visualizer, webcam, software)	4.7
Response to questions (from peers and tutors)	3.2
Overall delivery of presentation	3.8

Similarly, during student demonstration of practical tasks to their whole class during PTD, ample opportunities exist for feedback on student knowledge, skills and performance. In the earlier years, peer groups evaluated each other's performance and delivery (Table 1). Now, tutor feedback of group PTD performance is broadcast immediately and posted up weekly. At semester end, the best groups are rewarded in a simple prize-giving ceremony.

2.2 Automated feedback during GCL and PTD using Audience Response System

Recently, an audience response system (ARS) or "clickers" were introduced during practical classes (Alexander,2009) involving multiple choice or short answer questions. Topics range from basic practical identification type, second-order questions to more critical scenario/problem-based questions. Once ARS responses are locked in, quantitative and qualitative real-time feedback data are displayed and answers discussed by the tutor.

2.3 Feedback in OSCARs

Clinical anatomy learning, formatively assessed through the OSCAR, required students to respond quickly to practically-oriented tasks, mimicking the urgency of real clinical practice (Watmough, 2010). Student evaluation was highly positive for OSCARs including the feedback/ debrief sessions (Table 2). Comments included: *"Can we have OSCAR every week? Very very stimulating and increases the desire to study more about anatomy."*

Table 2: MBBS student evaluation of OSCAR and feedback learning

Percentage of MBBS students 'Strongly agree + Agree'		Year 1	Year 2
DURING OSCAR	Use of anatomy models, plastinated specimens & images stimulated my learning	99%	**94%**
	Incorporation of applied/clinical anatomy topics stimulated my learning.	98%	**96%**
	Arrangement of labs and audiovisual aids/multimedia were adequate for session	**90%**	**96%**
DURING DEBRIEF	I found the prompt feedback and discussion by tutors useful	**98%**	**98%**
	Content of the debrief session was delivered at a level appropriate to us students	**97%**	**96%**
TUTORS	Tutor(s) clarified difficult terms/concepts as required.	**97%**	**98%**
OVERALL	Current frequency of OSCAR sessions is appropriate for the semester (2/sem.)	**80%**	**74%**
	Overall, stimulation of anatomy learning through OSCAR was good.	**97%**	**94%**

Conclusion

Such a variety of feedback mechanisms (including formative feedback through practical-based OSCARs) form a relevant strategy in anatomy education and serve to benchmark students' knowledge base, promote reflection and act as a stimulus for further learning. Such feedback strategies can also be readily applied in other practical-based disciplines (e.g. nursing, allied health sciences and STEM subjects) and will inform the future design of assessment of learning.

Acknowledgements

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References

[1] Hattie, J. & Timperley, H. (2007). The Power of Feedback. Rev Educ Res, 77,81

[2] Hattie, J. (2009).Visible learning-A synthesis of over 800 meta-analyses relating to achievement.NY: Routledge.

[3] Ogilvie,R.W., Trusk, T.C., & Blue, A.V. (1999). Students' attitudes towards computer testing in a basic science course. Med Educ,33,828-831.

[4] Rosenberg, J. L., Lorenzo, M., Mazur, E. (2006). Peer Instruction: Making Science Engaging, NSTA Press.

[5] Alexander, C. J., Crescini, W. M., Juskewitch, J. E., Lachman, N. & Pawlina, W. (2009). Assessing the integration of audience response system technology in teaching of anatomical sciences. Anat Sci Ed, 2,160-66.

[6] Watmough, S.D.,O'Sullivan,H.&Taylor,D.C.M. (2010).Graduates from a reformed undergrad medical curriculum based on Tomorrow’s Doctors evaluate the effectiveness of their curriculum 6yrs after graduation. BMC Med Edu,10,65.

Affordances of an innovative ecosystem of multiple tabletops and Anatomy resources for supporting collaborative practical learning

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Abstract: This article explores the components of an innovative ecosystems consisting of networked multiple tabletops, Anatomy and other medical resources within a practical lab environment. The affordances of multi-touch tabletops as well as those of the other components of this novel ecosystem is discussed in terms of supporting collaborative and active learning in large cohorts with few facilitators. An analysis of their key design features and capabilities is also discussed. The potential impact of this ecosystem onto various types of learning are identified which strongly support their integration in learning space to support practical learning as well as 21st century skills for our next generation students.

Keywords: Collaborative learning, Multi touch Tabletop, Affordances, Active learning, innovative ecosystem, Anatomy practical learning

Introduction

Tabletop computers or multi-touch interactive displays, commonly referred to as tabletops, are increasingly being used in a broad spectrum of learning environments to engage groups of learners as well as support various interactions through digital technology (Lucia et al, 2009). Literature on tabletop affordances usually relates to those that support learning within the confines of the tabletop itself. This may not be sufficient to simultaneously engage multiple groups of students in a large cohort. To meet this challenge, an innovative ecosystem of tabletops has been designed for our Anatomy practical learning and comprises of networked student tabletops, teacher tabletop, Anatomy models/specimens, student groups and facilitators - all integrated within a practical lab space.

1. Active learning and Collaborative Learning

Collaborative learning enables solving problem/tasks with active contribution from all members. Tabletops, through its multi-touch capabilities, offer unique ways to engage students to share, manipulate and annotate digital contents/media while discussing, understanding or peer learning/teaching a concept. During active learning, a term encompassing collaborative learning, students are engaged in building and understanding facts, concepts, and skills through the completion of tasks and activities. However in medical education, this is often limited to adoption of interactive techniques and case based learning (Graffam, 2007).

