# ICCE 2014

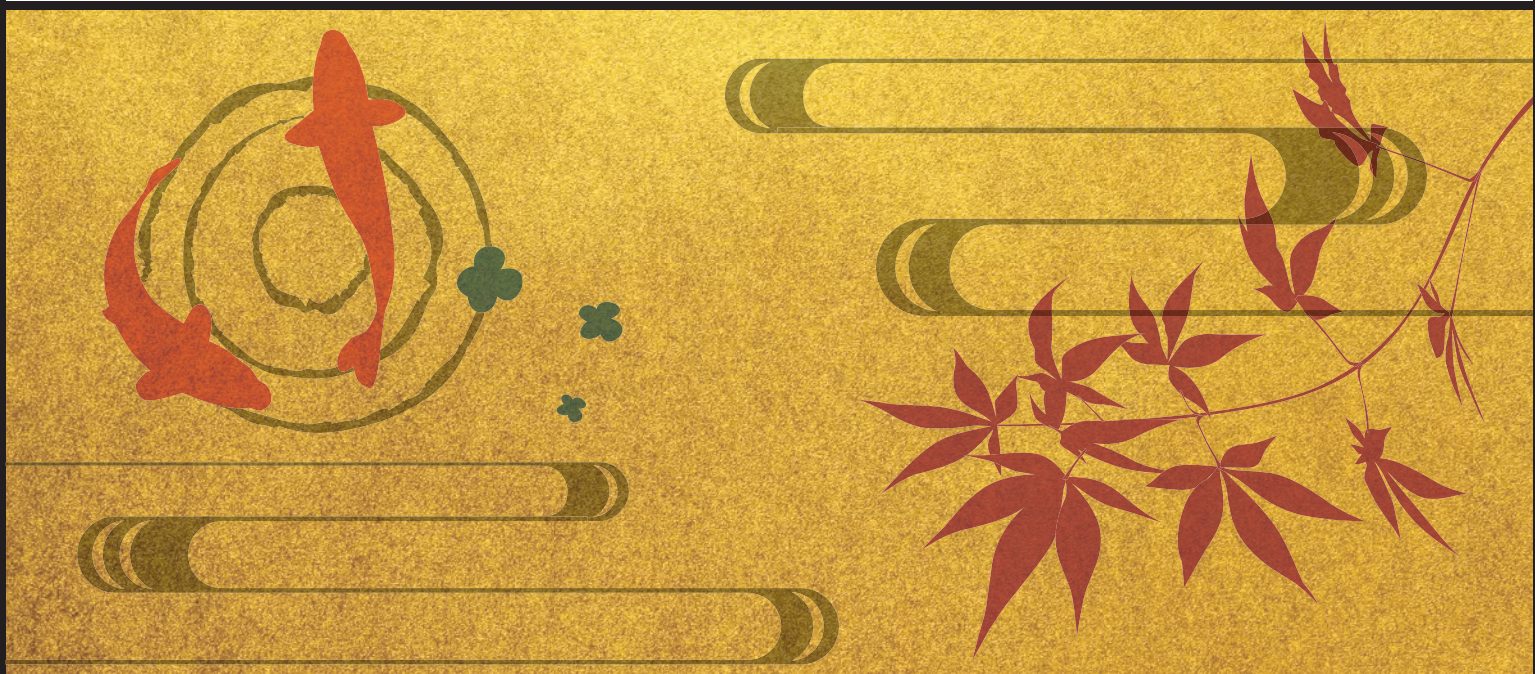## The 22nd
## INTERNATIONAL CONFERENCE ON
## COMPUTERS IN EDUCATION

Work-in-Progress Poster (WIPP) Proceedings

—— Nov 30 - Dec 4, 2014  Nara, Japan ——

# Work-In-Progress Poster Proceedings of the 22th International Conference on Computers in Education ICCE 2014

November 30, 2014 - December 4, 2014
Nara, Japan

**Editors**

Ahmad Fauzi MOHD AYUB
Tatsunori MATSUI
Chen-Chung LIU
Hiroaki OGATA
Siu Cheung KONG
Akihiro KASHIHARA

# PREFACE

The Work-In-Progress Poster (WIPP) session was held in conjunction with the conference: 22st International Conference on Computers in Education (ICCE 2014) which took place during November 30 and December 4, 2014, in Nara, Japan. 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 2014 comprised 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 Practice-driven Research, Teacher Professional Development and Policy of ICT in Education (PTP)

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 24 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 2014 local organizers for their effort in organizing the session and to make this happen.

Poster Coordination Co-Chairs, ICCE 2014

Ahmad Fauzi MOHD AYUB
Tatsunori MATSUI
Chen-Chung LIU
Hiroaki OGATA
Siu Cheung KONG
Akihiro KASHIHARA

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**Practice-driven Research, Teacher Professional Development and Policy of ICT in Education (PTP)**

# Reviewing System  of Writing for Hospital Nurses

**Hideyuki KANO [a*], Hirotaka NISHIYAMA[b*] , Koji TANAKA[c*], Liang CUI[c*] , Noriyuki MATSUDA[d*], Hirokazu MIURA[d*], Mitsuru IKEDA[b*], Hirokazu TAKI[d*]**

[a] *Graduate School of Systems Engineering, Wakayama University, Japan*
[b] *School of Knowledge Science, Japan Advanced Institute of Science and Technology, Japan*
[c] *Research Center for Service Science, Japan Advance Institute of Science and Technology, Japan*
[d] *Faculty of Systems Engineering, Wakayama University, Japan*
*s141018@center.wakayama-u.ac.jp

**Abstract:** This paper describes a system to aid in reviewing writing by nurses. Since 2010, we have held workshops for hospital nurses to help reduce the problem of burnout among the occupation. In workshops, novice nurses write about their specific experiences in their work. A tutor reviews their writing, and provides advice to help nurses think about their jobs differently despite their individual difficulties. To design our system, we investigated words from tutors' reviews and have constructed a reviewing ontology. Our system provides young tutors comments based on the words they use in reviewing. We expect this system can help provide a scaffold for tutors to review writings.

**Keywords:** writing review, nursing education, ontology, burnout syndrome

## 1. Introduction

In hospital nursing, "Burnout Syndrome" is a problem where nurses' deepening worries about the results of their work lead to high levels of turnover. Burnout occurs, many believe, because it is difficult to find a clear solution to workplace problems; nurses who care for a variety of patients and medical conditions respond to atypical problems day–to–day.

Thereby in cooperation with nursing organizations, the authors have conducted trainings in which participants write on personal difficulties and are provided a way of thinking through problems, along with a logical structure for training and guidance, to better train their thinking. In this training, the learner describes the history of their own thinking, using tools from Sizhi to represent the logical structure of their thinking(Chen, W, 2011). Detailed descriptions of "Sizhi" appear in this paper's references. This paper is intended only to provide guidance on this method.

In this paper, we consider the language used in the leadership of this training. Previous analyses of training have revealed that instruction has been ineffective for leaders less capable of expressing their thoughts in words. Problems in nursing are atypical and are difficult problems through which to guide nurses.

Thereby authors collected and codified the thinking of leaders, and designed and developed a tool to reuse this thinking to provide the correct guidance to leaders. Therefore, leaders can reuse advice that they have verbalized in the past. This technique is expected to promote better guidance and provide a systemized approach to improving guidance for trainees(Wilfeth, J, 2014).

## 2. Collection and systematization of vocabulary
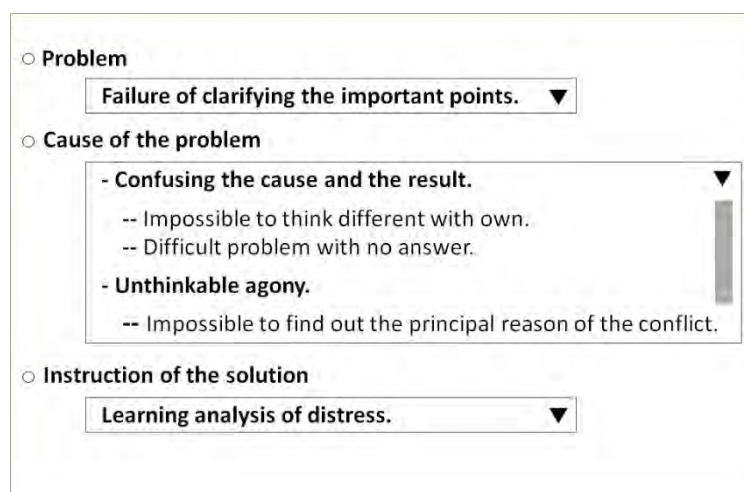
This chapter describes the collection and systematization of vocabulary that represents the thinking of skilled nurses. Collecting and accumulating thinking is implicitly a difficult activity. Thus, one of the authors ask skilled nurses who can verbalize their own thinking to express their intentions when the authors are teaching. We classified and systemized this thinking as an ontology based on the contents and stage of their guidance(Leki I, 1990).

As a result, teaching methods have focused on one method, identifying only two problems of the text to reduce the burden on leaders. Guidance on these consists of the following four items. Parentheses show the frequency of vocabulary items for each item.

1)**Problem (8)** : Describing a problem in the sentence (e.g. "Logical structure is not clear")
2)**Cause(s) of the problem (13)** : Description of the problem, whether derived from point of view or concept (e.g. "Too obsessed with bad results")
3)**Instruction on the solution (7)** : A teaching concept that either solves the problem or leads the thinking of the participant toward a better direction (e.g. "Avoid thinking about results")
4)**Suggestion(s) about the effectiveness of the solution (6)** : Describing the effect(s) that occur when the advice is put into practice, encouraging ambitious efforts from nurses (e.g. "Deepening understanding of current issues")

## 3. Reviewing tool

This chapter describes the reviewing tool used to guide leaders to help correct the codified vocabulary.



Figure 1.Screen of the reviewing tool.

Figure 1 shows a corrections screen using the tool. Questions embedded on the screen ask about how the contents suits the leader's teaching strategies. Past instructional content is referred to as a response for each item, found in the pull-down menu. Leaders can correct guidance by selecting suitable content for the current study among the responses listed.

Upon completion of the corrections, the review consists of correction sentences and output. Additionally, it is possible to enter text on one's own, instead of selecting from corrections of past statements. Therefore, if leaders cannot find appropriate comments, they can add an element to the tool.

## 4. Preliminary experiments

The author did preliminary experiments in order to ensure that the proposed system helps the corrector place their own thoughts into works. This chapter describes the experiment and its evaluation.

### 4.1 Experiment content

First, the author asked five experienced leaders to conduct correction guidance on one case, using Microsoft Word as a general editor. Next, they were asked to conduct the same correction guidance for the same case using the reviewing tool. We evaluated the tool by comparing the results of each of these sessions.

## 4.2 Experiment content

Each of the four types of evaluation content described above were evaluated using the system below:
- Type of guidance was not observed: 0 points.
- Some description of the type was provided, but little illustrative explanation was provided or description was insufficient: 1 point.
- The type is described without missing any essential features: 2 points.

When using Microsoft Word, subject A received 11 points, subject B received 12 points, subject C received 12 points, subject D received 9 points, and subject E received7 points.

Figure 3 graphs how scores differed between Microsoft Word and the reviewing tool, using the notepad provided by each subject.
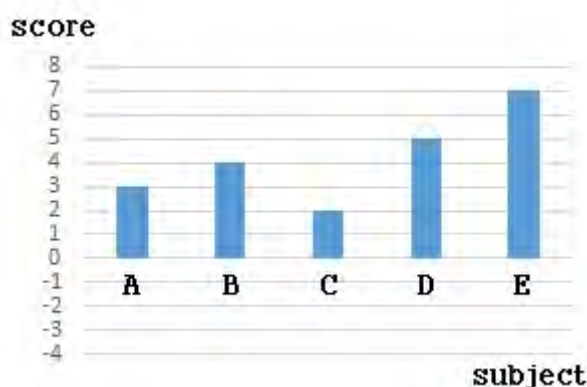


Figure 2. Difference in Scores between Reviewing Tool and MS Word

## 5. Conclusions

In this study, the authors proposed a system that can reuse skilled leader's thinking in the editing of writing designed to solve work¬–related stresses for nurses. The study confirms that the system is able to assist in the act of putting thinking into words of new leaders through a preliminary experiment. This system is scheduled to be introduced and evaluated in the context of actual guidance provided in the hospital.

## References

Chen, W., Fujii, M., Cui, L., Ikeda, M., Seta, K., & Matsuda, N. : Sizhi: Self-Dialogue Training through Reflective Case-Writing for Medical Service Education. In A. F. Mohd Ayub, B. Chang, K. Leelawong, F.-Y. Yu, T. Hirashima, & G. Biswas (Eds.), (pp. 551–558). Presented at the Workshop Proceedings of the 19th International Conference on Computers in Education, 2011.

Wilfeth, J. (2014).Training in Multimodal Technologies Requires Training in Assistive Technologies: The Current Moment in Composition: Professional Development for Multimodal Instruction.

Leki I. (1990). Coaching from the margins: issues in written response, Second Language Writing: Research Insights for the Classroom, Cambridge University Press.

# Scaffolding Topic Decomposition in Investigative Learning with Web Resources

**Keita KINOSHITA[a*], Akihiro KASHIHARA[a]**
[a] Graduate School of Informatics and Engineering,
The University of Electro-Communications, Tokyo, Japan
*keitakinoshita@uec.ac.jp

**Abstract:** Investigative learning with Web resources requires learners to find out related topics to be further investigated and decompose the topic into the related topics as sub-topics while navigating Web resources/pages to construct knowledge for learning the topic. However, finding out the related topics from Web resources/pages is not so easy for them. The purpose of this work is how to enhance an awareness of related topics during investigative learning process. This paper proposes a scaffolding method, which could promote finding out related topics from Web resources and activate the topic decomposition.

**Keywords:** attributes, investigative learning, iPad, learning scenario, scaffolding, Web

## 1. Introduction

In recent years, Web resources available for learning have increased, which also bring a lot of opportunities for learners to investigate any topic to learn. Such investigative learning allows learners to construct a wider, deeper, and timely knowledge from a great variety of Web resources.

On the other hand, Web resources do not always provide a learning scenario, which indicates the topics and their sequence to be learned. Therefore, the learners need to build the learning scenario by themselves. However, it is not so easy for them to build their learning scenario. Since they tend to pay more attention to Web resources/pages navigation and knowledge construction for learning the topic (Hill, and Hannafin, 1997), they often miss finding out related topics to be further investigated, which results in an insufficient investigation.

In order to resolve it, we have proposed the model of Web-based investigative learning (Kashihara, and Akiyama, 2013). This model requires learners to build the learning scenario by decomposing the topic into the related topics as sub-topics to be further investigated while learning Web resources. The learning scenario is represented as a tree of topics investigated (called topic tree), which is composed of partitive (part-whole) relations between the topic and sub-topics. We have been also developing a system in which learners could construct knowledge about a topic and build a learning scenario seamlessly based on the model of Web-based investigative learning. The results of the case study we have conducted suggest that this system allows the learners to build their learning scenario more structured, which also allows them to promote their reflection on constructed knowledge after investigative learning process (Kashihara, and Akiyama, 2013).

On the other hand, the learners are not always able to find out related topics from Web resources/pages. This indicates the necessity of scaffolds for finding out related topics during investigative learning process.

The main issue addressed in this paper is how to enhance an awareness of related-topics during investigative learning process to promote the topic decomposition. In order to address this issue, this paper proposes a scaffolding method for allowing learners to find out related topics by means of attributes representing the semantic relations between the topic and related topics. This paper also demonstrates an interactive learning scenario builder (iLSB for short) including the scaffolding method, which is implemented on iPad.

## 2. Scaffolding in iLSB

### 2.1 A Model of Web-Based Investigative Learning

In order to represent the process of building a learning scenario while learning Web resources, we have proposed a model of Web-based investigative learning (Kashihara, and Akiyama, 2013). This model includes three phases, which are phase of search for Web resources, navigational learning phase, and learning scenario building phase.

In the phase of search for Web resources, learners who undertake a task of investigating learning about a topic are expected to use a search engine such as Google with a keyword (called topic keyword) representing the topic to gather the Web resources suitable for learning the topic. They are then expected to navigate across these resources.

In the navigational learning phase, they are also expected to navigate the Web pages in the resources gathered to learn the contents and construct knowledge about the topic. Such knowledge construction with navigation is called navigational learning. In the navigational learning process, they could find out related topics to be further investigated, which can be viewed as sub-topics of the topic.

In the learning scenario building phase, the learners are expected to build a learning scenario by decomposing the topic into sub-topics, each of which could be further investigated and learned in the phases of search for Web resources and navigational learning.

These three phases are repeated until the topic decomposition does not occur anymore. The results of the case study suggest that model of Web-based investigative learning makes investigative learning more structured, and that it allows learners to promote reflection on knowledge constructed (Kashihara, and Akiyama, 2013).

### 2.2 Attributes as Scaffold

The attributes presented as scaffold represent the semantic relations between a topic and its sub-topics. When a learner investigates a topic *global warming* and learns the related topic *greenhouse gas*, for example, *greenhouse gas* is a main cause for global warming. In this case, *cause* indicates an attribute representing the semantic relation between *global warming* and *greenhouse gas*. We have enumerated such attributes from Japanese thesaurus, which are related to investigative learning.

The attributes to be presented in investigative learning process are expected to enhance an awareness of related topics to be extracted from Web resources and to promote topic decomposition. Let us here consider an example where a learner investigates a topic about *global warming*. *Global warming* can be classified into the topic type *phenomenon*. There are several attributes to be presented for this type such as *cause*, *background*, *principle*, *effect*, *countermeasure*, and so on. Such attributes could bring about the following effects. If he/she has not learned about the cause of *global warming* such as *greenhouse gas* during investigative learning process, the presented attribute *cause* could first allows him/her to be aware of the related topics (*greenhouse gas, CO2* for example) from Web resources/pages and to promote the navigational learning process. When he/she finds out related topics in navigational learning process, the presented attribute could second allow him/her to grasp the semantic relations between the topic and the related topics to make sure the correctness of the contents to be learned. When he/she has learned the cause of *global warming* such as *greenhouse gas* and builds the learning scenario, the presented attribute *cause* could finally allow him/her to be aware of sub-topic *greenhouse gas* to be decomposed from the topic *global warming* and to promote the topic decomposition.

### 2.3 iLSB: interactive Learning Scenario Builder

In order to scaffold the investigative learning process as modeled with the attributes, we have implemented iLSB including the scaffolding method on iPad. Figure 1 shows the user interface of iLSB. This system first requires the learners to input an initial topic as topic keyword and select the appropriate topic type. This system next allows the learners to use the search engine with the topic keyword to find out and navigate across Web resources fruitful for learning the topic. In navigational learning with these resources, they are allowed to browse the Web pages and extract keywords, which represent the contents

to be learned about the topic. If they could not become aware of related topics from the contents to be learned, they are allowed to use the attribute list to see the attributes, which induces them to become aware of the sub-topics. The keyword repository allows them to put the extracted keyword and to make inclusive relations among them, which represent knowledge constructed. In the keyword repository, the learners could become aware of sub-topics to be further investigated. In the learning scenario building, they are allowed to drag the keywords representing the sub-topics to drop them on the topic tree map. The next task for the learners is to investigate these sub-topics. Tapping a topic keyword in the topic tree and select appropriate topic type, they could set it up as the current topic investigated. The keyword repository to be provided is changed into the current topic keyword synchronously, which displays the keywords extracted in learning the current topic. The attributes to be presented in the attribute list are also changed into the current keyword's topic type synchronously.
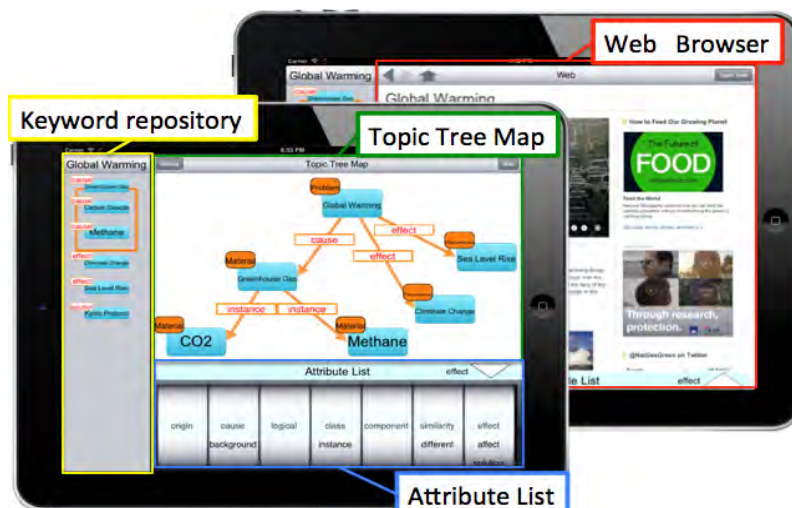


Figure 1. iLSB: interactive Learning Scenario Builder

## 3. Conclusion

This paper has proposed a scaffolding method, which presents attributes representing the semantic relations between the topic and sub-topics, for finding out related topics during investigative learning process and topic decomposition, and has demonstrated iLSB with the scaffolding method. In future, we will conduct more detailed evaluation with iLSB to refine the scaffolding method.

**References**
Hill, J.R., and Hannafin, M.J. (1997). Cognitive Strategies and Learning from the World Wide Web. Educational Technology Research and Development. b45(4), 37-64.
Kashihara, A., & Akiyama, N. (2013). Learner-Created Scenario for Investigative Learning with Web Resources: Proc. Of the 16th International Conference on Artificial Intelligence in Education (AIED2013), Memphis, USA 2013

# Visualization of Upgrading Presentation Documents with Presentation Schema

**Yusuke Uenaka[a], Akihiro Kashihara[b]**

[a,b]*Graduate School of Informatics and Engineering, The University of Electro-Communications*
[a]uenaka@uec.ac.jp, [b]akihiro_kashihara@inf.uec.ac.jp

**Abstract:** Creating presentation documents (P-documents) is an important activity in research, which involves composing semantic structure representing what to present and how to sequence the contents presented. However, novice researchers have fewer opportunities to get and accumulate experiences in composing semantic structure, which is essential in developing presentation skill. On the other hand, novice researchers usually upgrade their P-documents by referring to reviews to be obtained from the expert/intermediate researchers in the same research group to complete. This paper proposes a method for visualizing the upgrade process that identifies and represents the difference between each version of the upgraded P-document and the completed P-document.

**Keywords:** Presentation, upgrade, presentation document, semantic structure, presentation schema

## 1. Introduction

Following cognitive apprenticeship (Collins, 2006), we have developed a learning environment where novice researchers are allowed to create presentation documents (P-documents) with presentation schema (P-schema) that is a typical semantic structure in the P-documents accumulated in the same research group (Shibata, Kashihara, and Hasegawa, 2012). P-documents generally include semantic structure representing what to present and how to sequence the contents presented. Composing such semantic structure is essential in developing P-document skill.

However, novice researchers have fewer opportunities to compose semantic structure for creating P-documents. The main issue addressed in the learning environment is to help them accumulate experiences in the semantic structure composition to improve their presentation skill. In addition, we have made sure P-schema functions effectively in composing P-documents and their semantic structure (Shibata, Kashihara, and Hasegawa, 2012).

On the other hand, novice researchers usually upgrade their P-documents by referring to reviews to be obtained from the expert/intermediate researchers in the same research group to complete. In our learning environment, a novice researcher could upgrade his/her P-document with P-schema. In order to analyze the upgrade process from the initial version to the complete version of presentation document, this paper proposes a method for visualizing it, which identifies and represents the difference between each version of the upgraded P-document and the completed P-document. Such visualization could indicate the influence of P-schema on the upgrading process, and also allow the learner to reflect on his/her upgrading process.

## 2. Upgrade Process of Presentation Document

### 2.1 Difference Between Each Version and Completed P-Document

In the upgrade process of P-document based on P-schema, the novice researcher can use P-schema as a scaffold for composing the semantic structure to modify not only the semantic structure but also the contents of the slides. Figure 1 shows P-schema that is extracted from our research group (Shibata,

Kashihara, and Hasegawa, 2012). The modification is divided into the following operations: addition, deletion, change, and shift. Using such operations conducted from each version of the upgraded P-document to the completed P-document, we define the difference between the two P-documents. In other words, the difference is identified by means of how many modification operations are conducted between the two P-documents. There are two aspects on the difference between the P-documents, which are semantic structure and slide contents. The differences of the semantic structure and slide contents are identified from the two P-documents.

Figure 2 shows an example of the differences between each version of the upgraded P-document and the completed P-document (ver. 5). As for the semantic structure, Figure 2 suggests that the versions after ver. 3 have the same structure as the completed P-document. It also suggests that the slide contents of each version are gradually modified to the completed P-document.
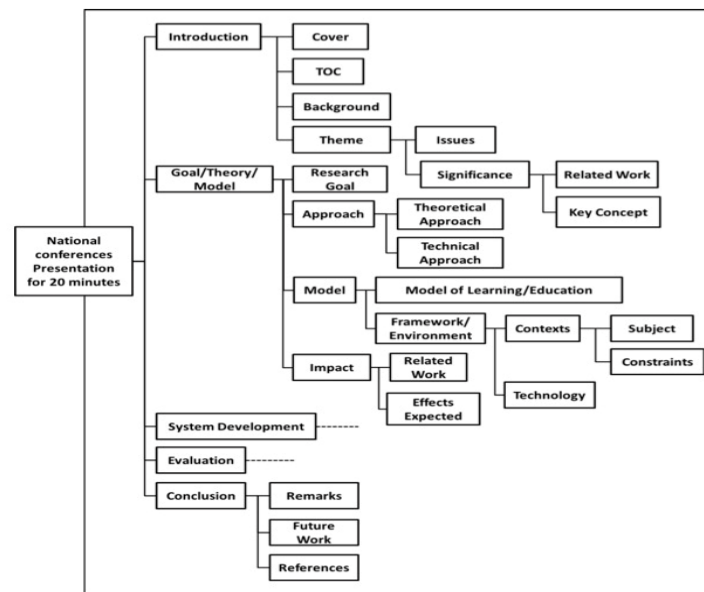


Figure 1.An Overview of P-schema.
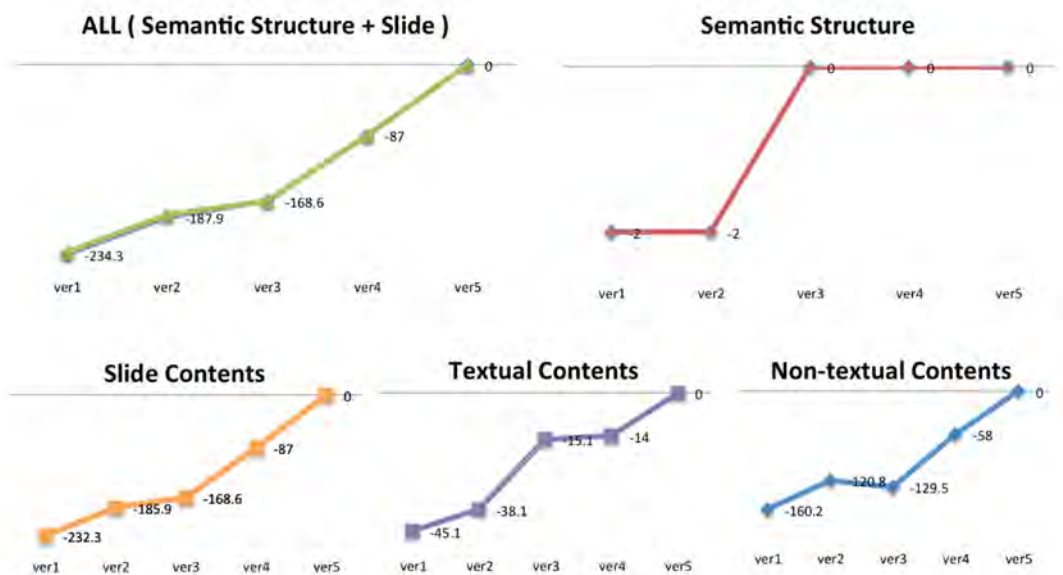


Figure 2. Visualization of P-Document Upgrade Process.

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## 2.2 Modification of Semantic Structure

The modification to the semantic structure tends to increase in the initial stages of the upgrade process, and also tends to decrease in the final stages. This indicates that P-schema allows the learner to pay more attention to composing the proper semantic structure in the initial stages of the upgrade process. Such proper semantic structure seems to play an important role in creating P-documents.

## 2.3 Modification of Slide Contents

As shown in Figure 2, the modification to the slide contents including textual and non-textual contents tends to be conducted in the whole process of upgrading the P-document. It particularly tends to increase in the final stages of the upgrade process. This indicates that the modification to the slide contents tends to be promoted after the semantic structure is properly composed. In this way, P-schema could allow the learner to compose not only the semantic structure but also the slide contents of P-documents.

## 3. Conclusion

This paper has proposed a method for visualizing the process of upgrading P-document with P-schema to analyze it. This method identifies the difference between each version of the upgraded P-document and the completed P-document. This paper also demonstrates that such visualization is expected to indicate the influence of P-schema on the upgrading process. We also expect it to allow the learner to reflect on his/her upgrading process.

In future, we will analyze the process of upgrading P-documents with the proposed method, and evaluate the effectiveness of the visualization.

## Acknowledgements

## References

A. Collins: Cognitive apprenticeships: The Cambridge Handbook of the Learning Sciences, R. Keith Sawyer (Ed.), Cambridge University Press, pp.47-60 (2006)

Y. Shibata, A. Kashihara, S. Hasegawa: "Schema-based Scaffolding for Creating Presentation Documents", Proc. Of ICCE2012, Singapore, pp.324-326 (2012)

# "A new Wiki way?" - An Experimental Study of Collaborative Knowledge Building Scripts

**Sven HEIMBUCH[a*], Kerstin UHDE & Daniel BODEMER[a]**
[a]*Media-Based Knowledge Construction, University of Duisburg-Essen, Germany*
*sven.heimbuch@uni-due.de

**Abstract:** One of Wikipedia's main guiding principles reads as follows: *Be Bold.* From Wikipedia's early days on users were encouraged to share their knowledge at any convenient time without major restrictions by either adding new content or editing the encyclopedia's existing content in the sense of knowledge building in collaborative writing systems. In order to ensure that authors and editors of articles successfully collaborate on shared knowledge artifacts, rules and guidelines have been implemented into the community closely related to the *Be Bold* principle. One of these guidelines is the so-called *Bold, Revert, Discuss (BRD) Cycle* that describes a workflow corresponding to a collaboration script on how individuals in an environment like Wikipedia should interact with each other to jointly create and manage articles. This cycle was primarily implemented to attract masses of new authors and editors to the community by lowering the bar for participation. From today's point of view it is debatable if this procedure should be further promoted or if alternative methods as the in this study proposed script *Talk, Consensus, Revise (TCR)* prove themselves as more effective for knowledge building with a special focus on socio-cognitive conflicts in Wikis. We expect that students collaboratively working together using the *TCR* alternative script will produce qualitatively higher articles and will perform better in a knowledge test about the study's topic.

**Keywords:** Wiki, knowledge building, collaboration scripts, collaborative learning

## 1. Introduction and Research Questions

Collaborative writing systems such as Wikipedia provide an open environment for collaborative learning by facilitating knowledge building processes in individuals and in the Wiki itself as social system. Scardamalia and Bereiter (1994) have defined knowledge building as the creation of knowledge as a social product. In recent years research has been conducted on how learning processes and knowledge building can be supported by measures of computer-supported collaboration. In this specific area of knowledge building in Wikis significant research was inspired by Piaget's constructivist school of thought (Cress & Kimmerle, 2008). According to the resulting Co-Evolution Model, analogous processes of internalisation and externalisation can be found in an individual's cognitive system as well as on a Wiki's system level. By mutually influencing each other's system, at every level manifold possibilities for socio-cognitive conflicts can arise if either one cognitive system's knowledge base dissents the social system or vice versa.

In collaborative learning scenarios making use of socio-cognitive conflicts plays an important role. Bell, Grossen & Perret-Clermont (1985) examined such conflicts that emerged if an individual is confronted with a different perspective contradictory to its own cognitive representation. Such conflicts lead to reorganisation and reconstruction of cognitive processes and furthermore to a success in learning, if the achievement of a consensus is required or desired. Similar aims have been followed by research on *Constructive Controversy* (Johnson, Johnson & Smith, 2000), a script that structures decision making and learning processes. Learners benefit from conflicts that have been systematically used and developed with opposing positions in mind. As a result, higher-quality argumentation, more complex formulation of concepts and more critical examinations of discussed topics can emerge.

Furthermore, in the area of computer-supported collaborative learning a number of different collaboration scripts for have been analysed and compared with each other (Dillenbourg, 2002). As a result, the meaning of social interaction was emphasized as a core element for collaborative learning: „From the designer's viewpoint, a script remains within the 'collaborative learning' philosophy if the script design rationale calls upon social interaction as core learning mechanism, not simply as an add-on to individual activities." (p. 28). In order to further examine collaboration scripts especially in Wiki-based environments, Wichmann and Rummel (2013) were interested in the effectiveness of a specific script that aimed at improving students' revision behaviour by prompting them to distribute their prior knowledge. The control group that worked on the article without any script wrote shorter articles, revised the articles less frequent and produced less coherent articles compared to the scripting condition. In addition to that, a positive correlation between the number of revisions and the coherency of the article has been observed. According to Papadopoulus, Demetriadis and Weinberger (2013) who examined the degrees of freedom script should provide, the level of coercion has an impact on the learning success. Higher coercion in scripted collaboration led to better learning outcomes, achieved by being encouraged to deeper elaborate the learning materials and by lowering extraneous cognitive load.

On the basis of the previously discussed research, in the following study we are mainly interested in the research question, if learners in collaborative writing scenarios benefit from a collaboration script that is primarily focussed on discussing the implementation of knowledge artefacts before an edit is conducted. This proposed *Talk, Consensus, Revise (TCR)* script will be contrasted against the *Bold, Revert, Discuss (BRD) Cycle* that was originally proposed by Wikipedia with a focus on encouraging editors and authors to quickly implement or edit knowledge artefacts. Further questions of interest are, if complying with our proposed alternative script will lead to higher quality articles and to what degree will knowledge building processes be influenced by individual differences in the cognitive variable *Need for Cognitive Closure* (Kruglanski & Webster, 1996).

## 2. Methods

In order to answer the interested research questions, an experimental study is currently conducted in a controlled laboratory setting with approximately $N = 60$ students ($N = 30$ dyads) at the end of the study. Two different collaboration scripts will be implemented and compared against each other as the independent variable which will be randomly assigned to each dyad. Figure 1 illustrates the condition's article editors and visual representations of the corresponding collaboration scripts. The *BRD* script corresponds to the original workflow proposed by Wikipedia, whereas the alternative *TCR* script is self-developed inspired by previous research on coordinated work in Wikis where higher level of coercion to discuss before editing was enacted.
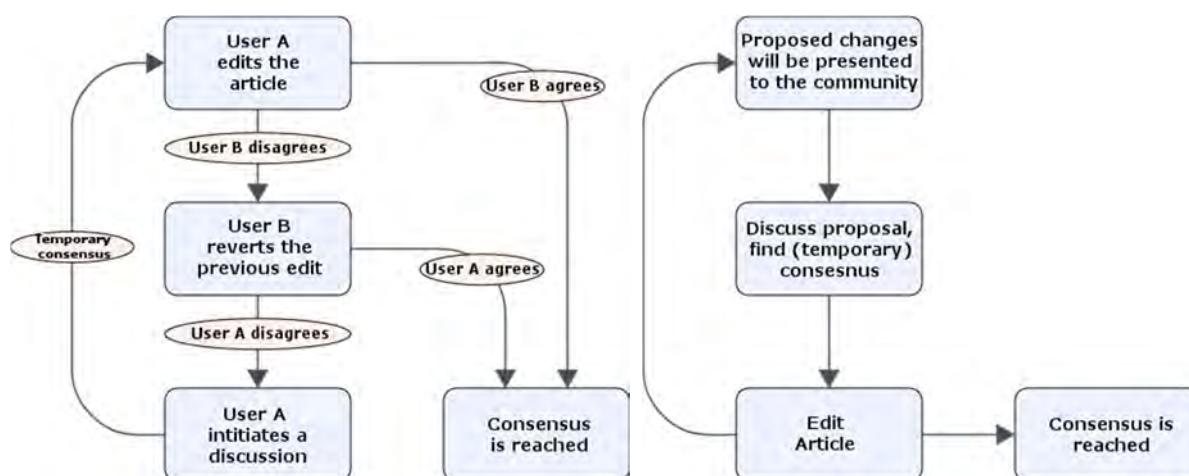


Figure 1. Illustrations of the respective article editors with *BRD* script (left) and *TCR* script (right).

The study's contents are on a pirate captain for whom contradictory information on several aspects of his life exists. At first, both participants in a dyad will have to read the same basic article to establish a common ground. Followed by that, opposing historical facts (learning material A or B) will be presented to either learning partner, in order to facilitate socio-cognitive-conflicts to arise. The common task will be to collaboratively author the basic article by editing existing paragraphs or adding entirely new artefacts to the article. After the collaborative writing task both participants will have to answer a multiple choice test that can only be fully solved if contents of both additional learning materials A and B have been made known to each partner. The complete study procedure is illustrated in Figure 2. The currently conducted study is scheduled to be finished until late September.
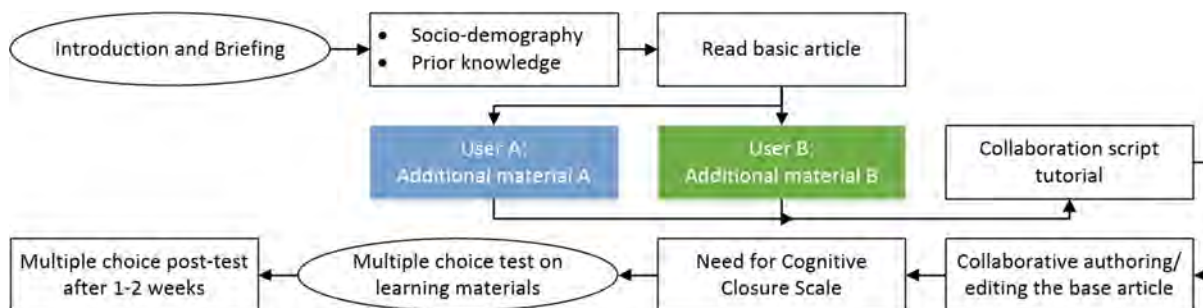


Figure 2. Study procedure for both experimental conditions.

## 3. Outlook

For our planned statistical analyses, the recorded data on *individual learning success* measured by two multiple choice tests at two different dates about the study's content will be processed and evaluated. Furthermore, qualitative content analyses on the final written texts of each dyad in both experimental conditions will be conducted. Finally, the influence of an individual's *Need for Cognitive Closure* on the resulting article and the *performance* in both multiple choice tests will be examined in detail. We expect the proposed alternative script (*TCR*) group to outperform the control (*BRD*) group on the quantitative as well as on the qualitative variables.

## References

Bell, N., Grossen, M., & Perret-Clermont, A.-N. (1985). Sociocognitive conflict and intellectual growth. *New Directions for Child and Adolescent Development*, *1985*(29), 41–54.

Cress, U., & Kimmerle, J. (2008). A systemic and cognitive view on collaborative knowledge building with wikis. *International Journal of Computer-Supported Collaborative Learning*, *3*(2), 105–122.

Dillenbourg, P. (2002). Over-scripting CSCL: The risks of blending collaborative learning with instructional design. In P. A. Kirschner (Ed.), *Three worlds of CSCL. Can we support CSCL?* (pp. 61–91). Heerlen, Open Universiteit Nederland.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (2000). Constructive Controversy: The Educative Power of Intellectual Conflict. *Change: The Magazine of Higher Learning*, *32*(1), 28–37.

Kruglanski, A. W., & Webster, D. M. (1996). Motivated closing of the mind: "Seizing" and "freezing." *Psychological Review*, *103*(2), 263–283.

Papadopoulos, P. m., Demetriadis, S. n., & Weinberger, A. (2013). "Make it explicit!": Improving collaboration through increase of script coercion. *Journal of Computer Assisted Learning*, *29*(4), 383–398.

Scardamalia, M., & Bereiter, C. (1994). Computer Support for Knowledge-Building Communities. *Journal of the Learning Sciences*, *3*(3), 265–283.

Wichmann, A., & Rummel, N. (2013). Improving revision in wiki-based writing: Coordination pays off. *Computers & Education*, *62*, 262–270.

# Supporting Regulatory Processes by Prompting and Visualising Monitoring Judgments

**Lenka SCHNAUBERT[a]\* & Daniel BODEMER[a]**
[a]*Media-Based Knowledge Construction, University of Duisburg-Essen, Germany*
*\*lenka.schnaubert@uni-due.de*

**Abstract:** Computer-based learning environments offer various opportunities to learn self-regulated as well as to support learners in doing so. For instance, they may provide various possibilities for students to purposefully interact with the system and control their learning processes in their own time. Metacognitive theories on self-regulated learning assume that learners need to utilise their own monitoring to control their learning processes. By carefully designing learning environments, we may guide these processes without interfering with self-regulation, but rather by building on individual regulatory skills. In the current study, we investigate the effects of two support components that potentially can facilitate learners' usage of their metacognitive skills: (a) explicitly asking learners to provide subjective validity ratings in order to stimulate metacognitive monitoring (prompting) and (b) feeding back these individual monitoring judgments at strategic points within the learning process in order to foster their usage for effectively controlling the learning process (visualisation). First results indicate that prompting and additionally visualising subjective validity ratings supports students in regulating their learning and resolving uncertainties, but it had no effect on the objective quality of their control decisions or domain specific learning outcome. One possible explanation might be the students' lack of ability to accurately monitor their learning. Continuing analyses are in progress to disentangle the relations between monitoring judgments, control behaviour, performance and monitoring accuracy. Further research should build on this study and use the learners' individual potentials to implicitly guide learning processes, but researchers and practitioners should be aware that a lack of self-regulatory skills might also produce the need for more explicit interventions.

**Keywords:** Metacognition, self-regulated learning, computer-based learning, validity ratings

## 1. Introduction & Research Questions

Successful learning highly depends on the individual skills to make beneficial study decisions. Such control decisions include when to initiate, continue and terminate a learning activity (Nelson & Narens, 1990) and, consequently, influence learning outcome. Metacognitive theories of self-regulated learning assume a cyclic model including a cognitive (object-) level and a metacognitive (meta-) level with the object-level informing the meta-level via monitoring processes (e.g., monitoring performance by judging the validity of one's own answers) and the meta-level influencing the object-level via control activities, e.g., initiating a search for more information (Nelson & Narens, 1990, see also Efklides, 2008). However, learners do not always spontaneously monitor their learning, even if they are capable of doing so (production deficit; Winne, 1996). And even if they do, they still may fail to use this information effectively for controlling the learning process (Dunlosky & Rawson, 2012). Since the individual ability to regulate one's own learning is regarded as central for lifelong learning, support mechanisms need to be developed which build on existing skills without disrupting individual learning procedures. Thus, even though explicit instructions can be effective, guiding learners less directive by assessing and visualising valuable, user-provided information might be a way to scaffold favourable self-regulation strategies. The usage of computers in education allows for such interventions. Not only do they provide the possibility to create learning environments in which learners can navigate self-directed and still have navigational support, they also may assess, store, prepare and visualise valuable information and allow users to dynamically alter inputs as well as access specific information pre-organised by teachers or the system itself in their own time.

In our study we want to test mechanisms to support monitoring and control processes by using the benefits computer-based learning scenarios offer. One way to encourage learners to use their full

potential is to prompt metacognitive processes (Bannert, 2006), e.g., by explicitly asking for monitoring judgments. To additionally support the usage of these judgments for deciding upon reasonable control behaviour, they should be adaptable and made available to the students while they make relevant study decisions. Therefore, our main research question is: Does prompting monitoring judgments and visualising them in a computer-based learning scenario support learning processes and outcomes? As yet, we only focused on a subset of relevant questions: What effect does such support have on the quality and quantity of control decisions? What effect does it have on immediate learning outcomes?

## 2. Research Methods

To answer these questions, we conducted an experimental study with 92 participants (university students, 25% male, 75% female). They were randomly assigned to one of three conditions: The prompting condition (PC) aimed at supporting learners to overcome a production deficit of monitoring by asking for monitoring judgments (i.e., validity ratings), the visualisation condition (VC) additionally aimed at supporting the usage of this information to control the learning process by providing the learners' with these self-set ratings during learning. A control condition (CC) received no such support.