2. Learning Design Of Ecosystem Of Tabletop and Anatomy Resources

In our School of Medicine, for active learning of human Anatomy and its related clinical applications, we have designed an innovative ecosystem of tabletops, digital anatomy resources, gross anatomy and histopathology resources integrated through a classroom technology. The components of the ecosystem are: (A) Student tabletops with preinstalled computer assisted anatomy software and a novel collaborative software (designed and produced by our industry partner Smart Surface Sdn Bhd) for groups of 8-10 students (B) a "demonstration console" with video camera, document camera, microphones, a teacher tabletop, examination couch etc. for practical skills demonstration (C) Multiple data projection screens to broadcast streams from the "demonstration console" (D) Anatomy resources - plastinated (dry) human cadavers, Anatomy models, skeletons and (E) Clickers.

The uniqueness of this ecosystem is the integration of digital media and collaborative technologies (through tabletops) with physical discipline based resources (models/specimens).This brings about a seamless transition from hands-on experience to collaborative learning to student research, juxtaposed with feedback, demonstration and guidance from the facilitators.

A seamless communication between the networked student tabletops and the teacher tabletop is achieved through the above mentioned collaborative software as an application over the tabletop operating system. It encompasses multi-user desktop interface with customized keyboards for note taking, annotations (on images), web browsers and content streaming etc. The teacher's tabletop has controlling/monitoring interface for contents streamed from it as well as a messaging system for receiving and responding to students' queries in real time.

Thus, within the same lab, guided by practical tasks, hands-on exploration of a physical Anatomy model such as a knee joint is seamlessly extended to identification of its parts through a labeled digital image followed by critical discussion of its functions by viewing an animation of knee movement via the tabletop. Students next simultaneously explore a plastinated knee specimen and a Magnetic Resonance Imaging (MRI) scan to collaboratively understand how anatomical knowledge relates to radiological imaging thus seamlessly moving between visual, auditory and kinaesthetic learning modalities. During this process they can message any queries to the teacher tabletop and obtain feedback. Such an innovative ecosystem thus has a varied and rich source of educational affordances.

3. Affordances

Affordances originally referred to "*just those action possibilities that are readily perceivable by an actor (user)*" (Norman, 1999). However, according to Gaver (1996), affordances exist whether or not the actor perceives them. Technological affordances are the quality of technology, such as communication, collaboration, multimodality etc., which allows learners to learn (Conole & Dyke, 2004). Combining verbal, non verbal, academic, social and digital interactions, tabletops create an environment for engaging in collaborative knowledge building.

3.1Affordances of ecosystem of multiple tabletops within a Anatomy resource centre

Our new ecosystem not only supports active learning but also lead a classroom orchestration of interactivity and networking of multiple student groups along with the

facilitators. Here we discuss the intrinsic affordances rather than the perceived ones. Anatomy learning is dependent on 3D conceptualization of the human body for which tabletops can acts as cognitive tools allowing several students to simultaneously explore and manipulate digital Anatomical image/objects as well as perform independent student web search. Its situation within an Anatomy resource centre, such as ours, extends its affordances to simultaneous multimodal interaction amongst students, facilitators, Anatomy models as well as digital content. It thus allows for multimodal representation of content, instructional procedures, ways of student-centered discovery and multiple ways of student interactions. It appeals to visual, kinesthetic and auditory senses for an all-round student experience while producing more effective gains in higher-order learning. Varied forms of visualizations of the world's most complicated structure – the human body, make Anatomy learning attractive, motivating and comprehensible for aiding deep learning.
This ecosystem is in tune with the constructivism paradigm that allows engagement in an activity that utilizes the content and skill that the students are learning.

The social affordances (creating a social space amongst group members) of our ecosystem includes both face to face interactions as well as social media accessible via the tabletops. Different media *forms* have different affordances (Laurillard, 2002). Our ecosystem includes all varieties of media forms to provide a rich and varied learning experience: *Narrative media* e.g. image/description of an Anatomical structure; *Interactive media* e.g. computer assisted anatomy modules; *Communicative media* that facilitate exchanges between teacher and student tabletops; *Adaptive media* e.g. for annotating pictures and *Productive media* e.g. production of schematic diagrams or a power point slides for sharing.

4. Conclusions and Implications

Our new ecosystem supports various types of learning (Naismith et al, 2004). It encourages *behaviorist learning* through real-life clinical scenarios streamed from the teacher tabletop, *constructivist learning* while clinical anatomy videos are presented for critical analyses, *situated learning* where student peer teaches clinical skills using the demonstration console (authentic context), *collaborative learning* whereby students manipulate the digital contents and *lifelong learning* where they learn web based search. This ecosystem has promise in promoting active practical learning as well as developing 21st century skills of handling information, problem solving, collaboration etc. (OECD, 2010).

Acknowledgements

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References

[1] Conole, G. & Dyke, M. (2004). Understanding and using technological affordances: a response to Boyle and Cook. ALT-J, Research in Learning Technology, 12(3), 301-308.
[2] Gaver, W. W. (1996). Affordances for interaction:The social is material for design. Ecological Psych, 8(2), 111–129.

[3] Graffam, B.(2007).Active learning in medical education: Strategies for beginning implementation. Medical Teacher, 29(1), 38-42.
[4] Laurillard, D. (2002). Rethinking university teaching. London: Routledge.
[5] Lucia T.L., Quigley, A., & Dix, A. (2009). A taxonomy for and analysis of multi-person-display ecosystems. Pers Ubiquit Comput,13,583–598.
[6] Naismith, L., Lonsdale P.,Vavoula G., & Sharples M. (2004). Mobile Technologies and Learning. Futurelab report.
[7] Norman, D.A. (1999). Affordances, Conventions and Design. Interactions, 6(3),38-43, ACM Press.
[8] OECD. (2010). The Nature of Learning: using research to inspire learning, Paris: OECD Publishing.