All instructions were given by the computer and – except for two upper time limits – the students worked entirely self-paced. After an introduction to the procedure and the assessment of some basic learner data (e.g., age, sex), the students had up to 20 min to study a text on blood sugar regulation and diabetes mellitus and then answered 20 binary learning tasks (t1). CC just answered the questions, while PC and VC additionally rated the validity of each answer (monitoring judgment) on a binary scale (prompting; cf. figure 1). The learners were then again provided with the learning tasks as well as their answers and had the opportunity to access additional information on each task (control behaviour). CC and PC were provided only with their answers, while VC was additionally provided with their previously assigned validity ratings (visualisation). They all were allowed to navigate freely for up to 15 min between the 20 tasks and additional information and were able to change their answers and – VC only – their validity ratings (t2). Afterwards, they had to answer the learning tasks again from scratch and all rated the validity of their answers (t3). At the end they conducted a multiple-choice post-test.

Up until now, our analyses focused on easily accessible process data, i.e., the number of information requests, and of correct or certain answers to the learning tasks. Additionally, we were interested in the quality of control decisions. While it is favourable to request mainly information on incorrectly solved items (objective quality), from a subject-centred perspective, low subjective validity should also trigger information requests (subjective quality).



Figure 1. Learning tasks with (left) and without (right) validity ratings.

## 3. Results and Discussion

To measure the objective quality of control decisions for each student, we computed within-subject phi-coefficients between the requests for specific information (requested vs. not requested) and the objective validity of the corresponding answer (correct vs. incorrect). To estimate subjective quality, we computed phi-coefficients between information requests and the respective subjective validity ratings (sure vs. unsure) for students providing such ratings (PC & VC). A one-way ANOVA revealed that the conditions did not affect objective quality ($F(2, 86) = 0.86$, $p = .427$), but a two-sample t-Test showed that visualisation ($M_{VC} = .69$, $SD_{VC} = .05$) in addition to mere prompting ($M_{PC} = .14$, $SD_{PC} = .05$) affected subjective quality ($t(56) = 7.87$, $p < .001$).

Quantity of control behaviour was operationalised by the number of items (0-20) to which additional information was requested. A Welch-test confirmed an overall effect for the conditions

($F$(2, 56.70) = 3.49, $p$ = .037), with PC requesting most information ($M_{PC}$ = 11.23, $SD_{PC}$ = 5.99), closely followed by VC ($M_{VC}$ = 10.70, $SD_{VC}$ = 3.34) and with CC requesting fewest information ($M_{CC}$ = 8.23, $SD_{CC}$ = 4.67). Planned contrasts (Helmert) revealed that learners in the two experimental conditions (PC & VC) requested significantly more information than those in the control condition ($t$(89) = 2.58, $p$ = .011), but the experimental conditions did not differ ($t$(89) = -0.43, $p$ = .670).

Regarding cognitive and metacognitive learning outcomes, we compared the number of correct as well as certain answers to the learning tasks after learning (t3). There was no significant difference in performance between the conditions ($F$(2, 89) = 1.99, $p$ = .143), but they differed with regard to their certainty ($F$(2, 89) = 11.56, $p$ < .001). Helmert contrasts revealed significant effects between the experimental conditions and the control condition ($t$(89) = 4.10, $p$ < .001) as well as between the experimental conditions ($t$(89) = 2.55, $p$ = .012), with VC being most confident ($M_{VC}$ = 17.70, $SD_{VC}$ = 2.42) followed by PC ($M_{PC}$ = 15.87, $SD_{PC}$ = 3.00) and CC ($M_{CC}$ = 14.26, $SD_{CC}$ = 2.92).

In summary, learners were partially supported in regulating their learning behaviour, but this did not translate into cognitive learning gains. Prompting monitoring judgments seems to affect how much information learners request, although visualising does not add to this effect. And while it does not help the objective quality of study decisions, learners having their own judgments available during learning use these judgments more consequently to guide their control decisions (subjective quality) and successfully clear up perceived uncertainties. This – unfortunately – does not translate into knowledge gains. One explanation for these ostensible inconsistencies might be a possible lack of monitoring accuracy, which is frequently reported (Winne & Nesbit, 2009). While learners seem to use their judgments to guide learning, and computer-based learning scenarios can be used to offer support, this might be ultimately futile, if the basis of their decisions (monitoring) is flawed. Thus, analyses are in progress to study and integrate measures of monitoring accuracy to disentangle the relations between monitoring judgments, control behaviour and performance. Further, we currently evaluate more process data (e.g., time data) as well as learning outcomes for untrained material (post-test) and conduct pre-post-test analyses on the learning tasks. Various further analyses are planned, for instance analysing the sequential data in more detail to find out how students use (1) their self-set validity ratings to structure their learning process and (2) the additional information to adjust their answers as well as their validity ratings. Also using two measures of diagnostic efficiency (sensitivity and specificity; cf. Schraw, Kuch, & Gutierrez, 2013) instead of phi-coefficients to estimate quality will eliminate some of the bias due to guesswork. Further research should build on this study and use the individual potential of students to implicitly guide learning processes, but researchers and practitioners should be aware that a lack of self-regulatory skills (availability deficit; Veenman, Van Hout-Wolters, & Afflerbach, 2006) might also call for a more blatant or directive approach.

## References

Bannert, M. (2006). Effects of reflection prompts when learning with hypermedia. *Journal of Educational Computing Research, 35*(4), 359–375.

Dunlosky, J., & Rawson, K. A. (2012). Overconfidence produces underachievement: Inaccurate self evaluations undermine students' learning and retention. *Learning and Instruction, 22*(4), 271–280.

Efklides, A. (2008). Metacognition - Defining its facets and levels of functioning in relation to self-regulation and co-regulation. *European Psychologist, 13*(4), 277–287.

Nelson, T. O., & Narens, L. (1990). Metamemory: A theoretical framework and new findings. In G. H. Bower (Ed.), *Psychology of Learning & Motivation* (Vol. 26, pp. 125–173). New York: Academic Press.

Schraw, G., Kuch, F., & Gutierrez, A. P. (2013). Measure for measure: Calibrating ten commonly used calibration scores. *Learning and Instruction, 24*, 48–57.

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning, 1*(1), 3–14.

Winne, P. H. (1996). A metacognitive view of individual differences in self-regulated learning. *Learning and Individual Differences, 8*(4), 327–353.

Winne, P. H., & Nesbit, J. C. (2009). Supporting self-regulated learning with cognitive tools. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of Metacognition in Education* (pp. 259–277). New York: Routledge.

# Patterns of Simulation-based Physics Learning: An eye-movement Analysis

**Guo-Li CHIOU & Meng-Jung TSAI**

*Graduate Institute of Digital Learning and Education,*
*National Taiwan University of Science and Technology, Taiwan*
*\*glchiou@mail.ntust.edu.tw*

**Abstract:** The purpose of this study was to investigate the scan patterns of simulation-based physics learning performed by learners' with different knowledge backgrounds. The eye-tracking technique was used to record ten graduate students' visual attention while learning with two physics simulations, and sequential analyses were conducted to construct their scan patterns. The participants were divided into either the better or the less prior knowledge group according to their pretest scores. The results showed that, the participants with better prior knowledge tended to make more visual transitions between texts and graphics, to explore more connections among the resulting images and other graphics, and to take more advantage of the interactivity of the simulations.

**Keywords:** Computer simulations, Eye-tracking, Physics learning

## 1. Introduction

Although computer simulations are claimed to offer enormous potential for overcoming the difficulties in learning abstract physics concepts and theories, how they can be used to support physics learning remains a contentious issue. Researchers have proposed many factors that may influence the effectiveness of physics simulations (e.g., Chang, Chen, Lin & Sung, 2012; de Jone & van Jooligen, 1998), and one key factor can be concluded as the differences in learners' knowledge and experience of physics learning. According to constructivism (von Glasersfeld, 1989), learners with different prior experience and knowledge have different starting points for learning physics, and may prefer different approaches to learning physics and conducting physics inquiry. We therefore argue that, students with different knowledge backgrounds may utilize different strategies for simulation-based physics learning, and it is more informative to investigate how students learn with physics simulations than to merely evaluate their learning outcomes.

Accordingly, this study aimed to explore the patterns of simulation-based physics learning between learners with different knowledge backgrounds. Owing to the development of eye-tracking technologies and statistical techniques in sequential analysis, it is now promising to study learners' scan patterns of simulation-based learning. One the one hand, an eye-tracking machine can simultaneously trace and recode the fixations and sequences of learners' visual attention while conducting physics simulations, and the obtained information can be used to infer the corresponding cognitive processes (please refer to Just & Carpenter (1980) for the *eye-mind assumption*). On the other hand, the technique in sequential analysis (Bakeman & Gottman, 1997; Tsai, et al., 2012) offers a method for constructing patterns of individuals' scan paths while learning with simulations.

## 2. Methodology

### 2.1 Participants

The participants in this study were ten graduate students recruited from a graduate-level course in research method. They were assumed to have different experience of learning physics because of their educational backgrounds; while four of them had a bachelor's degree in science, the other six had a bachelor's degree in art and social science.

### 2.2 Materials and measurement

Two computer simulations of pinhole physics were used as the learning materials in this study. The main difference between these two simulations lay in the level of interactivity. One of them was a non-interactive simulation that used shooting lines to represent light rays (starting from an object, through a pinhole, and then forming an image on a screen) for demonstrating how a pinhole camera works. In contrast, the other was an interactive simulation containing a movable cardboard with a pinhole that the participants could draw back and forth to change the sizes of the resulting pinhole images. Both simulations were accompanied by text that described the characteristics of pinhole images and explained how the resulting images were formed. However, it is worth noting that the two simulations were not presented in a fixed sequence. The participants could start with either simulation and then freely switch between them by clicking an icon within the simulation program.

In addition, this study used a paper-and-pencil test to measure the participants' understanding of pinhole physics. The test contained one problem that provided an object and a pinhole camera, and asked the participants to draw its resulting pinhole image. The test score was graded based on the correctness of the shape, size and orientation of the resulting images that the participants drew.

### 2.3 Apparatus

This study used FaceLAB 4.5 (with a sampling rate of 60 Hz) as the eye-tracking system to track the participants' visual attention while conducting the simulations. Also, GazeTracker 8.0, MATLab programming and SPSS 22.0 software were utilized to store or analyze the eye movement data.

### 2.4 Data collection and analysis

Each participant underwent a two-stage procedure for data collection in this study. First, each participant took the pretest individually by drawing their construed pinhole images of the given question. Then, after an eye-tracking calibration, each participant started to play the simulations individually with a ten-minute limitation. The participants' eye movements were tracked and recorded by the FaceLAB 4.5 and GaceTracker 8 throughout the learning process.

Based on the relevance to the understanding of pinhole physics, ten areas of interest (AOI) were designated within the two simulations for eye-movement analyses. For each AOI, we calculated the total reading time, total fixation duration and the total regression number (please refer to Lai, et al. (2013) for the definitions of these eye-tracking indicators). In addition, the sequence of each participant's visual attention transitions between any two AOIs was also coded for conducting further sequential analysis (Bakeman & Gottman, 1997) to find out the scan patterns.

Moreover, this study used the following procedure to examine whether the participants' prior knowledge correlated with their scan patterns. First, the participants were divided into two groups according to their pretest scores. Four participants who obtained the full score were assigned to the better prior knowledge (BPK) group, while the other six who scored zero were assigned to the less prior knowledge (LPK) group. Then, for each AOI, a series of Mann–Whitney U tests were conducted to examine the differences between the BPK and LPK groups in terms of the three eye-movement indicators mentioned above. In addition, both groups' scan patterns of simulation-based physics learning were constructed and compared according to the results of sequential analyses.

## 3. Results

For each AOI, the eye-tracking measures were calculated in terms of the total reading time, the total fixation duration, and the total regression number. The results of a series of Mann–Whitney U tests reveal no significant difference between the BPK and the LPK groups in any of the eye-tracking measure for each AOI.

The technique of sequential analysis (Bakeman & Gottman, 1997) was utilized to find out both the BPK and LPK groups' scan patterns of simulation-based learning. The LPK and the BPK groups' scan patterns can be visualized as Figure 1 and 2. The squares in the figures represent all AOIs (the meaning of each AOI was listed below the figures), and the arrows represent either a significant transition between any two AOIs or a significant repletion within the same AOI (each arrowhead points to the direction of transition). For example, regarding the AOI '1D' in Figure 1, the LPK participants tended

to repeatedly read the '1D' (1D→1D, $p < .05$) or shifted their attention from '1D' to '1Im' (1D→1Im, $p < .05$).

Some differences between the LPK and the BPK groups' scan patterns can be identified by comparing Figure 1 and 2. For example, the BPK participants made more transitions between textual and graphical AOIs in the first simulation. More specifically, after attending on the graphical AOI (such as '1Im' and '1P'), the BPK participants might turn into the textual description '1D' (1Im→1D, $p < .05$; 1P→1D, $p < .05$). In addition, the BPK participants were more likely to switch their attention between graphical AOIs, such as from '1Im' to '1P' (1Im→1P, $p < .05$) and bi-directionally between '1O' and '1P' (1O→1P, $p < .05$; 1P→1O, $p < .05$). In contrast, the LPK group made less transition both between textual and graphical AOIs and between any two graphical AOIs. Moreover, the BPK participants tended not to repeatedly focus on the resulting pinhole images in both simulations (1Im and 2Im), but to immediately switch their attention from the image to the pinhole (1Im→1P, $p < .05$), or from the image to the text description (1Im→1D, $p < .05$). In contrast, the LPK participants were more likely to repeatedly study the resulting images in both simulations (1Im→1Im, $p < .05$; 2Im→2Im, $p < .05$), but less likely to switch from the images to other textual or graphical AOIs (except that of 2Im→2P, $p < .05$). Furthermore, the BPK participants paid more attention on '2In' (2In→2In, $p < .05$) and made more transitions from '2O' to '2In' (2O→2In, $p < .05$).
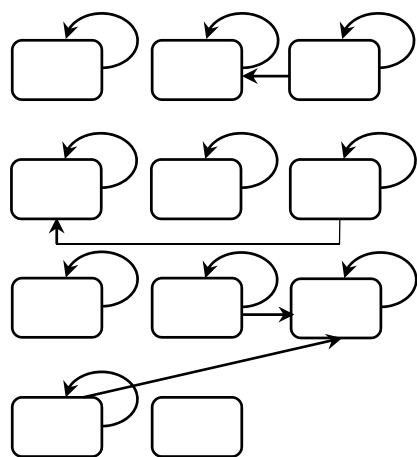


Fig 1. LPK group's scan patterns          Fig 2. BPK group's scan patterns
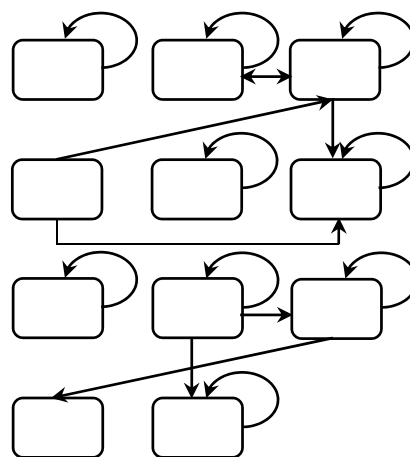
Note: **1C**: the text that gives an overall instruction to pinhole physics in the 1st simulation; **1O**: the object that "emits" light in the 1st simulation; **1P**: the cardboard with a pinhole in the 1st simulation; **1Im**: the resulting pinhole image in the 1st simulation; **1D**: the text that describes the features of the resulting pinhole image in the 1st simulation; **2C**: the text that describes the features of the resulting pinhole image in the 2nd simulation; **2O**: the object that "emits" light in the 2nd simulation; **2P**: the cardboard with a pinhole in the 1st simulation; **2Im**: the resulting pinhole image in the 2nd simulation; **2In**: the instruction for manipulating the pinhole in the 2nd simulation.

## 4. Conclusion

According to the results of sequential analyses, the BPK and the LPK participants had different scan patterns of simulation-based physics learning in the following three aspects. First, the BPK participants made more transitions both between textual and graphical AOIs and between any two graphical AOIs than the LPK participants. Second, while the LPK participants tended to focus repeatedly on the resulting pinhole images in both simulations, the BPK participants were more likely to connect the images with other textual or graphical AOIs in the simulations. Last, the BPK participants took more advantages of the interactivity of the second simulation by actively manipulating the distance between the pinhole and the object than the LPK participants. These findings may provide profound implications for improving simulation-based physics learning, particularly for learners with different knowledge backgrounds.

4. **References** (All references will be provided in the conference.)

# Antecedents of Replies and Non-Replies in Online Discussion Forums: Evidence from a Think-Aloud Study

**Jürgen BUDER & Anja RUDAT**
*Knowledge Media Research Center, Tübingen, Germany*
j.buder@iwm-kmrc.de

**Abstract:** This paper investigates users' intentions to reply and their actual replies in an informal learning online discussion. Based on the literature, it was expected that two factors determine whether users will reply to a discussion post: a) cognitive conflict between the attitude expressed in a post and a user's attitude; b) degree of emotionality of a discussion post. In order to test for these assumptions, 19 participants were requested to think aloud while reading through an online forum discussion on the advantages and disadvantages of alternative medicine. Verbalizations of users were coded for intentions to reply or not to reply, and for underlying reasons. Moreover, actual responses were coded for agreement and disagreement. Results indicate that cognitive conflict plays an important role when contributing to an online discussion, whereas emotionality only plays a minor role.

**Keywords:** Online discussions, participation, informal learning

## 1. Introduction

Participation is the key ingredient of computer-supported collaboration (Stahl, 2005). There is lot of research about the effects of messages on recipients. For instance, readers exhibit confirmation bias, a tendency for attending to information that is consistent to their attitude (Hart, Albarracin, Eagly, Brechan, Lindberg, & Merrill, 2009). In contrast, comparatively little is known about the reasons why people move from a recipient's stance (reading, listening) and actively participate in online discourse (writing, speaking). In typical small group settings, a lot of the dynamics of group discussions can be explained by reciprocity (Joyce & Kraut, 2006). However, the dynamics of participation in larger groups are poorly understood. As our field has begun to address mass collaboration (e.g., in MOOCs), this becomes an important issue for online education. This paper tries to close this gap by providing evidence on the factors that turn readers of an online discussion forum into active participants.

The paper briefly describes the rationale for the study by focusing on two factors that might influence participation: cognitive conflict and emotionality. Subsequently, the method of this study (think-aloud verbalizations) is explained. Selected results of the study are presented, leading to a brief conclusion about the main findings.

## 2. Theoretical Background

From an educational perspective, two strands of literature focus on antecedents of cooperative and collaborative learning. First, Cohen (1994) has pointed at the strong linear relationship between participation in discourse and cooperative learning performance. Second, socio-cognitivist theories of learning describe cognitive conflict between persons as an important antecedent of learning (Doise & Mugny, 1984; Schwind, Buder, Cress, & Hesse, 2012). Taking these two strands of literature together, it can be speculated that cognitive conflict might be an important antecedent of participation in online discussions. In other words, learners should be most likely to respond to online discussion posts that are inconsistent to their knowledge and/or attitudes.

A second factor that might spur participation in online discussions is the emotionality of a discussion post. For instance, Chmiel et al. (2011) reported that participation in a political online discussion forum was determined by the amount of negativity expressed. Anecdotal evidence for the

importance of emotionality as a precursor to participation also comes from the prevalence of heated debates (flame wars) on the Internet. Thus, it can be hypothesized that learners are more likely to respond to online discussion posts that are emotionally laden.

## 3. The Present Study

The present study seeks to investigate how cognitive conflict and emotionality are associated with learners' intentions to reply and their actual replies in an online discussion forum. Studies on participation in large forums often investigate online discussions "in the wild", for instance by using machine learning methods like sentiment analysis (e.g., Chmiel et al., 2011). The present study, however, uses a different approach, the think-aloud technique (Ericsson & Simon, 1998). Individual participants of this study read a carefully controlled excerpt from a fictitious online discussion, and were requested to verbalize their thoughts upon reading the discussion, as well as their intention to reply to given discussion posts. This technique does not only provide deeper insights into the psychological mechanisms of participation, it also permits to investigate reasons why users are sometimes *not* willing to respond to a discussion post.

## 4. Method

19 participants (7 male, 12 female; average age 27.1 years) from a German university took part in this study, and received 12 € for participation (duration of 90 minutes). The material for this study consisted of a fictitious online discussion about the advantages and disadvantages of alternative medicine. An initial discussion entry was followed by 24 actual discussion posts (12 providing arguments in favor, and 12 providing arguments against the use of alternative medicine). Moreover, half of the discussion posts were composed in an emotional style, using emotionally laden words. After pre-testing, the material was carefully controlled for length, emotional valence, and persuasiveness. In the main study, participants first had to rate their attitude with regard to the topic (for vs. against the use of alternative medicine) on a 5-point Likert scale. After training the think-aloud technique with a different discussion, the alternative medicine discussion was displayed on a computer screen. Participants were asked to verbalize their thoughts on each discussion post, particularly with regard to the question whether they would intend to reply or not. The experimenter sat in the same room and encouraged verbalizations if participants were silent for longer stretches of time. After the verbalization phase, all 24 posts were presented again in a second phase. Here, participants were asked to write actual replies if they wanted to respond to certain discussion posts.

Verbalizations were coded according to intention (intention to reply, intention not to reply, no intention expressed). Moreover, reasons for intentions were categorized according to the perceived content of a post (e.g., experiencing conflict or consensus), the perceived style of post (e.g., rational style), the perceived characteristics of the author (e.g., close-mindedness), and self-reports (e.g., lack of knowledge). Actual replies written in the second phase were coded according to whether they expressed agreement or disagreement.

## 5. Results

On average, participants verbalized an intention to reply on 27.8% of posts, and an intention not to reply on 21.5% of posts. As for the intentions to reply, participants felt a stronger desire to respond to discussion posts that expressed a viewpoint that is inconsistent with prior attitude ($M = 0.35$, $SD = 0.31$) than to posts that expressed a consistent viewpoint ($M = 0.21$, $SD = 0.19$). Statistical analysis showed that this was a significant difference, $F(1, 14) = 6.13$, $p = .027$, partial $\eta^2 = .305$. This is in line with our expectation that cognitive conflict through inconsistent posts is an important antecedent of participation. However, we did not yield a significant difference in the intention to reply to emotional posts ($M = 0.30$, $SD = 0.25$) versus non-emotional posts ($M = 0.29$, $SD = 0.23$), $F(1, 14) < 1$, *ns*.

As for intentions not to reply, there was no difference between inconsistent posts ($M = 0.18$, $SD = 0.26$) and consistent posts ($M = 0.24$, $SD = 0.27$), $F(1, 14) = 1.55$, $p = .234$, partial $\eta^2 = .100$. There was also no difference between emotional posts ($M = 0.23$, $SD = 0.30$) and non-emotional posts ($M = 0.20$, $SD = 0.24$), $F(1, 14) < 1$, $ns$.

Participants' verbalizations were also coded for reasons to reply or not to reply. The three types of verbalization most often associated with an intention to reply were experiences of conflict (29.2%; particularly with inconsistent posts), feelings that a post contained weak arguments (16.3%; slightly more with regard to consistent posts), and experiences of consensus (14.2%; particularly with consistent posts). The three types of verbalization most often associated with an intention not to reply were experiences of consensus (20.9%; particularly with consistent pots), lack of knowledge (18.1%), and feelings that post contained weak arguments (18.0%; slightly more with regard to consistent posts).

Finally, actual replies were analyzed and coded. Participants replied more often to posts that were inconsistent to their own opinion ($M = 0.28$, $SD = 0.28$) than to posts that were consistent ($M = 0.17$, $SD = 0.22$), $F(1, 14) = 4.59$, $p = .05$, partial $\eta^2 = .247$. However, other than they intended, participants replied more often to non-emotional posts ($M = 0.28$, $SD = 0.28$) than to emotional posts ($M = 0.18$, $SD = 0.22$), $F(1, 14) = 6.00$, $p = .028$, partial $\eta^2 = .300$. Further analyses on the coded categories revealed that consistent posts resulted in both agreeing (12.1%) and disagreeing (14.1%) replies. In contrast, inconsistent posts very frequently led to disagreeing replies (47.1%), but never to agreeing replies (0.0%).

## 6. Conclusions

Results confirmed our expectation that inconsistent posts are associated with stronger cognitive conflict which in turn raised both the intention to reply and actual participation. It is interesting to note that users exhibit confirmation bias (preference for consistent information) as recipients of content, but exhibit a disconfirmation bias (preference for inconsistent information) as producers of content. In contrast to previous studies (Chmiel et al., 2011), we did not yield strong effects of the emotionality of a message. Finally, feelings of consensus and feelings that a post contained weak arguments were indicators of both an intention to reply, and an intention not to reply. Taken together, these findings can help to better understand the dynamics of participation, collaboration, and thus to learning in online settings.

## References
Chmiel, A., Sobkowicz, P., Sienkiewicz, J., Paltoglou, G., Buckley, K., Thelwall, M., & Hołyst, J. A. (2011). Negative emotions boost users activity at BBC Forum, *Physica A, 390*, 2936-2944.
Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research, 64*, 1-35.
Doise, W., & Mugny, G. (1984). *The social development of the intellect.* Cambridge: Cambridge University Press.
Ericsson, K. A., & Simon, H. A. (1998). How to study thinking in everyday life: Contrasting think-aloud protocols with descriptions and explanations of thinking. *Mind, Culture, & Activity, 5*(3), 178-186.
Hart, W., Albarracin, D., Eagly, A. H., Brechan, I., Lindberg, M. J., & Merrill, L. (2009). Feeling validated versus being correct: A meta-analysis of selective exposure to information. *Psychological Bulletin, 135*, 555-588.
Joyce, E., & Kraut, R. E. (2006). Predicting continued participation in newsgroups. *Journal of Computer-Mediated Communication, 11*, 723-747.
Schwind, C., Buder, J., Cress, U., & Hesse, F. W. (2012). Preference-inconsistent recommendations: An effective approach for reducing confirmation bias and stimulating divergent thinking? *Computers & Education, 58*, 787–796.
Stahl, G. (2005). *Group cognition: Computer support for collaborative knowledge building.* Cambridge, MA: MIT Press.

# Development of a Learning Support System for Visualization and Acquisition of Knowledge through Collaborative Problem Posing

**Yasuomi TAKANO [a*], Koki MIURA [a], Keiko TSUJI [b], Daisuke KANEKO [c], Hiroto YAMAKAWA [d] & Hiroshi KOMATSUGAWA [a]**

[a]*Graduate School of Photonics Science, Chitose Institute of Science and Technology, Japan*
[b]*School of Health Sciences, University of Occupational and Environmental Health, Japan*
[c]*School of Economics, Hokusei Gakuen University, Japan*
[d]*Faculty of Photonics Science Chitose Institute of Science and Technology, Japan*
*takano210@kklab.spub.chitose.ac.jp

**Abstract:** In this paper, we propose a learning support system that enables learners to acquire knowledge through a collaborative problem-posing procedure. One of the characteristics of this system is the view function of its knowledge map, which can be used to visualize the domain knowledge acquired by learners in subjects with a well-defined knowledge body such as mathematics, information science, nursing, and medical care. In the present study, we evaluate the effectiveness of the system through visualization of the knowledge map in a class on nursing process theory.

**Keywords:** LMS, CSCL, Problem Posing

## 1. Introduction

It is important for learners to acquire and utilize knowledge in academic disciplines requiring advanced expertise, such as mathematics, information science, nursing, and medical care. The semantic structure of these academic disciplines can be constructed under a body of domain knowledge that includes properties with hierarchies and relations. In the present study, we hypothesize that in collaborative learning, visualization of a semantic structure using a "knowledge map" is effective in knowledge acquisition and utilization, and cognition of new knowledge. We propose a computer-supported learning system that consists of (1) a web-based training (WBT) function with drills semantically related to knowledge, (2) a view function of the knowledge map that highlights the knowledge acquired by each learner in color on the basis of his/her learning results, and (3) a collaborative problem-posing function through which each learner can pose a new drill and register it into the system. To achieve (3), we modified our system to make it a computer-supported collaborative learning system. The system was introduced into a class on nursing process theory. We then evaluated the effectiveness of the system.

## 2. Proposed System

### 2.1 WBT Function

We applied "CIST-Solomon" as the system for the WBT function. CIST-Solomon is a learning management system that can manage learners' learning processes and results (Yamakawa et al., 2011). The system includes 40,000 drill contents covering several academic disciplines such as mathematics, information science, and nursing. In the present study, a knowledge frame was also implemented in CIST-Solomon's a relational database. It included information on corresponding drill contents and related information on the neighboring frame. The degree of learners' knowledge acquisition was defined as the rate whether of the number of times drill contents were successfully positioned in the appropriate knowledge map or not.

## 2.2 View Function of the Knowledge Map

A view function of the knowledge map was implemented in CIST-Solomon. Using this function, each learner could select a knowledge frame graphically visualized on the web-based map and study learning contents related to the knowledge frame. In addition, each learner could check the status of knowledge acquisition through the map. Fig. 1 shows a screenshot of the knowledge map and drill contents.
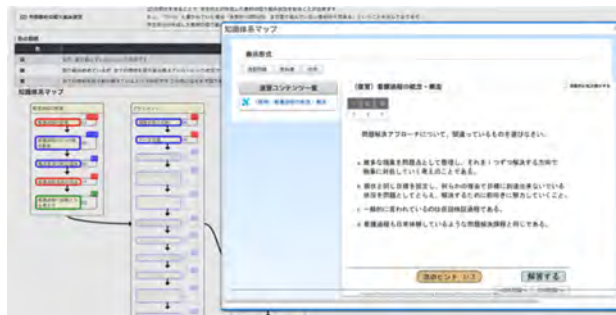


Figure 1. Screenshot of knowledge map and drill contents.

## 2.3 Collaborative Problem-posing Function

We implemented a problem-posing function through which learners could create and share drills in CIST-Solomon. In the problem-posing process, learners could relate the knowledge frame to the drills they created. This procedure could also be realized through the user interface of the knowledge map. The problem-posing function and the knowledge map were used for collaborative learning. Drill contents that learners created were published on the knowledge map and shared by other group members, who could solve drill contents through the knowledge map. This learning situation was referred to as collaborative problem-posing learning. It was assumed that the discovery of new knowledge was realized through the collaborative problem-posing process.

The drill format used for the problem-posing function included the description of a drill statement, an answer column, and a hint. The problem-posing procedure consisted of five steps: (1) creating a drill statement, (2) creating an answer column, (3) creating a hint, (4) selecting knowledge frame lists, and finally (5) confirming the created drill. A teacher checked the correctness of the drill contents.

## 3. The Outline of the Lecture

We introduced our methods into a lecture on nursing process theory held by the department of nursing of a certain university. This lecture is conducted for college sophomores and aims to teach them practical nursing skills. This basic nursing lecture has a large effect on all nursing-related fields. In national nursing tests, questions from different areas can have a major relationship with these fields. Therefore, acquiring the knowledge on basic skills provided in the lecture is important. The lecture is designed to stimulate students' productivity and to expand their understanding of nursing through group discussion and problem posing. The teaching staff involved in this lecture prepared a knowledge map, which was applied to the proposed system.



Figure 2. Class model designed.

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The outline of the class is shown in Fig. 2. In step [1], using the WBT function, teachers provide preparatory assignments that include texts and drills to learners. The drill contents are related to the knowledge frame in advance. Learners can select the drills through the knowledge map. In step [2], teachers conduct a face-to-face class. In step [3-a], teachers provide assignments for the class to review. In step [3-b-1], using the problem-posing function, each learner reviews the content of the face-to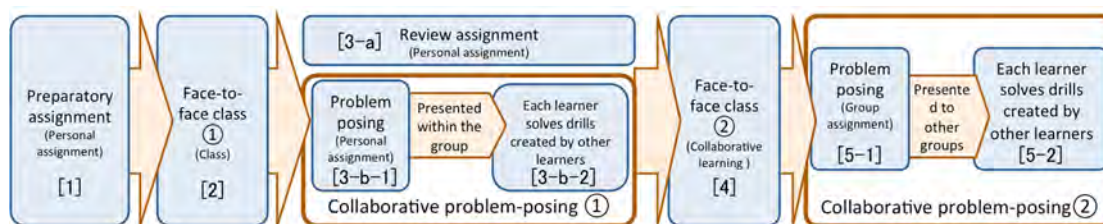-face class and poses problems for the group members to solve. Learners also select the appropriate knowledge type from the knowledge map. In step [3-b-2], each learner solves drills created by other learners using the knowledge map. In step [4], face-to-face collaborative learning is introduced. Group members are encouraged to elaborate on the knowledge they gained through the process outlined in [3-a]. In step [5-1], group members discuss their knowledge through a series of learning processes and summarize the knowledge to pose a problem for their group; each group then has to solve one problem. The created drill is shown to other group members. In [5-2], each learner can view and select drills created in the process outlined in [5-1] on the knowledge map and solve them using CIST-Solomon.

## 4. Evaluation

### 4.1 Evaluation through Questionnaire
A questionnaire survey was conducted with 69 students. In the questionnaire, students were asked to respond to the question: "What do you find useful/not useful when you use the system?" This was a free description type of question. The answers were as follows: "It's a complicated system and hard to use," "It's not user-friendly, and I'm having trouble grasping what I learned." These answers indicate that students found it difficult to operate the system. Therefore, improvements to the user interface of the view function of the knowledge map are needed.

### 4.2 Evaluation by Concordance Rate of Drill Contents Positioning
Students' ability to position individual drill contents in the appropriate knowledge map showed their degree of knowledge acquisition. Students were asked to position their drill contents in the knowledge map when they pose the problem. Then, the class teacher independently positioned students' drill contents in the knowledge map. The concordance rate of drill contents positioning could be calculated be comparing the results of both the students and teacher's actions. The rate can be used for evaluating the view function of the knowledge map. In a previous study, students positioned their drill contents without using a knowledge map (Miura et al, 2013). At that time, the average of the concordance rate of drill contents positioning was 27%. In contrast, the average was 62% in this study. The results of a t-test showed that there was a significant difference in the results of both studies (p <0.05). The results of this study indicate that the view function of our system's knowledge map is effective for selecting appropriate knowledge types. In other words, the view function of our system's knowledge map is effective for acquiring knowledge.

## 5. Conclusion
In this study, we developed a system that had a view function of knowledge map. We evaluated the effectiveness of this system after implementing it in a class on nursing process theory. The results of a questionnaire survey conducted after the class indicated that the function was difficult for students to use. However, a comparison of the concordance rates of drill contents positioning in this and a previous study showed that the view function was effective for acquiring knowledge. In the future, it will be necessary to make improvements to the view function's user interface.

## References
Miura, K., Yamakawa, H., Kaneko, D., Tsuji, K., & Komatsugawa, H. (2013). Proposal of Support System for Knowledge Acquisition in Collaborative Quizzes Creation. *Proceedings of JSiSE conference for students in Hokkaido 2013.* Japanese Society for Information and System in Education. 11-12.
Yamakawa, H., Komatsugawa, H., & Yoshida, J. (2011). An adaptive ICT education service based on course knowledge database in science and technologies. *Work-in-Progress Poster Papers of the 19th International Conference on Computers in Education.* Asia-Pacific Society for Computers in Education 7–9.

# How to Learn About Art in a Museum Setting Using Multitouch Technology: Providing Affordances for Collaboration and Comparison

**Katharina SCHEITER [a*], Katrin SCHLEINSCHOK[a] & Daniel BODEMER[b]**
[a]*Knowledge Media Research Center, Tuebingen, Germany*
[b]*Media-Based Knowledge Construction, University of Duisburg-Essen, Germany*
*k.scheiter@iwm-kmrc.de

**Abstract:** In the present study we investigated the process of collaborative meaning making of art using multitouch technologies. Dyads of students first visited an art exhibit, where they were instructed to pick their most favorite artworks from the exhibit by marking them in an iPod App. Subsequently, they explored their collection of favorites, which were displayed as high-resolution images on a large multitouch table and which could be moved and resized on the display using multitouch gestures. In a control condition, no instructions were given on how to explore the artworks, whereas in the experimental condition students were instructed to compare artworks to gain a deeper understanding of them. Moreover, automatic suggestions for comparing artworks between students' selections were presented. The goal of the instruction was to help students identify commonalities and differences among the artworks along four art-relevant dimensions: epoch, symbolism, method of production, and genre. After the exploration students filled in various posttests that assessed their understanding of art. Data collection has just been finished and results from the interaction data (audio and video recordings) and performance data will be reported at the conference.

**Keywords:** learning in museums, computer-supported collaborative learning, comparison, multitouch technology

## 1. Introduction

One of the central motives for visiting a museum's art exhibit is aesthetic experience. Aesthetic judgments, however, are not just an affective response; rather, they result from a variety of cognitive processes (Leder, Belke, Oeberst, & Augustin, 2004). These processes involve classification (e.g., identifying an artwork's epoch) and interpretation (e.g., identifying an artwork's theme). Positive aesthetic judgments are more likely if a beholder can derive a basic understanding from the artwork. However, most museums provide only little support for visitors to engage in meaning making. Typically only small labels with the artist's name and period of living are provided. Extended information provided via audio guides is often too complex, the usability is often limited, and because of the need to carry headphones communication with others is restricted. Therefore, many visitors refrain from using audio guides, thereby leaving their information needs unsatisfied. This may be one reason for why visitors often spend only a few seconds on studying a piece of art (Hein, 1998). In the present paper, we describe one approach to helping visitors in meaning making by using modern technologies, namely, large multitouch tabletop displays (MTT). We sketch a first study evaluating whether the MTT's interface supports collaborative engagement and, as a consequence, better understanding of art. This study is part of a larger project (EyeVisit).

### 1.1 The project EyeVisit

EyeVisit combines psychological research with innovative technological developments and makes them applicable in real-life situations such as (informal) learning in museums. At the heart of the project is a large MTT that allows displaying high-resolution images, videos, and audio and written text files. Multiple users can simultaneously interact with these objects by activating, resizing, and moving them

using multitouch finger gestures. Additionally, an iPhone/iPod visitor App allows retrieving an interactive map of the museum and background information on each artwork as well as marking one's favorite artworks to explore them in more detail at the MTT after an exhibit visit. Once a user puts the mobile device onto the MTT, his or her selected favorites will be automatically displayed. Currently, the EyeVisit system is used in the Herzog Anton Ulrich Museum (Braunschweig, Germany) under real-world conditions by the museum's visitors, and at Knowledge Media Research Center (KMRC) for running experimental studies. For the latter purpose, KMRC additionally simulated a museum context in its facilities by arranging high-resolution copies of the museum's most liked artworks (i.e., 44 paintings and objects from Renaissance, Baroque, and Rococo) in a museum-like setting.

*1.2 Rationale of the present study*
The goal of the present study was to identify ways of facilitating visitors' meaning-making process of art by directing their attention to commonalities and differences among artworks. In research on meaning making of art contextual and social factors are emphasized. That is, a single artwork is not understood in isolation; rather, meaning is derived from comparing different pieces of art to each other. Ideally, this process is facilitated by a curator's deliberate design decision for an exhibit regarding the spatial arrangement of artwork (Krukar, 2014). Moreover, museum visitors often explore exhibits in groups (e.g., as a family, couple, or friends); therefore, communication about artwork plays a vital role in meaning making (explanatory engagement; Leinhardt & Crowley, 1998). The relevance of comparison is also reflected in the learning sciences research literature. Comparison of elements with respect to their commonalities and differences is one of the pivotal mechanisms of learning through abstraction (Markman & Gentner, 1998). In particular, comparing elements that share many (superficial) similarities while thereby highlighting the few, distinct differences important to understanding enhances learning (Scheiter, Gerjets, & Schuh, 2004). Correspondingly, in collaborative learning scenarios it has been shown that slightly different knowledge backgrounds, views, or opinions can trigger curiosity, controversial discourses, and better learning (Doise & Mugny, 1978), particularly if learners are provided with information on their learning partners' views or knowledge (Bodemer, 2011). Accordingly, asking visitors of a museum to collaboratively compare pieces of artwork that appear highly similar in some respects (e.g., their epoch) but differ in important other aspects (e.g., their genre) should support their meaning making and collaborative elaboration. This assumption was tested in a study using the technological affordances of the MTT to support comparison processes during informal collaboration.

## 2. Study

Seventy-six students were assigned to two groups. In the instructed-comparison group, students working in dyads were explicitly prompted to compare pieces of art while exploring their favorite artworks using the MTT, whereby they received support in the selection of to-be-compared pieces. In the control group, students explored their favorite pieces of art at the MTT without any instructional support. Initially, students filled in a questionnaire assessing their prior knowledge and interest in art. They then received a 3-pages, written introduction to the interpretation of art according to which artwork can be described along four dimensions: epochs (e.g., Renaissance, Baroque, and Rococo), symbolism (i.e., themes such as power, science, religion), methods of production (e.g., paintings, sculptures), and genres (e.g., landscapes, portraits). These dimensions were also the ones we wanted students to learn about. Subsequently, students were asked to explore KMRC's art exhibit for 15 minutes (see first panel of Figure 1) and to mark their nine most favorite artworks using the iPod App (second panel). Afterwards, dyads put their iPods onto the MTT (third panel) to display their selected pieces of art (fourth panel). Students in the control group were instructed to explore their selection for 15 minutes by using multitouch gestures. Students in the instructed-comparison group were informed about the potential benefit of comparing elements and supported by automatic suggestions for comparing artworks between students' selections. The software's algorithm was based on a similarity matrix of all artworks, whereby such comparisons were prompted that involved objects that differed only with respect to one or two of the dimensions addressed in the introduction, but else were identical. Suggested objects were color highlighted upon touching a displayed artwork.

Figure 1. Materials and set-up: KMRC museum; iPod App; multitouch table with artwork display; selection of artworks from a dyad with highlighted elements (from left to right).

After the exploration at the MTT, students were asked to individually fill in a posttest, which consisted of three parts: In the first multiple-choice test students were asked to rate for 30 pairs of artwork from the exhibit whether they were similar or dissimilar regarding epoch, symbolism, methods of production, and genre, and to select the correct option for each dimension and artwork. In the second task, students were asked to compare another 10 pairs of artwork in an open format. Finally, to test their memory of the artworks, they were given a 60-item multiple-choice test that asked them to identify pictorial details from the various pieces of art. Finally, students were debriefed.

## 3. Preliminary Results

So far, only the items of the first multiple-choice test have been analyzed. They show that students still found it difficult to identify the correct epochs for the artworks (40.2% accuracy), whereas the other dimensions of art interpretation were somewhat easier (symbolism: 60.3%; methods of production: 83.9%; genre: 67.9%). There were no differences among conditions regarding this test. However, a first inspection of the video and audio recordings during the exploration at the MTT suggests that there is large variability in students' interaction and communication patterns both between the two groups as well as within groups. For instance, some dyads sort the artworks based on the insights achieved from comparing them in a very systematic fashion, whereas others hardly engage in any deeper reflection. Thus, it is expected that the coding of this data (currently ongoing) will yield a more valid predictor of students' understanding of art than the actual assignment to experimental groups. Results from these analyses will be reported at the conference.

**References**

Bodemer, D. (2011). Tacit guidance for collaborative multimedia learning. *Computers in Human Behavior, 27*, 1097-1086.

Doise, W., & Mugny, G. (1978). Socio-cognitive conflict and structure of individual and collective performances. *European Journal of Social Psychology, 8,* 181–192.

Hein, G. E. (1998). *Learning in the Museum.* London: Routledge.

Krukar, J. (2014). Walk, Look, Remember: The influence of the gallery's spatial layout on human memory for an art exhibition. *Behavioral Sciences, 4*, 181–201.

Leder, H., Belke, B., Oeberst, A., & Augustin, D. (2004). A model of aesthetic appreciation and aesthetic judgments. *British Journal of Psychology, 95*, 489–508.

Leinhardt, G. & Crowley, K. (1998). *Museum Learning as conversational elaboration: A proposal to capture, code, and analyze museum talk.* (Museum Learning Collaborative Technical Report MLC-01). Pittsburgh, PA: University of Pittsburgh, Learning Research and Development Center.

Markman, A. B., & Gentner, D. (1996). Commonalities and differences in similarity comparisons. *Memory & Cognition*, *24*, 235–249.

Scheiter, K., Gerjets, P., & Schuh, J. (2004). The impact of example comparisons on schema acquisition: Do learners really need multiple examples? In Y. B. Kafai, B. Sandoval, N. Enyedy, A. S. Nixon, & F. Herrera (Eds.), *Proceedings of the 6th International Conference of the Learning Sciences* (pp. 457–464). Mahwah, NJ: Erlbaum.

# Practice of the Instructional Design Class for 1st Year Medical Students by Blended Learning

**Yoshikazu ASADA[a*]**

[a]*Medical Simulation Center, Jichi Medical University, Japan*
*yasada@jichi.ac.jp*

**Abstract:** In this research, the introductory course of instructional design was attempted for freshpeople to examine the reaction of the theory and how they want to use it. The class was done by blended learning style, using classroom activities and Moodle. From the questionnaire that was done at the last class, it showed that students' motivation of and interest in instructional design was very high and they wanted to use the knowledge about it. However, some students understand the verbal information incorrect. To improve the class, using the flipped classroom style for enhancing their discussion.

**Keywords:** medical education, blended learning, instructional design, moodle, freshpeople education

## 1. Introduction

Most of the physicians are lifelong learner and teacher. They have to learn latest medical knowledge. When they learn medical procedures or non-technical skills by simulation-based training, the curriculum was designed based on instructional design theory. On the other hand, they teach their juniors and colleagues as a healthcare professional. In addition, they educate patients as a part of the treatment. Thus, the knowledge of instructional design theory is important for both situations.

In Japan, medical university is started just after the high school graduation as well as the other department. Therefore, there is little chance to learn the liberal arts for medical students. In this research, the introductory course of instructional design was attempted for freshpeople to examine the reaction of the theory and how they want to use it.

## 2. Methods

### 2.1 Learners and the theme of the class

Learners were opened at the first term of 1st year of our university students. This class was elective and limited to 30 participants. There were no preconditions for attending class.

Instructional design is basically the study of teaching method and theories, but some of the knowledge such as ARCS model (Keller, 2010) about the learner's motivation is useful and able to use for the position of a learner. Therefore, the objectives of the class were following two things: (1) to learn basic, essential ideas of instructional design such as ARCS model or Gagne's nine levels of learning (2) to discuss the idea of the usage of this knowledge for own learning (and for mutual learning, if possible) activities.

### 2.2 Design of the class

There were ten classes in the term, and each was 70 minutes. There were about 25 classes in a week (5 classes per day). Since instructional design is unfamiliar to students and there is a little association with medicine, it is a little hard to understand instructional design only from lecture. Therefore, the class was by blended learning style: classroom activities and e-learning assessment by moodle.

### 2.2.1 Classroom

In the classroom, lecture time was about 15 to 20 minutes and the remaining time was used for discussion with students or self-learning using some worksheets.

At the end of the class, students wrote the reflection sheet of the class. The sheet had 3 free description questions: (1) "What did you learn and think in today's class?" (2) "If you have question or comment about today's class, please write it." (3) "If you have any questions, comments or suggestion for the class, please write it." The question (1) was essential and for attendance check. The teacher wrote feedback comments on their sheet by the next class and give them back. In addition, some important comments or questions were covered at the beginning of the next class. The question (3) was to assess the satisfaction of the students.

### 2.2.2 Learning Management System

To enhance students learning, not only the classroom activities, but also the e-learning was used. Moodle is installed on the university's web server, so in this research Moodle was used as LMS.

In the class, Moodle was used for two purposes: (1) providing reference materials of each class, such as the PDF of keynote slides, paper materials, and video clips of YouTube (2) assessments with the forum. Students had to post at least one topic and to make more than one comment each other. The assessments were tracked by "Activity completion" of Moodle, and students were able to find their own completion status.

Most assessments were used for review and reflection of the previous classes, but some assessments were used as a preparation of the class for trying the flipped classroom (Bergmann & Sams, 2012) style.

### 2.2.3 Final Report

There were two final report of the class: (1) to write "how to use instructional design knowledge for their own future learning activities" as a reflection of the class (2) to make their own "course syllabus" by filling the worksheet. Some parts of the second to the last class and the last class were for writing these reports as self-learning.

### 2.2.4 Questionnaire with Mini Quizzes

At the end of the last class, questionnaire with mini quizzes was done. The questionnaire had 4 parts: (1) question about their motivation based on ARCS model (2) question about their self-learning style based on Gagne's nine levels of learning (3) question about their learning outcomes and reflection based on Gagne's five categories of learning (4) the total impression of the class.

In the question (1) and (2), each sentences has two meanings: questionnaire and quiz. For example, there were sentences such as "Was learning requirements set?" in part (1). Students answered the question by 7-point Likert scale and then wrote the adequate domain of ARCS. Question (3) and (4) was done by free description.

## 3. Results

### 3.1 The Results of Final Reports

All students submitted the reports and passed criteria.

All students wrote about ARCS model in the report (1). Some students mentioned about mutual learning to encourage their self-confidence and satisfaction, or about simulation-based training to enhance the relevance of the basic medicine.

## 3.2 From the Questionnaire

Table 1 shows the result of the students' motivation about the class. There were 16 questions with ARCS model, but here shows only the top categories of ARCS.

Table 1: Students' motivation about the class

| < Question > | < Average > | < SD > |
|---|---|---|
| Attention | 6.6 | 0.5 |
| Relevance | 6.0 | 0.8 |
| Confidence | 5.6 | 1.4 |
| Satisfaction | 6.3 | 0.8 |

From the free description comments, some students answered that there was a lot of time for discussion each other compared to other classes so they were very motivated. Other students wrote that the time was too short to discuss and they wanted to join extra class if possible.

## 4. Discussion

From the questionnaire, students thought that this class was motivated and they were interested in instructional design. It shows that the purpose of the class is partially achieved. However, some students answered that the discussion time was very short and they wanted to learn more. The class was only 70 minutes per day, so it was too short to learn new things and to discuss each other.

One idea to improve the class and to solve the problem is to use flipped classroom. In this research, flipped style was used only a few times. The flipped style of learning was the first time to students so this time was only for trial. Although there are some problems to use flipped classroom, such as the internet accessible environment for each students, the flipped style was not so hard for students.

The final reports showed that students understand the basic concept of instructional design to some extent. On the other hand, there were some mistakes in the mini quizzes. It shows that students know the meaning of the concepts but their understanding and connections between terms and meanings is not correct. To bring in the flipped classroom style and make some preposition assessment will be useful to enhance their learning, especially learning verbal information or basic intellectual skills.

## 5. Conclusion

The introductory class of the instructional design was done for the freshpeople of medical school by blended learning. From the questionnaire, the motivation of students was very high. To improve this class and motivate students more, using the flipped classroom style will be one of a possible idea.

**References**
Keller, J.M. (2010). Motivational Design for Learning and Performance: The ARCS Model Approach. Berlin: Springer.
Bergmann, J. & Sams, A. (2012) Flip Your Classroom: Reach Every Student in Every Class Every Day. Washington: ISTE.

# Reconstruction of a Link-List Type Learning System into an Explorative Virtual Learning Portal Based on an Avatar–Agent Model

**Shu MATSUURA [a*], Shoko FUJIMOTO[a], Motomu NAITO[b]**

[a]*Tokyo Gakugei University, Japan*
[b]*Knowledge Synergy Inc.,Japan*
*shumats0@gmail.com

**Abstract:** This study describes the reconstruction of our Topic Maps-based e-learning system into an explorative online learning portal. Topic map ontology provides a structured system of knowledge, learning resources, a webpage design, and methods of recommendation. The previous system's webpages were essentially organized link lists annotated with learning records and evaluations. The purpose of this study was to transform the previous site into a virtual environment portal that facilitates explorative self-learning. For this purpose, an avatar–agent model was introduced, with the avatar representing the learner and the agent representing the system and instructor. This model implements the visualization of personal learning development and motivates exploration based on communication.

**Keywords:** Virtual learning environment, Topic Maps ontology, avatar–agent model, conference publications

## 1. Introduction

In this study, we have constructed an e-learning portal, "Everyday Physics on Web (http://tm.u-gakugei.ac.jp/epw/)" (Matsuura, 2009), based on Topic Maps semantic technology (Park, Hunting, 2002). This learning site's domains range from natural sciences to daily life knowledge, industry, artifacts, and policies. These domains' subjects were associated in topic map ontology and also with some types of online learning materials.

The structure of web architecture has been defined in the topic map ontology. Navigation structures, web design, and a part of the recommendation system have also been defined in the ontology. This ontology provides a consistent structure in the entire system, and it enables ease in systematic reconstruction. Although the ontology is basically generic and static, the development of the user's learning history is specific, and in some sense, rather narrative.

One key feature of online learning is communication with other users, instructors, and the system (Childs, M., Peachey, A., 2013). Communication invokes learners' motivation, and communication and reflection might be the important factors for explorative learning. In our previous system, these communication components were annotated to the links and learning materials.

In this study, an avatar–agent model was introduced to the ontology. The system's leading factor was changed from link lists to a dialog between an avatar and an agent, and the user's learning history was explicitly visualized.

## 2. Avatar–agent model

In the proposed model, the avatar represents the user, and the agent represents the system and the instructors. Messages on the learning history and evaluation come from the agent; the instructors' comments are represented as given by the agent. The homepage begins with the dialog between the avatar and the agent. The user's learning history is presented as the avatar's talks, and comments from other users are shown as their avatars' talking.

Avatars change their figures according to the users' learning status. For this purpose, the records of a user's activities are converted to points, which are grouped into the three categories of content

request, drill learning, and communication. The features of the emerging avatar depend on the points of these three categories. In addition, the avatar receives items that correspond to the domains explored by the user. On the "avatar's room" page, one can visit another avatar's room and see that avatar's status through these items.

The agent seems to "talk" the drills' questions and examples of answers. The user's answers and the other users' comments on the answers are represented as the avatars' collaborative discussions. In the essay drills, the users' answers are displayed on the question page. This particularly helps learners to better consider questions without a single optimized answer.

## 3. Results

### 3.1 Communication

The learning system's instructors must comment online, commenting at least on the users' questions and worries. Instructors may also reply, to some extent, to the users' impressions. To their soliloquy-like comments, some words of encouragement in fixed forms may be sufficient as replies.

Table 1 shows the number of comments by the users about multichoice drills in a semester before reconstruction. The comments were divided into four categories according to their meaning. Mostly, they were written in short sentences. The rate of positive comments exceeded that of negative comments. To the negative comments, instructors sent some advice. Thus, as an avatar–agent dialog, an instructor's comment for an avatar's negative comment or question, or a randomly selected encouraging phrase or a hint phrase (Table 2) for a positive comment was shown automatically.

Table 1: Rate of positive and negative comments sent on the multichoice drills.

|  | On understanding | On the impression of quiz | On the user's will | Question |
|---|---|---|---|---|
| Total number of comments | 329 | 56 | 90 | 6 |
| Mean number of letters per comment | 22 | 30 | 32 | 47 |
| Rate of positive comments | 60.8 | 57.1 | 99* |  |
| Rate of negative comments | 39.2 | 42.9 | 1* |  |

Data were collected during spring semester 2012. *Number of negative comments was 1 in 90.

Table 2: Examples of agent's phrases automatically shown for avatar's positive comments*.

| Type | Phrases |
|---|---|
| Cheering | "I know you work hard. I know you are growing." "A bit tired with drills? Let's go to explore related subjects." "If you feel a topic difficult, I recommend you to explore the topics related with it." |
| Hint | "Let's try simulations and videos related with the text." "You can learn from a simulation like playing a game." "Don't you try a new field today?" |

*Examples of avatar's positive comments are such as "I finally understood the drill." "It was a nice chance to know and think about it." "I've got interested in..."

### 3.2 Effect of the presentation of the avatar–agent dialog

Figure 1 shows the results of a questionnaire administered to university students after the autumn semester 2012, during which the avatar–agent was introduced. Students ($N = 172$ respondents) were asked whether they were motivated to practice drills, read content, and ask questions of the instructor by viewing the avatar–agent dialog. The results showed that more than half the students felt motivated to practice drills and read learning resources; about one-third of the students felt like asking questions.
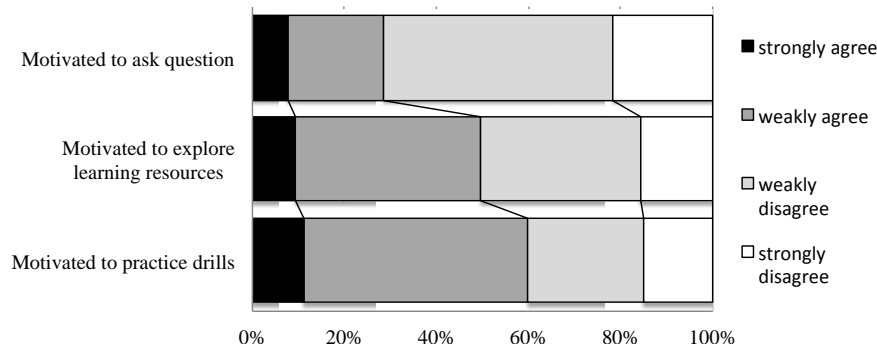
Figure 1. Results of the questionnaire on motivation for action after reading the avatar–agent dialog

Table 3 shows the students' responses to the multiple-choice question regarding why, after observing the avatar's dialog, they selected the actions shown in fig. 1. The results suggested that rather than to play the avatar's functions, the students were more motivated to learn through the dialogs. As for the gaming nature of this learning environment, it was suspected that the students did not necessarily require the system to be as enjoyable as a game.

Table 3: Reasons for the selection of the actions shown in Fig. 1 (one can select more than one item)

|  | Number of students |  | Number of students |
|---|---|---|---|
| To deepen understanding | 179 | To increase knowledge | 149 |
| To be able to solve quiz | 134 | To gain better evaluation | 121 |
| To overcome weakness | 100 | To establish knowledge | 89 |
| *To increase points | 81 | *To change my mood | 79 |
| *To raise an avatar | 75 | Others | 26 |

*These items are system specific.

## 4. Conclusion

A link list with an annotation type e-learning system was reconstructed and aimed at an exploratory learning environment based on a dialog-centered interface. The dialogs between an avatar and an agent corresponded to those between a learner and an instructor and were supplemented with automatic replies containing encouraging phrases. This method was based on the learners making more self-encouraging comments compared with the negative comments that the instructor should address first.

Approximately half the respondents felt somewhat motivated to explore the system by looking at the dialog-centered portal. This suggests that the dialog evokes reflection on learning and stimulates further exploration.

## Acknowledgements

## References

Matsuura, S. (2009). Development of a Trans-Field Learning System Based on Multidimensional Topic Maps. *Linked Topic Maps, Fifth International Conference on Topic Maps Research and Applications TMRA 2009*, University of Leipzig, Institute fur Informatik, 19, 83-89.

Park, J., & Hunting, S.(eds) (2002). XML Topic Maps: Creating and Using Topic Maps for the Web. Addison-Wesley Professional.

Childs, M., & Peachey, A. (2013). Understanding Learning in Virtual Worlds. Springer-Verlag London.

# A Discussion on Web-based Learning Contents with the AR technology and its Authoring Tools to Improve Students' Skills in Exercise Courses

**Tatsuya KOBAYASHI [a*], Hitoshi SASAKI [a], Akinori TOGUCHI [b], and Kazunori MIZUNO [a]**
[a] Faculty of Engineering, Takushoku University, JAPAN
[b] Media Labo Co., Ltd., JAPAN
*r08446@eitl.cs.takushoku-u.ac.jp

**Abstract:** In recent years, use of Web based instruction manuals by using Web browser have been made in Exercise Courses such as practical subjects and exercises. So far, we developed new e-Learning contents for learners by using the AR(Augmented Reality) technology that can instruct to actual equipment and we conducted the evaluation experiment. Results of evaluation experiment was indicated that content is useful for Exercise Courses. However, there is a problem that it is not easy for teacher to create contents when consider using contents in real classes. To solve these problems, we developed authoring tool using the Action-Script3.0 and conducted the evaluation experiment. We developed a new authoring tool using JavaScript and HTML5. Moreover, we improve GUI of authoring tool by using jQuery. In addition, we expand the function by using WebRTC and Google Drive for ease of use.

**Keywords:** learning contents, exercise courses, AR technology, authoring tool

## 1. Introduction

In the engineering education field, laboratory courses such as practical subjects and exercises are very important lessons for confirming theories studied. In these courses, use of Web based instruction manuals(Takayama, 2008) by using Web browser have been made in recent years. The Web based instruction manual is containing rich illustration to describe about experiments work. However, there is a problem that it is not easy for some students to associate that web based instruction manuals and real environment(Toguchi, 2010). To solve this problem, we have developed new e-Learning content by using the AR technology(Toguchi, 2010) that can superimpose instructions on actual equipment so far. To use in real classes, teacher need to create new e-Learning content by using the AR technology by describing XML. However, to create the contents going to describe each type of information in XML tags was big burden(Toguchi, 2011). Because teacher must be specified one by one the coordinates of the object to be superimposed and have programming knowledge. Moreover we worked on the development of Authoring tool that can create contents in text input and simple mouse operation in order to easily create contents even unnecessary to write in XML(Toguchi, 2012).

At first, development of authoring tool using the Action Script was developed. Moreover the evaluation experiment of authoring tool is also implemented, content creation can be easily even people that do not have programming knowledge was confirmed. Then the operation has been suggested in real classes by results of the evaluation experiment. Demanded more convenience, and worked on the development of authoring tool able to create content with only a Web browser without relying on plugins such as Flash Player by using JavaScript and HTML5. Moreover, we review GUI of authoring tool by using jQuery. In addition, we improved the function of authoring tool by using WebRTC and Google Drive for ease of use.

In this paper, we report improvement of authoring tool using JavaScript and HTML5 that newly worked on the development.

## 2. The authoring tool using JavaScript and HTML5

We thought content could be created in a Web browser by performing developed using JavaScript. That it is possible to expand the range of use. We newly worked on the development of authoring tool(Kobayashi, 2013) using JavaScript and HTML5(W3C, 2004). Moreover, it was developed by use of jQuery(Resig, J. 2006). It is a lightweight JavaScript library focused on DOM(Document Object Model) manipulation and change. By using jQuery, can implement the complicated processing by less description. In addition jQuery is a cross-browser, can be used without worrying about the differences between browsers.



Figure 1. Example of editing a learning content.

In addition, improved this authoring tool by using WebRTC(Web Real Time Communication) (W3C, n.d.). It is one of a framework for the Web application that allows real-time communication on the Web browser. We could be easily used because API such as getUserMedia and PeerConnection has already been prepared. In this way we has been working so far in order to easier to use. Basic functions are the same as authoring tool using Action Script. However, we newly improved the three main functions and tried at the improvement of convenience. Figure 1 is showing edited a learning content actually by placing an object to be superimposed on image of the real environment.

First, "image read and display function " was improved the ability of read and display function of the real environment by using WebRTC. Moreover, we improved superposition of instruction tag to allow the real environment of remote location. Next," object placement and edit function "was added newly a format bar to authoring tool using JavaScript and HTML5. Therefore, improved to free formatting from the format bar into the object. In the format

```
<data>
  <annotation step="1">
   <icon>Annotation/images/7.png</icon>
   <content>
    <text size="25"
color="#f6e61e">10k</text>
    <media type="null">null</media>
   </content>
   <position>
    <x>111.6</x>
    <y>13.3</y>
    <z>0</z>
   </position>
   <size>
    <width>100</width>
    <height>100</height>
   </size>
  </annotation>
    .
    .
```

bar can be set font-size, font-color, bold, italic and input text start position. In the format bar, can set font-size, font-color, and bold, italic and text-align. Therefore, it has become possible to  Figure 2. Figure 1 of XML file created.

edit the object freely than authoring tool using Action  Script. Finally, "Content output function" was improved to be able to save the Cloud storage using Google Drive(Google,  2012). It is a cloud storage service provided free of charge up to 5GB by Google. By saving in Google Drive, it can access the files from environment connected to the Internet. In addition, it was becomes possible to share and edit jointly. Figure 2 is showing output XML file from Figure 1.

## 3. Conclusions

In this paper, we reported authoring tool using JavaScript and HTML5. We expanded the function of this authoring tool by using a variety of techniques. At first, we improved GUI of this authoring tool by using jQuery. User can be used regardless of the type of Web browser in the device of user because jQuery is a cross-browser. Second, we developed to allow reading the real environment of remote location by using WebRTC. Third, user was able to save the Cloud storage by using Google Drive. User can access the files from environment connected to the Internet and becomes possible to share and edit jointly. For these expand of functions, this authoring tool became easier to use.

### Acknowledgements

### References

Takayama, T., Kato, K., Sasaki, H., & Shikoda, A. (2008). Proficiency Evaluation for Engineering Experimentation Utilizing Web Log Analysis. IEICE technical report, 108(146), 63–66.
Toguchi, A., Sasaki, H., & Shikoda, A. (2010). A Development of Web Learning Contents by using the Augmented Reality. 26th Conference Proceedings Japan Society for Educational Technology, 371–372.
Toguchi, A., Sasaki, H., Mizuno. K., & Shikoda, A. (2011). A Development of Web Learning Contents by using the Augmented Reality(2). 27th Conference Proceedings Japan Society for Educational Technology, 237–238.
Toguchi, A., Hatanaka, A., Sasaki, H., & Mizuno, K. (2012). A Development of Web Learning Contents by using the Augmented Reality(3). 28th Conference Proceedings Japan Society for Educational Technology, 863–864.
Kobayashi, T., Sasaki, H., Toguchi, A., Mizuno, K., & Hatanaka, A. (2013). A Development of Web Learning Contents by using the Augmented Reality(4). 29th Conference Proceedings Japan Society for Educational Technology, 845–846.
W3C. (2004). HTML5. Retrieved January 10, 2014, from http://www.w3.org/TR/html5/
Resig, J. (2006). jQuery. Retrieved January 10, 2014, from http://jquery.com/
W3C. (n.d.). WebRTC. Retrieved May 20, 2014, from http://www.webrtc.org/
Google. (2012). Google Drive. Retrieved May 20, 2014, from https://drive.google.com

# An Online System for Scoring and Plagiarism Detection in University Programing Class

**Asako OHNO[*], Takahiro YAMASAKI, and Kin-ichioroh TOKIWA**
*Faculty of Engineering, Osaka Sangyo University, Japan*
*ohno@eic.osaka-sandai.ac.jp

**Abstract:** Scoring and plagiarism detection in university programming classes are important but time-consuming and burdensome tasks for teachers. In this paper, we explain about the structure and functions of the online education support system developed for university programming class. The system mainly provides two functions: scoring function and plagiarism detection function implementing two different kind of similarity measuring methods that had been proposed in the previous studies. Each of the methods calculates similarity between a pair of source codes in different aspect: content-based similarity and style-based similarity. This paper also describes how those two different methods work for the system to provide each functions with summarized explanations of each of the methods.
**Keywords:** Source code similarity, programming education, online education support system

## 1. Introduction

There have been many education support systems proposed for programming class. Along with the recent diffusion of Java in university programming classes, many of the system are aiming to score or detect plagiarism among Java source files (Ihantola, et al., 2010). Another survey said it was difficult to evaluate which one of the proposed systems was the most efficient because many of them applied the system to the source codes with were in designated formats (Queirós and Leal, 2012).

There are some issues to be considered regarding the nature of source codes produced as assignments in programming classes when providing scoring and plagiarism detection function. For example, source codes produced as assignments are generally short in length so that it difficult to quantify feature that contains rich enough information to represent its algorithmic or structural features. This characteristic makes it difficult to measure similarity between model answer and students' source codes. It may also difficult to find plagiarism from a pair of short source codes. Further, regarding plagiarism detection function, it is difficult to distinguish similarities in nature with the ones caused by plagiarism because generally, source codes produced in programming classes are produced to achieve the same purpose and the students are often ordered to use the same algorithms that they had just learned in their class. We have developed an education support system for (mainly Java, but also applicable for C) programming class that implemented two similarity measuring methods: FRef (Ohno and Murao, 2007) that quantifies content-based similarity from short source codes by using arbitrary-chosen reference source codes as scoring function and CM Algorithm (Ohno and Murao, 2011) that quantified author's coding style feature instead of content-based feature by training a set of hidden Markov models. In this way, we can achieve plagiarism detection robust against disguising copied source codes and ghost writing which were both difficult to deal with content-based similarity measurements. Furthermore, there is also a possibility of reducing psychological burdens for both teachers and students through the plagiarism detecting process.

The rest of the paper is organized as follows: we explain about the summarized procedures and characteristics of two different methods in Section 2, explain about structure and main functions provided to teachers and students via web-based GUI in Section 3, and summarized the paper with future works in Section 4.

## 2. Implemented methods

In this study, we developed an online education support system for university programming class. To provide scoring and plagiarism detection function, the system is implementing two kinds of

similarity measuring methods: FRef and CM Algorithm. Table 1 summarizes the differences in two methods.

Table 1: Differences in proposed two similarity measuring methods

| Method | FRef | CM Algorithm |
|---|---|---|
| Usage | Scoring, Source code retrieval | Plagiarism detection, Teaching coding standard |
| How to calculate similarity | Calculate a reference vector with a number of reference source code and calculate Euclidean distance between two source codes' reference vectors | Input a submitted source code and calculate output probability of the coding models (HMM), and compare the result with the model answer's case |
| Similarity criteria | Content-based similarity | Style-based similarity |

FRef is originally proposed to find similar source codes in the repository. As a preprocessing, a source code is firstly tokenized and normalized to be represented as a sequence of tokens. A number of reference source codes had been chosen arbitrary from the repository are also transformed into token sequences. By using two kinds of token sequences, a set of co-occurrence matrices each of which represents distributions of shared tokens between the two sequences are generated. Then the distribution tendency of the shared tokens is quantified by calculating 5 kinds of *Textural Features*. The 5 textural features for each of the co-occurrence matrices are treated as elements of a feature vector called *reference vector*. In this way, content-based feature of a source code is represented relatively by utilizing a number of reference source codes as a number of different bases. The detailed procedure of FRef can be found in the former work (Ohno and Murao, 2007).

As the preprocessing of CM Algorithm, a source code is tokenized and normalized into one of the predefined three kinds of tokens groups: basing point tokens, identification tokens, and others. The tokens used in most source codes regardless the kind of programming languages, such as braces (ex. ``{"), assignment operators (ex. ``="), comments, punctuation marks (ex. ``;") are treated as one of 14 types of *basing-point tokens*. In CM Algorithm, we quantify the superficial feature of source code files occur regardless of the content as the author's *coding style feature*. The feature is defined as the occurrence pattern of *adjacent* tokens of basing point tokens called *identification tokens,* i.e. 1 to 4-letter spaces, tabs, and linefeeds. The remaining tokens are called and normalized as *other tokens*.
After representing a source code by a token sequence consists of one of the three groups of tokens, a token sequence is divided into a number of subsequences by using other tokens as delimiters to fit as input data of coding *models*. The structure and kinds of parameters of the coding models are based on *hidden markov model.* The coding style feature of author is represented as parameters and structures of a set of 28 coding models. Each of which represents different parts of the author's coding style. The detailed procedure of CM Algorithm can be found in the former work (Ohno and Murao, 2011).
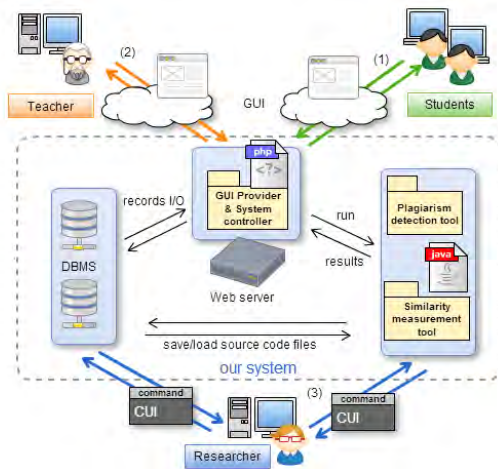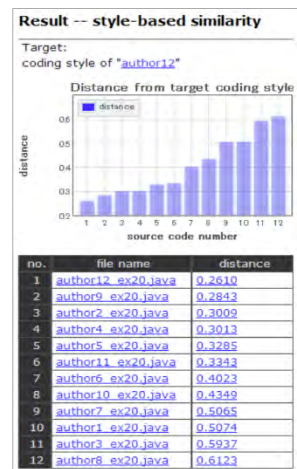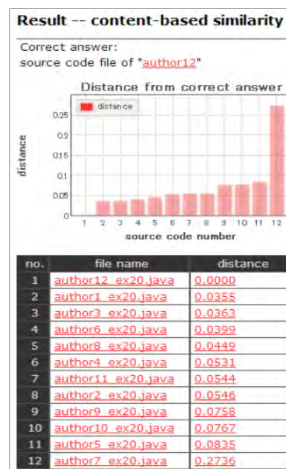


igure 1. An overview of the developed system.



Figure 2. Examples of similarity calculation results.

## 3. About the system

Figure 1 shows an overview of the system. The system consists of two similarity measurement tools developed in Java, GUI and controller of the system developed in PHP and Database Management System. Figure 2 shows examples of similarity calculation results provided for teachers via web-based GUI. The content-based similarity calculated by FRef is utilized for scoring (left) and the style-based similarity calculated by CM Algorithm is utilized for plagiarism detection (right). As shown in Figure 4, the repository of the system consists two parts: a database utilized in our system and a data set of source code files. A database contains users' information such as ID and password for teachers and students, user profile for students such as his/her coding style feature, progress of assignments, information of assignments such as questions and answers, information of grading such as scores and possibility of plagiarism for each of the assignments. A data set of source code files is only utilized at the preparation phase; that is, calculation of reference vectors for source code similarity measurement and training of coding models to represent students' coding style features utilized for plagiarism detections. Another chance is that when a source code is newly posted, modified, or delated.
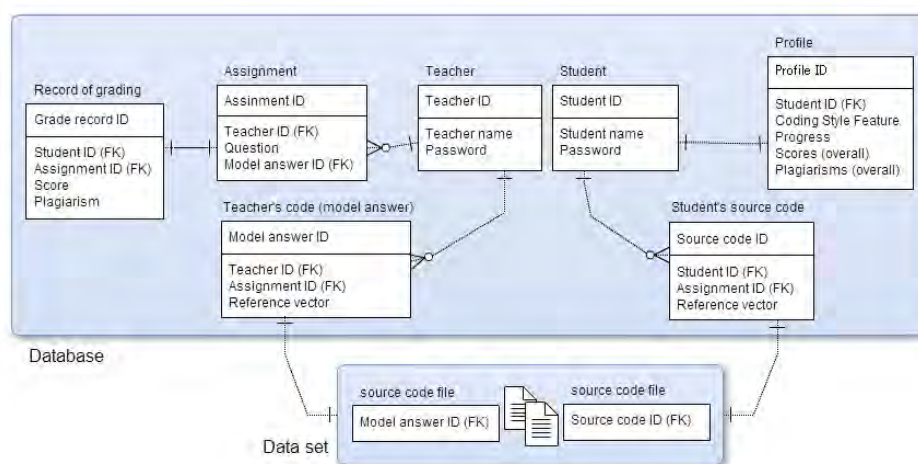


Figure 4. An overview of the repository.

## 4. Conclusion

In this paper, we developed an online education support system that provides scoring and plagiarism detection functions for the users accessed to the system via web-based GUI. The system is implementing two different kind of similarity measuring method each of which had special features that proved high accuracy in source code similarity measurement according to content- and style-based similarities. As a future work, we apply the system into the real-world programming class for performance evaluation and modification.

## Acknowledgements

## References

Queirós, R. and Leal, J. P. (2012). Programming Exercises Evaluation Systems - An Interoperability Survey. *Proceedings of the 4th International Conference on Computer Supported Education, 1*, 83-90.

Ihantola, P. et. Al (2010) Review of recent systems for automatic assessment of programming assignments, *Proceedings of the 10th Koli Calling International Conference on Computing Education Research*, pp.86-93.

Ohno, A. and Murao, H. (2007). Measuring source code similarity using reference vectors. *International Journal of Innovative Computing, Information and Control, 3*(3), 525-538.

Ohno, A. and Murao, H. (2011). An Author Identification of In-Class Source Codes by using the Forward-Backward Coding Models. *ICIC Express Letters Part B: Applications*, 2(2), 453-458.

# Mobile-Assisted Learning Experimental Design: Current Deficiencies and Potential Improvements

**Yao-Ting SUNG[a], Han-Yueh LEE[b*], Je-Ming YANG[b], Wei-Cheng CHEN[b], Hak-Ping TAM[c], Yi-Shian LEE[d]**

[a]*Department of Educational Psychology and Counseling, National Taiwan Normal University,Taiwan*
[b]*Research Center for Psychological and Educational Testing, National Taiwan Normal University, Taiwan*
[c]*Graduate Institute of Science Education, National Taiwan Normal University, Taipei, Taiwan*
[d]*Aim for the Top University Project Office, National Taiwan Normal University, Taipei, Taiwan*
*ckshoupon@hotmail.com

**Abstract:** Due to the fact that mobile devices and educational software developed and expanded substantially in recent years, the importance of mobile-assisted learning may be raised. This study aimed to investigate the lack of the experimental design mobile-assisted leaning studies, and tried to make suggestions. Researchers collected all of the experimental studies on mobile-assisted learning published in ERIC and ISI from 2003 to 2013, which amounted to 216 studies. The four primary variables (research design, methods for initial equivalence in quasi-experiment, measuring tools and their reliability and validity, and sample size) were coded and preliminarily analyzed into frequency tables. Results of the study are as follows: (1) Researchers of 33.33% studies conducted the research by pre-experimental design or quasi-experimental design without equating, which were not rigorous sufficiently; (2) reliability and validity of outcome measures were not reported in 80% studies; and (3) sample sizes of approximate 30% studies were inadequate to draw an accurate statistical conclusion.

**Keywords:** Mobile-assisted learning, Design of experiments, Rigorous

## 1. Introduction

Along with the rapid development of mobile technology and software, mobile-assisted learning has already been widely adopted. In all mobile-assisted learning, a learner uses a mobile device (such as a smart phone, personal digital assistant, tablet PC, laptop, or other portable computer) to help them learn (Hwang, Tsai and Yang, 2008; Shih, Chu, Hwang and Kinshuk, 2011). There are several advantages of using a mobile device, such as the powerful calculating, high portability, wireless internet, instant communications, and context awareness. The advantages make mobile-devices become a tool with great potential for both traditional formal learning and informal outdoor learning. Although there were lots of experimental design studies exploring the effect of mobile-assisted learning, Cheung and Slavin (2013) warned that the results must be interpreted with caution because of serious methodological problems. They sorted out the common problems including the lack of a control group, limited evidence of initial equivalence between experimental and control groups, questionable outcome measures, small sample sizes, etc. Therefore, to examine the rigor of experimental design and improve the quality of educational experimental research will become increasingly important.

Valentine and Cooper (2008) proposed a research quality assessment scale named Study Design and Implementation Assessment Device (DIAD). DIAD includes four dimensions, which are internal validity, construct validity, external validity, and statistical conclusion validity. Internal validity refers to the validity of inferences about whether some intervention has caused an observed outcome. Construct validity refers to the extent of representative that intervention and outcome measures are supposed to be. External validity is the degree to which the results of a research can be generalized to other populations, settings, time, treatment variations, or outcomes. Statistical conclusion validity is the precision of outcome estimation. Based on the four dimensions proposed above, the purpose of this

study is to examine the current deficiencies and potential improvements in experimental design about mobile-assisted learning researches in last ten years.

## 2. Method
### 5.1 Data Sources, Search Strategy, and Search Results

This research employed electronic search to retrieve journal articles published since 2003 to 2013. The main databases were the Education Resources Information Center (ERIC) and the Social Sciences Citation Index (SSCI) database of the Institute of Science Index (ISI). Two sets of keywords were used: (1) mobile-device related keywords, including mobile, wireless, ubiquitous, wearable, portable, handheld, mobile phone, personal digital assistant (PDA), palmtop, pad, web pad, tablet PC, tablet computer, laptop, e-book, digital pen, pocket dictionary, and classroom response system; and (2) learning related keywords, including teaching, learning, training, and lecture. The two sets of keywords were combined to search the databases. The search yielded 4121 relevant literatures, and then reviewed by three researchers to assess their appropriateness for this study. Literatures were excluded if not using experimentation as research method. 216 articles were retained last for further analysis.

### 5.2 Variables Selection and Coding

To examine the studies' experimental design features, we chosen and coded four variables referred to the four dimensions of DIAD. The coded variables are as follows: research design (internal validity), methods for initial equivalence in quasi-experimental design (internal validity), measuring tools and their reliability and validity (construct validity), and sample size (external validity and statistical conclusion validity). Study coding was conducted by three researchers working independently. When disagreements occurred, the researchers inspected the studies in question together and reached a final agreement.

## 3. Result and Discussions
### 5.3 Internal validity

As shown in Table 1, we first found that true experimental studies are 35.65% of the total. This implies that only about a third of the studies are highly rigorous. Second, quasi-experimental studies took up the largest proportion (49.54%) of all research designs. Since quasi-experimental design lack the element of random assignment to experiment and control group, baseline comparability becomes an important issue. We further analyzed whether researchers used any of the method to ensure initial equivalence or not. There are 62.62% studies took two groups comparability into consideration by using adequate equating methods such as: (1) using t-test to confirm there are no significant difference between two groups in pre-test scores; (2) using gain scores (post-test – pre-test) as dependent variable to compare two groups; or (3) using ANCOVA or MANCOVA to exclude the difference between baseline ability of the two groups. However, there are still 37.38% studies didn't use any adequate equating procedures. Third, pre-experimental studies accounted for 14.82% of the total. This design cannot discriminate the treatment effect between intervention and participants' self-growth because of lacking a control group. To sum up, 72 of the 216 studies (33.33 %) were not rigorous sufficiently if we add pre-experimental studies to quasi-experimental studies that not using any equating procedures.

Table 1: Research design and methods for initial equivalence in quasi-experimental design.

| Research design | Rigorous | *N* of articles | % of total | % of QEAs |
|---|---|---|---|---|
| 1. Pre-experimental design | Not rig | 32 | 14.82% | - |
| 2. Quasi-experimental design | - | 107 | 49.54% | 100% |
|    2.1 t-test of pre-test scores are *ns* | Rig | 26 | - | 24.30% |
|    2.2 Using gain scores as dependent variable | Rig | 6 | - | 5.61% |
|    2.3 Using ANCOVA or MANCOVA | Rig | 35 | - | 32.71% |
|    2.4 Not using any adequate equating method | Not rig | 40 | - | 37.38% |

| | | | | |
|---|---|---|---|---|
| 3. True experimental design | Highly rig | 77 | 35.65% | - |

*Note.* N = number; QEAs = Quasi-experimental articles; rig = rigorous; *ns* = none significant.

## 3.1 Construct validity

According to the examination about the measuring tools and their respective reliability and validity (see Table 2) among the literatures, only 39 studies reported test reliability and validity both, which was only 18.06% of the total. Since decent test reliability and validity is the cornerstone of all rigorous research, approximate 80% of the research on this topic could make improvement.

Table 2: Measuring tools and their reliability and validity.

| Measuring Tool / Reliability and validity | Number of articles | Percent of total |
|---|---|---|
| 1.Self-design test/ unreported | 99 | 45.83% |
| 2.Self-design test/only reliability or validity | 57 | 26.39% |
| 3.Self-design test/ both reliability and validity | 34 | 15.74% |
| 4. Standardized test / unreported | 15 | 6.94% |
| 5. Standardized test / only reliability or validity | 6 | 2.78% |
| 6. Standardized test / both reliability and validity | 5 | 2.32% |

## 3.2 External validity and Statistical conclusion validity

Based on the description of various sample sizes (see Table 3), 73 studies had samples smaller than 50 people. According to Valentine and Cooper (2008), sample sizes must be at least 50 people or more in order to predict results fully and accurately. It means the results of 33.80% of the quantitative literature on mobile-assisted learning needs to be re-examined.

Table 3: Sample size.

| Sample size | Number of articles | Percent of total |
|---|---|---|
| 1. Below 50 | 73 | 33.80% |
| 2. 50-99 | 71 | 32.87% |
| 3.100-149 | 29 | 13.43% |
| 4.150-199 | 11 | 5.09% |
| 5. 200-249 | 8 | 3.70% |
| 6. Above 250 | 24 | 11.11% |

## 4. Conclusion and Future Work

According to the above, the standards of experiments on mobile-assisted learning need to be raised higher. Researchers could consider the 4 elements that DIAD proposed (internal validity, construct validity, external validity, and statistical conclusion validity) as a research criterion, and deal with them more rigorously in new studies. Furthermore, researchers could conduct a meta-analysis to compare and discuss the effects of various variables in the field.

## References

Cheung, C. K., & Slavin, R. E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review 9*, 88-113.

Hwang, G. J., Tsai, C. C., & Yang, S. J. H. (2008). Criteria, strategies and research issues of context-aware ubiquitous learning. *Educational Technology & Society 11*(2), 81-91.

Shih, J. L., Chu, H. C., Hwang, G. J., & Kinshuk. (2011). An investigation of attitudes of students and teachers about participating in a context-aware ubiquitous learning activity. *British Journal of Educational Technology 42*(3), 373-394.

Valentine, J. C., & Cooper, H. (2008). A systematic and transparent approach for assessing the methodological quality of intervention effectiveness research: The study design and implementation assessment device (Study DIAD). *Psychological Methods, 13*(2), 130-149.

# An Interactive Tool to Increase the Value of Learning

**Tosh YAMAMOTO** [a*]**, Maki OKUNUKI**[b]**,  Wu-Yuin HWANG**[c] **& Kentaro KOBAYASHI**[d]
[a]*The Center for Teaching and Learning, Kansai University A, Japan*
[b]*The Center for Teaching and Learning, Kansai University A, Japan*
[c]*Graduate Institute of Network Learning Technology, National Central University, Taiwan*
[d]*Researcher, Taisho University, Japan*
*ctltosh@kansai-u.ac.jp

**Abstract:** In this paper, it is extended that the value of interaction in education is fortified in a large-size classroom as well as in an international graduate classroom, in terms of the instant poll, understanding monitor, and the text message system, so as to initiate dialogs in learning in and outside classroom. It is our goal here that the interactive tool such as Clica can trigger the initiation for collaborative and deeper learning by learners. This paper is a report of an active learning project in progress for the interactivity in such challenged learning environments.

**Keywords:** Value in Learning, interactivity, ICT tool, clicker, text message, poll, understanding monitor, TBL, PBL

## 1. Introduction

We educators sometimes wonder what is in the mind of learners while the class is being conducted. Are they feeling comfortable being submerged into the unexplored world of knowledge or experience? Are they challenged by a newly introduced concept? Or are they lost in the forest of knowledge? So far, the instructor can do nothing but looking at students' facial expressions or sparkles of the eye to guess what in the student's mind. Is there any way to have a good grasp of what is going on in the learner's mind even in a large size class? Is there any way to know the impact or effectiveness of interaction in learning between the instructor and his/her students while the class is in session?

In this paper, it is extended that the value of interaction in education is fortified in a large-size classroom, say, 100 ~ 1000 students, or a graduate course with various international students, in terms of the instant poll and text message system called Clica, developed by the Digital Knowledge, Co.& Ltd. It is our goal here that the interactive tool such as Clica can trigger collaborative and deeper learning by learners. The various interactive experiments have been conducted in the undergraduate courses at Kansai University and the graduate courses at National Central University. This paper is a progress report of what has been found.

In what follows, the value in education is looked at carefully in the light of the value of interactivity in learning at first. And then, the current issues are reviewed. In the end, we will see the future direction of the research for the use of the newly introduced interactive probing tool.

## 2. Interactivity in Learning

### 2.1 The Value of Interactivity in Learning

Why is the interactivity in learning so important?  Tanya Elias (2011) puts it that "Learning is a product of interaction. Depending on the epistemology underlying the learning design, leaners might interact with instructors and tutors, with content and/or with other people. Many educators expend enormous amounts of effort to designing their learning to maximize the value of those interactions."  It follows that the value extended by the instructor and others including the content must be endorsed and then transcended by the learner. It is the future design of education!

## 2.2 Current Issues in Education

While observing the current classroom in the higher education, there are many issues to be addressed. First, we notice the large size of the class. Most schools have been economized in the operation of teaching by a small number of faculty members. This situation is very serious in an institution that is financially tight, where the matter of the operation cost is put more in front of the educational mission. Thus, the limited number of instructors there must conduct classes in a large size class, in order to educate a large population of students. In such a situation, it is very difficult for the instructor to have a good grasp of what each individual student is engaged in during the class. There is a limit of what one instructor can do in the large class or in an international graduate course.

## 2.3 Proposal

Our proposal here is to put the learning content in different learning context to overcome the difficulties mentioned above. With the advance of ICT in education, we can easily monitor students learning processes in the classroom, using the default application (browser) their own smartphones or tablet PCs. One such monitoring service is called Clica. Although there are many other ways to achieve the same level of success, we chose Clica for the following reasons. Here is a list of advantages.

- Clica does not require a special hardware or an application for communication. A preinstalled regular browser serves the purpose.
- There is no extra fee required for Clica usage. It is free of any charges.
- No preparation or account set up is required. Clica can be usable whenever the instructor or his/her students want to make use of in the course.
- The information and knowledge accumulated as well as the ideas and the discussion contents in the course are free from the public prying eyes. A service provided by Clica and the archived information will be secured to the course users only. Students in the course can securely discuss and exchange ideas online in and outside classroom throughout the course. It is a 24/7 course tool for engaged learners!
- Above all, all students as well as the instructor can be "on the same page" in the process of learning in the course.
- If the course is meant for the project-based learning through the team-based learning, each team can house their own discussion space in addition to the information sharing space for the entire class.

## 3. Clica

### 3.1 Basic Functions

The following figures show the basic functions of Clica. Figure 1 shows the log-in window. Without logging in, students cannot participate in the dialog in class. Figure 2 shows the activity window. There are three sections of activities. The top is for the instant poll. The second section is for monitoring students' understanding. And the bottom section is for text messaging to develop dialogs. It should be noted that the result of the poll, the understanding monitor, and the text message are archived and can be downloaded and used for the learning analytics.

### 3.2 Experiments

With a belief that active learning can produce more learning outcomes than passive learning, in addition to the content of learning, the interactive context for learning has been even added to the one-directional lecture style classroom. For example, as a lecture content evolved in class, students were prompted

Figure 1. The Log in Window.



Figure 2. The Interactive Features

on the Clica screen to provide their thoughts and ideas about the key points. At the beginning stage of the Clica use, the communication was between the instructor and his/her students. However, as the students became use to Clica, they helped each other understand the introduced content deeper by sharing their views among themselves and by providing information that other students did not know. In the end, an ideal collaborative learning comm
unity was established. Thus, both in the large size classroom and in the international graduate course, highly interactive learning environments were established.

## 4. Progress and the Future Direction

Students' engaged and active learning is the key to lead us to the better future. Thus, the mission of education is to make them stand on their own feet to think critically and creatively in teams through communication. Our goal is to make such communication within the team as well as in class seamless to share various views and to deepen understanding. We would like to enrich more the interactivity in learning in the large size by implementing ICT yet to come.

## Acknowledgements

## References

Anderson, J. E. (2007). Clickers in the Large Classroom: Current Research and Best-Practice Tips. *CBE Life Sciences Education.* Vol. 6, Spring 2007. Available: http://www.lifescied.org/
Martyn, M. (2007). Clickers in the Classroom: An Active Learning Approach. Further research will determine whether clickers complement or surpass other active learning approaches in improving learning outcomes. *EDUCAUSE Quarterly.* No. 2, 2007. Available: http://net.educause.edu/ir/library/pdf/EQM0729.pdf.
Yamamoto, T. (20013). Make a Wish upon ICT. *Japan Universities for Computer Education Journal, 2013.*

# Code Book©- The development of an Adventure Action Game for History Instruction and the Evaluation of Flow State, Learning Performance and Gender Difference

**Hao-Wei CHEN [a], Huei-Tse HOU [a*], Yi-Shiuan CHOU [b]**

[a]*Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taiwan*
[b]*Graduate Institute of Information and Computer Education, National Taiwan Normal University*
*\*hthou@mail.ntust.edu.tw*

**Abstract:** This study aims to develop a first-person adventure action game-Code Book© for history learning, and to explore learners' learning performance and their flow state in the game. The present empirical research included 38 Taiwanese college students. The results showed that learners' learning performance improved and they reached high flow state. In addition, no significant difference was found between male and female students in terms of their learning performance and flow state, suggesting that this game is suitable for learners of both genders.

**Keywords:** history, game-based learning, role-playing, flow, learning effectiveness

## 1. Introduction

In the recent years, Game-based learning (GBL) has been applied to many school subjects. History is one of the subjects that contain many elements such as people, place, events, and so on. Learners were traditionally required to memorize lots of knowledge for history learning, and it may reduce their learning motivation. Dondlinger (2007) indicated that games can stimulate learners' deep thinking in history learning. Several studies have also reported that GBL provides a self-learning environment (Raybourn & Bos, 2005) and it can promote learners' motivation (Annetta et al., 2009). In the present study, our research team (NTUST MEG)(http://www.ntustmeg.net/) developed an educational game with FPS Game Creator© to assist learners in learning the history of Opium Wars (a diplomatic event in China, 1840-1842). The background of the game was during the World War II, and a secret agent was looking for a confidential file in the headquarter of the German Army. The secret agent needed to analyze the information in the books or confidential files hidden in different locations and to get the code book to escape from the headquarter. The study adopted the role-playing theories (Shaftel & Shaftel, 1967) by asking the learners to play the secret agent. With the background and missions in the game, learners were encouraged to accomplish the missions by believing that they were the agent in the game. We also adopted the scaffolding theory (Wood, Bruner, & Ross, 1976) by showing history information along with the prompt of every file (see Figure 1). With the prompt, players could find out the code book and the way out. This game also added intense plots and the scenario of chasing and escaping from the enemy (see Figure 2). This study aims to explore learners' flow state in history learning through this action game, to evaluate learners' learning performance, and to analyze gender differences.

**Figure 1 Screenshot of the game-a related historical file was found**



**Figure 2 Screenshot of the game-challenging scenarios**

## 2. Method

Participants in this study were 38 college students from one institute of technology in Taiwan. They were 11 males and 27 females of 19-22 years old. This study adopted the flow scale developed by Kiili(2006) to measure the learners' flow. The Chinese version was translated and revised by Hou & Chou(2012). The five-point Likert scale questionnaire included 23 items with two dimensions: flow antecedents and flow experience. The analysis of data from our samples showed that its Chronbach's alpha reliability was 0.93. This study used the same questions in pre- and post-tests, and the questions were designed by an expert in history. There were five questions for the test. The procedures of this study were as follows. Five minutes for the pre-test, ten minutes for introduction of the game and basic operations, 25 minutes for students to play the game, five minutes for the post-test and 25 minutes for the flow questionnaire.

## 3. Results and Discussions

In terms of learning effectiveness, this study conducted a paired-samples t-test on the pre- and post-test scores. The results indicated that after the GBL activity, students' knowledge in history was significantly improved (t=-5.33, p<0.001).

**Table 1 Paired-Samples t Test**

| Outcome | pretest(n=38) | | pretest(n=38) | | |
|---|---|---|---|---|---|
| | M | SD | M | SD | t |
| Pretest-posttest | 1.32 | 1.25 | 2.68 | 1.45 | -5.33*** |

***p<0.001

As for the flow, as shown in Table 2, the average scores of each dimension were above 3.00 (the median was 3.00). It shows that most of the learners were reached high flow state during the game. In terms of the sub-dimension of the flow antecedents, the mean scores of feedback (M=3.68) and playability (M=3.68) were higher, suggesting that learners could know how they performed in the game based on the feedbacks and that learners could play the game easily. In addition, in terms of the sub-dimension of flow experience, the average scores of concentration (M=3.80) and time distortion (M=3.79) were higher, implying that learners' attention to the game was high. This high attention to the game made learners forget about the time and reach high flow experience.

**Table 2 The mean and standard deviation of flow questionnaire**

| Flow Dimensions | M | SD |
|---|---|---|
| Flow Antecedents | 3.63 | 0.67 |

| | | |
|---|---|---|
| Challenge | 3.54 | 0.83 |
| Goal | 3.64 | 0.78 |
| Feedback | 3.68 | 0.76 |
| Control | 3.62 | 0.75 |
| Playability | 3.68 | 0.77 |
| Indicators of Flow Experience | 3.73 | 0.59 |
| Concentration | 3.80 | 0.80 |
| Time distortion | 3.79 | 0.70 |
| Autotelic experience | 3.70 | 0.82 |
| Loss of self-consciousness | 3.57 | 0.68 |

The study explored the differences of flow state and learning performance between learners of different genders with a t-test (see Table 3). The results showed that no significant difference was found between male and female students in terms of their flow antecedents ($t=0.12$, $p=0.906$) and flow experience ($t=-0.29$, $p=0.774$). This finding violated our hypothesis that male students may be more involved in the 3D first-person action game. One possible explanation is that most participants in this study are students from the multimedia design discipline, and many of them had the experience in 3D game objects design or operation. Moreover, the game included both battle and puzzle-solving missions. Whether the player could accomplish the missions mainly relied on the clues hidden behind the history knowledge. This may explain why no significant difference in students' interests in this part was observed between males and females. Scores from both genders in all dimensions were higher than the median 3.00, suggesting a positive flow state to a certain degree. Likewise, no significant difference existed between males and females in their improved learning performance. Therefore, this game should be suitable for both genders even though it was an action game.

**Table 3 Gender difference in flow state and pre- and post-tests**

| Dimensions | Groups | | | | | |
|---|---|---|---|---|---|---|
| | Male(n=11) | | Female(n=27) | | | |
| | M | SD | M | SD | t | p |
| Flow Antecedents | 3.65 | 0.60 | 3.63 | 0.70 | 0.12 | .906 |
| Indicators of Flow Experience | 3.68 | 0.64 | 3.74 | 0.58 | -0.29 | .774 |
| pretest scores | 1.73 | 1.35 | 1.15 | 1.20 | 1.30 | .201 |
| posttest scores | 3.00 | 1.84 | 2.56 | 1.28 | 0.85 | .400 |

Future research may further investigate learners' learning process with more large-scale experiments and behavioral pattern analysis.

**Acknowledgements**

**References**

Annetta, L. A., Minogu, J., Holmes, S. Y., & Cheng, M. T. (2009). Investigating the impact of video games on high school students' engagement and learning about genetics. *Computers & Education, 53*, 74-85.

Dondlinger, M. J. (2007). Educational video game design: A review of the literature. *Journal of Applied Educational Technology, 4*(1), 21-31.

Hou, H. T., & Chou, Y. S. (2012). *Exploring the technology acceptance and flow state of a chamber escape game-Escape The Lab© for learning electromagnet concept*. Poster presented at the 20th International Conference on Computers in Education (ICCE2012), Singapore, November 26-30, 2012.

Kiili, K. (2006). Evaluations of experiential gaming model. *Human Technology, 2*(2), 187-201.

Raybourn, E. M., & Bos, N. (2005). Design and evaluation challenges of serious games. In *Proceeding of the SIGCH! Conference on Human factors in computing systems*, (pp. 2049-2050), ACM, USA.

Shaftel, F. R., & Shaftel, G. (1967). *Role-playing for social values: decision-making in the social studies*. Prentice-Hall.

# Does Text-to-speech Synthesis Fit the EFL Learners' Needs in EIL Context?

**MARTRIWATI[a], Herri MULYONO[a]\*, & Devi Nur VEBRIYANTI**
[a]*University of Muhammadiyah PROF. DR. HAMKA, Indonesia*
*\*hmulyono@uhamka.ac.id*

**Abstract:** The present study attempts to evaluate a TTS synthesis system from the perspective of EIL. 100 pre-service teachers are selected to evaluate speech produced by a TTS synthesis system with the respect of intelligibility, naturalness, prosody, and social impression. A questionnaire adopting the MOS X is developed to evaluate speech in three experiments.

**Keywords:** Text-to-speech (TTS), English as international language (EIL), English as foreign language (EFL)

## 1. Introduction

Many literature (e.g. Handley, 2009; Sha, 2010; Sobkowiak, 2003) have discussed potential benefits from utilizing text-to-speech (TTS) synthesis in English as foreign language (EFL) classroom. The TTS synthesis, in computer assisted language learning (CALL) contexts may be used as a reading machine, a pronunciation model and for conversational partner (Handley, 2009; Handley & Hamel, 2005). The use of English as international language (EIL) has emerged number of people who speak variety of English, known as *World Englishes* (see Jenkins, 2006; Jenkins, 2009). In this tenet, English may be contextualized with the respect of a local culture and context as well. Such contextualization, of course, will drive the scope of authentic materials beyond what it has previously been defined by some well-known authors (e.g. Brown, 2004; Harmer, 2007).

So far, the evaluation of TTS synthesis as CALL application has been evaluated in perspective of native speakers. In such evaluation, a good English model is still justified in reference with a model from its native speakers. This justification seems to overlook the wide use of the world Englishes in daily communication. Jenkins (2006, p. 175) argues that there is a need "to abandon the native speaker as the yardstick and to establish empirically some other means of defining an expert (and less expert) speaker of English." Thus, the present study attempts to evaluate a TTS synthesis system from the perspective of EIL. The research questions being addressed is: "Does text-to-speech synthesis fit the EFL learners' needs in EIL context?"

## 2. Methodology

### 2.1 Research design

The present study attempts to evaluate a TTS synthesis system from the perspective of EIL. For such a purpose, the study adopts an experimental design with two methods including survey and test. As shown in Table 1, the TTS synthesis system is evaluated with respect to four aspects, including intelligibility, naturalness, prosody and social impression (see section 2.4). A listening comprehension test will be performed to evaluate the pre-service teachers' listening comprehension before and after an intervention.

### 2.2 Participants

As the present study attempts to evaluate the use of TTS synthesis in CALL, Handley (2009) suggests that the participants should be the end-user of TTS synthesis in CALL context. For such a purpose, the present study selects 100 pre-service teachers to participate. At present, the 100 pre-service teachers are taking a course on instructional technology at the university of Muhammadiyah Prof. DR. HAMKA Jakarta Indonesia. One of the course modules taught to the pre-service teachers is using

technology to facilitate English teaching. In this module, the participants are introduced to TTS to support their further English teaching.

### 2.3 TTS synthesizer

In current study employs NaturalReader (NR) for the TTS synthesizer. We have sought that NR suggests benefits in ELT particularly the teaching of listening comprehension (Mulyono, 2014). In addition, NR has similar features as other TTS synthesizer as in Sha's (2010) experiment. Table 1 shows the features of NR used:

Table 1: The features of TTS synthesis used.

| TTS synthesizer | Sex | Voice | English use | XML* Tag |
|---|---|---|---|---|
| NaturalReader | Female | Natural Voice Kate | American | Kate |
| NaturalReader | Male | Natural Voice Paul | American | Paul |

### 2.4 Instruments

Three sets of questionnaire are employed to evaluate the pre-service teacher perceptions towards: 1) NS recorded materials, and 2) EIL recorded materials, spoken by NNS, 3) listening materials developed by using TTS synthesis. The three sets of questionnaire adopts 15 item number questionnaire with 7-point scale MOS (mean opinion scale) X suggested by Polkosky and Lewis (2003) for each factor including intelligibility, naturalness, prosody, and social impression. Polkosky and Lewis propose that such a questionnaire was "a theoretically-derived, [and] psychometrically sound factor structure" (p. 174). They also suggest that each factor deployed in the questionnaire was reliable for applicability evaluation, $\alpha > .70$.

In addition to questionnaire, a listening comprehension test will be developed to examine if the pre-service teachers' perceptions of TTS technology may affect their listening comprehensions. The test will be distributed prior to and after an intervention. A delayed posttest will also be distributed to the research participants to evaluate the effect in a longer term.

### 2.5 Experiment procedure

In the first experiment, the participants are given a listening comprehension task. The audio materials used for the listening materials are taken from webpages that use American English. The American English is selected as it is used during the instructional technology course. After the first experiment, the first questionnaire is distributed to gather information about the pre-service teachers' perception toward the NS recorded materials.

In the second experiment, the participants are given the second listening comprehension task that uses EIL recorded materials. This second listening comprehension task will be similar to the first one. The second questionnaire is distributed after the listening comprehension task to evaluate the participants' perception towards the EIL materials.

In the second experiment, the participants are asked to have the third listening comprehension task with similar content to the two previous ones. In the third listening task, the listening materials are developed by using TTS synthesis. The materials are designed in reference to context of the participants' daily life. The third set of questionnaire is distributed after the listening comprehension task to evaluate the pre-service teachers' perception towards the materials produced by the TTS synthesis.

### 2.6 Progress

Recently, we are at the preparation stage. In this stage, we are attempting to get consent for the use of materials from the webpage publisher. At the same time, we are now developing for the questionnaires used for the research instruments and the listening scripts.

Liu, C.-C. et al. (Eds.) (2014). Proceedings of the 22nd International Conference on Computers in Education. Japan: Asia-Pacific Society for Computers in Education

## References

Brown, H. D. (2004). *Language assessment: Principles and classroom practices*. New York: Longman.

Handley, Z. (2009). Is text-to-speech synthesis ready for use in computer-assisted language learning? *Speech Communication, 51*(10), 906-919. doi: http://dx.doi.org/10.1016/j.specom.2008.12.004

Handley, Z., H, & Hamel, M.-J. (2005). Establishing a methodology for benchmarking speech synthesis for computer-assisted language learning (CALL). *Language Learning & Technology, 9*(3), 99-120.

Harmer, J. (2007). *The practice of English language teaching* (4th ed.). Essex: Pearson Education Limited.

Jenkins, J. (2006). Current perspectives on teaching world Englishes and English as a Lingua Franca. *TESOL Quarterly, 40*(1), 157-181. doi: 10.2307/40264515

Jenkins, J. (2009). *World Englishes: A resource book for students*. London: Routledge.

Mulyono, H. (2014). Creating native-like but comprehensible listening texts for EFL learners using NaturalReader. *TESL-EJ, 18*(1).

Polkosky, M., & Lewis, J. (2003). Expanding the MOS: Development and psychometric evaluation of the MOS-R and MOS-X. *International Journal of Speech Technology, 6*(2), 161-182. doi: 10.1023/A:1022390615396

Sha, G. (2010). Using TTS voices to develop audio materials for listening comprehension: A digital approach. *British Journal of Educational Technology, 41*(4), 632-641. doi: 10.1111/j.1467-8535.2009.01025.x

Sobkowiak, W. (2003). TTS in EFL CALL - Some pedagogical considerations. *Teaching English with Technology, 3*(4), 3-11.

# Collecting Pairs of Word Senses and Their Context Sentences for Generating English Vocabulary Tests

**Yuni SUSANTI[a*], Ryu IIDA[a] & Takenobu TOKUNAGA[a]**
[a]*Department of Computer Science, Tokyo Institute of Technology, Japan*
*susanti.y.aa@m.titech.ac.jp

**Abstract:** This paper describes our ongoing work for automatically generating multiple-choice questions for English vocabulary tests. Vocabulary-type questions consist of four components: a target word, context sentences, a correct choice and distractors. To generate such type of questions, identifying the word sense of a target word in a context is crucial to create a correct choice in the context sentences. We propose a novel Backward method that utilizes the existing search engine API to obtain context sentences for a given target word sense and further applied word sense disambiguation to confirm the retrieved context sentences. Our preliminary experiment showed that the proposed method achieved 0.951 in accuracy in collecting word sense-context pairs.

**Keywords:** Question generation, multiple-choice vocabulary questions, language learning, word sense disambiguation

## 1. Introduction

As the demands of communication across diverse communities have been developing in the recent years, the use of English as the main international language has increased to interact with different societies both in business and academic settings. Owing to this, English proficiency tests such as TOEFL® and TOEIC® are important to measure the English skill of non-native English speakers. However, since the past questions of those tests are not freely distributed, test takers can only rely on a limited number of test samples and preparation books. It is beneficial for the test takers if similar questions of those tests can be automatically generated from vast amount of materials in the Internet.

To address that issue, this research works on automatic question generation for English proficiency test practice. As an example, we focused on the vocabulary-type questions because it is the majority type of questions in the TOEFL iBT® reading section and also appears in other English proficiency tests such as TOEIC®. TOEFL iBT® vocabulary-type questions consist of four components as shown in the right part of Figure 1: a target word, context sentences, a correct choice and distractors (wrong choices). To generate such type of questions, identifying the word sense of a target word in a given context is crucial especially to produce the choices (a correct choice and distractors) of the question. That is why, collecting pairs of a word used in a certain sense and its context (i.e. sentences in the passage that contain the target word, henceforth called *context sentences*) is indispensable. In this research, we propose a novel Backward (BW) method that utilizes the existing search engine API to obtain context sentences for a given target word from the Internet.

## 2. Related Work

Question generation in the language learning domain has been broadly studied, e.g. generation of fill-in-the-blank questions for completing a sentence, words collocation, synonym, antonym, etc. This paper describes our work on generating vocabulary-type questions which ask for "closest in meaning" of a target word. Similar work has been done by Brown et al. (2005), generating multiple-choice questions where their components were taken from WordNet (Fellbaum, 1998). Lin et al. (2007) also adopted WordNet filtered with web corpus searching for producing English adjective questions.

## 3. Method

To generate context sentences, we use the combination of the proposing BW method with Word Sense Disambiguation (WSD). The BW method chooses a sense of a target word randomly from the dictionary, and then uses a search engine to retrieve a snippet from the Internet that contains the target word with the chosen sense. WSD is then applied to the target word in the retrieved snippet to confirm that the predicted word sense is the same as the chosen sense. The confirmed snippet is used as context sentences for generating a question.
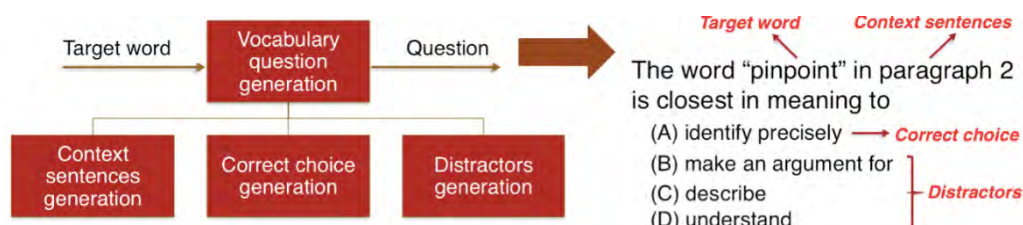


Figure 1. General workflow and components of TOEFL iBT® vocabulary-type questions.

### 3.1 Backward Method

In the BW method, given a target word, we start by choosing one of its word senses that has an example sentence in WordNet. Next, a query for the search engine is created from the example sentence by taking the target word and its adjacent words in both sides after removing the stop words such as *the, on, are,* etc. The third step submits the query to the search engine to retrieve snippets containing the target word with the chosen sense, and the last step selects one snippet which is the most suitable context sentences for the target word based on the following 3 scores: 1) word overlap between the example sentence and the snippet, 2) the number of adjacent query words to the target words in the snippet after removing the stop words, 3) the number of query words appearing in the snippet. The BW method is illustrated in Figure 2.



Figure 2. Backward Method.

### 3.2 Word Sense Disambiguation (WSD)

WSD is the task of identifying the meaning of words in context in a computational manner (Navigli, 2009). Vocabulary-type questions ask for "the closest in meaning" of a target word, thus to generate the correct choice we need to identify the meaning of the target word in a particular context. Therefore, WSD is very important in generating vocabulary-type questions, especially to generate a correct choice. The state of the art WSD methods as explained in McCarthy (2009) reaches around 0.37 in accuracy with knowledge-based approach, 0.88 with supervised and 0.82 with unsupervised approach. Further explanation on WSD can be found in survey papers by Navigli (2009) and McCarthy (2009). In this research we used Lesk Algorithm (Lesk, 1986) which chooses the sense that shares the highest number of words in its gloss in a dictionary and the current context. For example,

> Context sentence: I **inserted** the <u>key</u> and **locked** the door.
> Sense 1: Metal device shaped in such a way that when it is **inserted** into the appropriate **lock** the **lock**'s mechanism can be rotated.
> Sense 2: Something crucial for explaining; "The key to development is economic integration."

In this case, sense 1 is the correct sense for the target word "key" because its definition has 3 words overlap (*insert, lock, lock*) with the context sentence, while sense 2 has 0 overlap.

## 4. Result and Discussions

We conducted a preliminary experiment on two target word sets: 98 target words from sample question and preparation books of TOEFL iBT®, and 98 target words from Senseval data which is data from WSD workshop. These two target word sets share no common word. The Bing Search API was used as the search engine. The result is presented in Table 1.

Table 1: Experimental result.

| Methods | TOEFL iBT® | Senseval |
|---|---|---|
| WSD (Lesk Algorithm) | 0.602 | 0.296 |
| BW | 0.885 | 0.745 |
| BW + WSD | 0.951 | 0.843 |

In the evaluation of WSD, WSD was applied to target words in the TOEFL questions or in the Senseval data to predict their word sense. In the BW case, provided a sense of the target word, the BW method tries to find the context sentences in which the target word is used with the given sense. The word senses used in this experiment were chosen randomly from the first 2 senses in WordNet. Manual judgment was done to check whether the retrieved context sentences include the target word in the given sense or not. We further applied WSD to the target words in the retrieved contexts by the BW method, and filtered out those cases that the given and predicted word senses did not match. This result is shown in the "BW+WSD" row.

The accuracy of the BW method reached 0.885 on TOEFL iBT® data. In addition, by combining with WSD the accuracy improved to 0.951. Although it is still a preliminary evaluation, the proposed BW method combined with WSD shows promising results in this research. In particular, this method is suitable for our domain (language learning) because WSD in this domain is in general easier compared with common WSD domains (used in Senseval data) as shown in Table 1.

## 5. Future Work

We proposed a novel method to collect pairs of word senses and their context sentences from the Internet as the early steps for generating multiple-choice English vocabulary tests. In forthcoming work we will generate correct choice by using the sense's synonym or definition and the distractors of the questions to complete all necessary components of multiple-choice vocabulary questions. Next we also plan to evaluate generated questions through real English test for English learning students.

## References

Brown, J. C., Frishkoff, G.A., Eskenazi, M. (2005). Automatic Question Generation for Vocabulary Assessment. *Proceedings of Human Language Technology Conference and Conference on Empirical Methods in Natural Language Processing* (pp. 819-826).

Fellbaum, C. (1998). WordNet: An Electronic Lexical Database. Cambridge, MA: MIT Press.

Lesk, M. (1986). Automatic Sense Disambiguation Using Machine Readable Dictionaries: How to Tell a Pine Cone from an Ice Cream Cone. *Proceedings of the ACM SIGDOC Conference* (pp. 24-26), Toronto.

Lin, Y. C., Sung, L. C., Chen and M. C. (2007). An Automatic Multiple-Choice Question Generation Scheme for English Adjective Understanding. *CCE 2007 Workshop Proc. of Modeling, Management and Generation of Problems / Questions in eLearning* (pp. 137-142).

McCarthy, D. (2009). Word Sense Disambiguation: An Overview. *Language and Linguistics Compass 3* (2), 537-558.

Navigli, R. (2009). Word Sense Disambiguation: A Survey. *ACM Computing Surveys* (41), 2, Article 10.

# Effectiveness of Vision-Based Word Learning Using Head-Mounted Display

**Naoki SEKIGUCHI, Keiji YASUDA, Naoki KAWAI & Hiroaki KIMURA**

*KDDI R&D Laboratories. Inc.*

na-sekiguchi@kddilabs.jp

**Abstract:** We propose a word learning system using a lightweight head-mounted display (HMD). The system displays the relevant foreign word corresponding to the image recognized within the learner's field of view. We carried out an evaluation by comparing the number of memorized words under different conditions: i.e., where the words were related or unrelated to the learner's field of view using the HMD or a smartphone. The results of the experiments showed the effectiveness of the proposed system.

**Keywords:** Head-mounted Display, Image Recognition, Word Learning, Mobile Learning

## 1. Introduction

Many studies have examined the effectiveness of vocabulary learning methods using mobile devices, such as smartphones. Thornton and Houser (2005) sent three short mini-lessons via e-mail to university students each day, but only 10% of the subjects reported reading the messages each time. Lu (2008) sent two vocabulary lessons using the short message service every day and confirmed that there was a large deviation in study frequency, and it was clear that the lower the study frequency, the lower the vocabulary gain. According to these experiments, the problem was that the frequency of learner responses was low. If learners were enthusiastic about something other than learning or the learners' hands were not available, they ignored the message sent to their mobile devices. The possible cause for the infrequency of study was the small but troublesome action of taking the device out of their pockets or lack of interest. On the other hand, a context-aware learning system has been reported as an effective way of increasing learning opportunities. Li et al. (2012) developed the SCROLL system of recall learning quizzes via context i.e. location, time, and so on. Although the system contributed to an increase in learner responses, the consideration of gaining learner interest was not sufficient.

In this paper, we propose a vision-based word learning system that displays the foreign word related to the learner's field of view on a head-mounted display (HMD) to increase learning opportunities and learner interest. The latest lightweight HMD, such as Google Glass, can provide information to learners without any physical action. Hence, learners will not ignore the received information displayed on the lightweight HMD. In addition, the HMD can capture the learner's field of view as a still image using the built-in camera. Therefore, learners can acquire foreign words within the learner's direct field of view by using the HMD. Learning through experience and in real life contexts significantly facilitates the learning process (Brown, Collins, and Dugui 1989). Therefore, vocabulary acquisition is more effective for learners when the words are related to their activities, for example, when picking out a product from store shelves or looking at interesting signs. Little research has been conducted to survey the effect of learning using HMDs. Therefore, we evaluated the system by comparing the number of memorized words under different conditions. This study aims to answer the following research questions: (1) How much of an effect does the difference in visibility or comfort between HMD and smartphone have on learning and (2) is learning foreign words related to the learner's field of view a more effective method than showing words regardless of the context?

## 2. Word learning system under three different conditions

In order to explore the above research questions, we developed a word learning system as an Android application and prepared the following three different conditions.

- Condition A: Words only using a smartphone
- Condition B: Words only using an HMD
- Condition C: Words related to the learners' field of view using an HMD (proposed system)

Condition A uses a smartphone that displays the information as shown in Figure 1 (a), and conditions B and C use an HMD that displays the information as shown in Figure 1 (b), (c), respectively. In condition C, the proposed system captures the learner's field of view as a still image using a camera built into the HMD and immediately checks whether a part of the image matches the reference image in a prepared data set via image recognition technology based on binary local features (Uchida and Sakazawa 2013). The data set contains a number of reference images and relevant English-Japanese word pairs. A set of these processes is sequentially repeated about every second. If the image matches, the system selects the relevant word pair for display on the HMD in three seconds so that the learner can understand the information in the image. Thus, in condition C, the system displays the foreign words within the learner's field of view.

In conditions A and B, the learner learns the word regardless of the context. In the case of conditions A and B, the system provides English and Japanese word pairs for an eight-second interval. Then the system shows another word pair after two seconds. In the case of condition C, the learner can see the word on the HMD when looking at one of the 15 prepared reference pictures on the wall of the experiment room. For example, when the learner watches a picture of passports, the HMD displays the word "immigration." And then, learners memorize the word in each condition. Through the experiments, our research question (1) will be addressed by comparing the number of memorized words in conditions A and B, and research question (2) will be addressed by comparing the number of memorized words in conditions B and C.
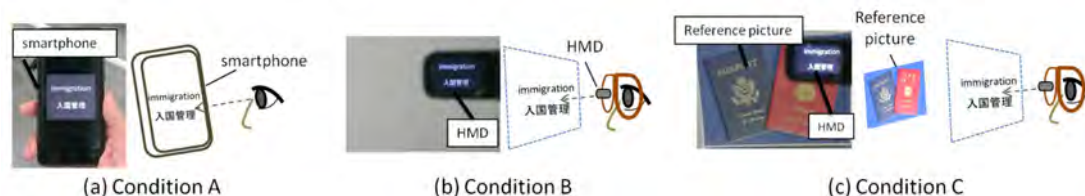


Figure 1. The view that a learner sees and schematics under each conditions

## 3. Experiments and result

The subjects were issued instructions on the procedures for the experiments. Before starting the experiment, all subjects became accustomed to wearing the HMD to accustom them to seeing images through it as naturally as possible. We divided subjects into two groups. One group conducted experiments A, B, and C in that order (first using a smartphone). The other group conducted experiments B, C, and A in that order (first using the HMD). The word test was conducted before and after each experiment, and the number of memorized words was enumerated. Other experimental conditions were as follows.

- Number of subjects: Eight Japanese college students
- Data set of word translation pair: 45 (15 words/each condition of A to C) of high difficulty i.e. low frequency, English nouns were selected from JACET 8000. Data sets used in each condition varied with the subjects.
- HMD: Vuzix M100 Smart Glasses

In order to evaluate the effectiveness of the system, the subjects took the same word translation tests before and after each experiment. We consider the increased numbers of correctly answered words as learning effects. We performed a Wilcoxon signed-rank test to compare the learning effects of the three conditions. The results of the test are shown in table 1. Here, the average number of memorized words under each condition and the significant difference between three pairs of conditions are shown. The results indicated no significant difference between conditions A and B. However, condition B had the potential of being more effective for learning because the information sent to the smartphone was often ignored whereas the information sent to the HMD was seldom ignored. The results of the test between conditions B and C showed a marginally significant difference at a significance level of 5% in a one-sided test. These results indicated that the proposed system was more effective for learning words than just showing the word regardless of the context. The reason was that the system made it easier to memorize words by associating foreign words with an image within the learner's actual field of view. However, we did not confirm a significant difference between conditions A and C. Some subjects did

not concentrate on learning because the HMD was uncomfortable, even though they had some practice using it before the experiments.

After the experiments, we conducted a survey in the form of a questionnaire, e.g., Q1: Is the HMD easy to wear? and Q2: Is the HMD a useful device for learning foreign words? The answers were collected and scored using a five-point scale. The results of the questionnaire are shown in Figure 2. The responses to Q1 indicated that only two subjects considered the HMD comfortable to wear; the others regarded the HMD as uncomfortable. In fact, some subjects took the time to acquire the ability to properly watch the display. On the other hand, the result of Q2 indicated that half of the subjects regarded the HMD as a useful device. The two subjects who answered, "The HMD is not useful for learning foreign words" also remarked as follows.

- "This HMD is not comfortable."
- "I was distracted from learning because I was unfamiliar with the HMD."

Considering these points, the proposed system was apparently a more effective learning system once the user became more accustomed to the HMD.

Table 1 : Resultt of Wilcoxon Signed Rank Test

| Condition | M | SD | Amount of statistics | |
|---|---|---|---|---|
| | | | compared with A | compared with B |
| A | 6.5 | 2.5 | N/A | ** - |
| B | 6.25 | 3.07 | ** | N/A |
| C | 8 | 2.55 | ** | * |

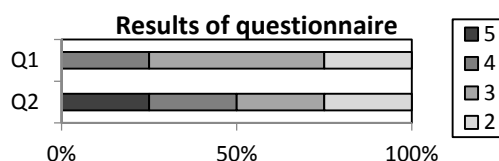* Significance level of 5 %
** No significant difference



Figure 2. Results of questionnaire

## 4. Conclusions

In this paper, we proposed a word learning system using a lightweight HMD that displayed a foreign word within the learner's field of view. After comparing the number of memorized words among three different conditions, we concluded that the proposed system was more effective than simply showing the word regardless of the context. We intend to carry out experiments to evaluate the learning opportunities using the system as a future research task.

## Acknowledgements

## References

Thornton, P., & Houser, C. (2005). Using mobile phones in English education in Japan. JCAL, 21(3), 217-228.
Lu, M. (2008). Effectiveness of vocabulary learning via mobile phone. JCAL, 24(6), 515-525.
Li, M., Ogata, H., Hou, B., Uosaki, N., & Yano, Y. (2012). Personalization in context-aware ubiquitous learning-log system. WMUTE, 2012 IEEE Seventh International Conference on (pp. 41-48). IEEE.
Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational researcher, 18(1), 32-42.
Uchida, Y., & Sakazawa, S. (2013). Image Retrieval with Fisher Vectors of Binary Features. In Pattern Recognition (ACPR), 2013 2nd IAPR Asian Conference on (pp. 23-28). IEEE.
JACET Basic Words Revision Committee. (2003). JACET List of 8000 Words (JACET 8000).

# Self-Directed Vocabulary Learning in Facebook: From the Perspective of Social Presence

**Yu-Chuan Joni Chao[a*], Greg Chung-Hsien Wu[b] and Hsing-Chin Lee**

[a*]*Providence University;* [b]*National Chengchi University;* *National Taipei University of Business*

joninz@gmail.com    gregwu1975@gmail.com    hsingchinlee@ntub.edu.tw

**Abstract:** This work-in-progress study, part of a granted research project that aims to assist university students of English as a foreign language (EFL) to use Facebook for self-directed vocabulary learning (SDVL), is to explore (1) to what extent Facebook motivates learners' participation and (2) to what extent Facebook motivates learners' engagement in the online learning community so as to achieve learners' satisfaction. As the key factor of using Facebook for self-directed learning is what its social presence affords, the research design reported in this paper is a replication of the Kim's study (2011) that developed an instrument to measure social presence in distance higher education: The research project is conducted in an English department in a Taiwanese university. Approximate 180 first-year students are recruited. After the three-week SDVL experiences in Facebook, they respond to the social presence scale of four measures – mutual attention and support, affective connectedness, sense of community and open communication. In addition, the participants' postings are examined for cross-reference data to capture learning behaviors. For post-intervention evaluation, the modified learning satisfaction scale (Arbaugh, 2000) and the perceived learning achievement (Eom, Wen, Ashill, 2006) are used. Results from the study's investigation will shed lights on why Facebook can assist language learning. The pedagogical implication is that social presence supports self-directed learning in such a social networking community.

**Keywords:** Facebook, self-directed learning, social presence

## 6. Introduction

Intentional vocabulary teaching and learning is usually limited in the curriculum of English as a foreign language (EFL) at the tertiary level. The research project aims to assist self-directed learning that involves college students to take an active role in learning vocabulary. As social networking sites (SNSs) provide a personal learning environment and community of practice that connects like-minded people for informal knowledge exchange, SNSs might enable learner-centered designs and self-directed learning. This research proposes a self-directed vocabulary learning (SDVL) project via Facebook to assist EFL learners to develop their means of expanding vocabulary knowledge and size.

## 7. Self-directed learning situated in the online social networking environment

Self-directed learning has been regarded as critical part of individualizing learning experiences (Caffarella, 1993). As online learning often situates control of implementation with the learner, more and more researchers have turned the importance of self-directed learning (SDL) skills to online learning environments. Song and Hill (2007) introduced a conceptual model for understanding self-directed learning in online learning contexts. Sze-yeng and Hussain's (2010) utilized a socio-constructivist learning environment for an instructional design and development module to facilitate self-directed learning within a higher education setting. According to Knowles' self-directed learning model (1990), 'others' are seen as collaborators, potential resource persons rather than competitors in the learning process. Most agree that peer support, collaboration and communication are particularly effective in technology-based learning because in which students need to be more self-directed. In Deng

and Yuen's (2011) proposed framework for structuring activities of writing, reading and commenting on blogs, the interactive functionality of blogs was used mostly for exchanging social support rather than reflective dialogue.

The pedagogy of developing self-directed learners is based on the assumption that learners who take control of their learning will become successful. However, creating a self-directed learning program does not in itself enable learners to become self-directed. The critical issue is how the necessary supportive circumstances and contexts can be provided to help EFL learners develop the necessary capacity and willingness to take on responsibility for their own learning. The instructional design of the SDVL project addresses how the available SNS such as Facebook can be used as a constructivist learning environment for EFL learners. The research design is to examine a multiplicity of motivation sources so as to document both students' perceptions and processes that motivate students to actually engage in and carry out the SDVL task in the social networking site.

## 8. Instructional Design

Similar to the educational affordances of blogs that provide opportunities of writing, reading and comment, the latest technology Facebook has emerged to become the platform that college students are most comfortable to log in and use because of efficiency of communication and stronger social connections between classmates (Odom, Jarvis, M'Randa & Peek, 2013). Deng and Yuen's framework (2011) is adapted for the instructional framework of vocabulary learning activities adapt: All that students' self-directed communication with self via posting for sharing and with the community of learners via reading and responding to peers' postings is what contributes to meaningful and deep learning. The design of collaboration among peers in non-competitive activities is relevant to the features of a social constructivist learning environment. That is, the SDVL in Facebook is driven by peer collaboration and communication.

The directions of the SDVL project are designed to include "four strands" (Nation, 2007) in the learning activities. Meanwhile, learning activities engage participants in different types of learning (e.g., explicit learning, implicit learning, and interactive learning), induce different involvements (e.g., need, search and evaluate), and reinforce deep processing strategies like finding an image for semantic elaboration, English-English definition.

## 9. Research design and data collection

Considerable research has indicated that a carefully planned application of social media can have a great influence on student learning outcomes. Beyond the ultimate goal of vocabulary learning outcomes in terms of second language acquisition (SLA), the empirical study is to explore what motivates EFL learners to actually engage in and carry out the SDVL task in the social networking site: (1) to what extent Facebook motivates learners' participation and (2) to what extent Facebook motivates learners' engagement in the online learning community so as to achieve learners' satisfaction. The research project is conducted in an English department in a Taiwanese university. Approximate 180 first-year students are recruited. The popular social networking site Facebook is used for undertaking self-directed vocabulary learning that requires students to share and post academic words on the wall of Friend Group. They are required to weekly choose at least three words from Academic Word List and report the selected words by exploring the usage (definition and part of speech), showing the use in the context (sentences from the text they found), and sharing their reflection for three weeks. They are also required to respond to at least three peers' posted words. After the three-week SDVL experiences in Facebook, they respond to the social presence scale of four measures – mutual attention and support (6 items), affective connectedness (5 items), sense of community (4 items) and open communication (4 items). In addition, participants' discussion threads in Facebook are classified by the four-factor measures for cross-reference of qualitative data to capture learning behaviors. For post-intervention evaluation, the modified learning satisfaction scale (3 items) (Arbaugh, 2000) and the perceived learning achievement

Liu, C.-C. et al. (Eds.) (2014). Proceedings of the 22<sup>nd</sup> International Conference on Computers in Education. Japan: Asia-Pacific Society for Computers in Education

(4 items) (Eom, Wen, Ashill, 2006) are used. Quantitative data will be analyzed by structural equation model (SEM), multiple regression and correlation.

## 10. Conclusion

Results from the study's investigation will shed lights on how relevant the educational use of Facebook can assist social constructivist learning for students' vocabulary practices. The pedagogical implication is that social presence can support self-directed learning in an online learning community.

## Acknowledgements

## References

Arbaugh, J. B. (2000). Virtual classroom characteristics and student satisfaction with internet-based MBA courses. Journal of Management Education, 24, 1, 32–54.

Caffarella, R. (1993). Self-directed learning. New Directions for Adult and Continuing Education, 57, 25-35. Deng, L., & Yuen, A. H. K. (2011). Towards a framework for educational affordances of blogs. Computers & Education, 56(2), 441–451.

Eom, S. B., Wen, H. J. & Ashill, N. (2006). The determinants of students' perceived learning outcomes and satisfaction in university online education: an empirical investigation. Decision Sciences Journal of Innovative Education, 4, 2, 215–235.

Kim, J. (2011). Developing an instrument to measure social presence in distance higher education. British Journal of Educational Technology, 42(5), 763-777.

Knowles, M. S. (1990). Fostering competence in self-directed learning, In R. S. Smith (Ed. ) Learning to learn across the life span. San Francisco, CA: Jossey-Bass.

Nation, I. S. P. (2007). The four strands. International Journal of Innovation in Language Learning and Teaching, 1(1), 2-13.

Odom, S. F., Jarvis, H. D., M'Randa, R. S., & Peek, C. (2013). Social media tools in the leadership classroom: Students' perceptions of use. Journal of Leadership Education, 12(1), 34-53.

Song, L., & Hill, J. R. (2007). A conceptual model for understanding self-directed learning in online environments. Journal of Interactive Online Learning, 6(1), 27-42.

Sze-yeng, F., & Hussain, R. M. R. (2010). Self-directed learning in a socioconstructivist learning environment. Procedia-Social and Behavioral Sciences, 9, 1913-1917.nderson, R. E. (1992). Social impacts of computing: Codes of professional ethics. *Social Science Computing Review*, *10*(2), 453-469.

# Computer Scaffolding Peer Response to Enhance Elementary Students' Writing Performance: a Case Study of a Summer School

**Wan-Chen CHANG[a]\*, Calvin C. Y. LIAO[ab], Tak-Wai CHAN[b]**

[a]*Research Center for Science and Technology for Learning, National Central University, Taiwan*
[b]*Graduate Institute of Network Learning Technology, National Central University, Taiwan*
*altheawcc@cl.ncu.edu.tw

**Abstract:** The present study investigated the effects of scaffolding peer response on Tomorrow's Writing Platform (TWP) to enhance writing performance of elementary students. The program were conducted in a summer school in the period of three weeks, 15 days. The participants included 28 three to fourth-grade students recruited from neighbor 7 elementary schools in Taoyuan, Taiwan. The preliminary results showed that the participants could increase the length of writing article as the writing lesson. Peer response analysis showed the affective response were used the most and the editing response were the least. Writing performance would be affected by writing structure and participants' writing experience.

**Keywords:** Writing performance, scaffolding peer response, Tomorrow's Writing Platform

## 1. Introduction

Previous studies have noted revision is commonly regarded as a central and important part of writing (e.g., Fitzgerald & Markham, 1987; Fitzgerald, 1987). There are vast studies to explore the effect of peer response to enhance students' writing quality and writing performance(e.g., Paulus, 1999; Strijbos, Narciss, & Dünnebier, 2010). Moreover, most studies instructed students how to give their comments to their peers' writing products. However, we thought elementary school students need more direct assistance to response other writing products so we proposed "scaffolding peer response" which were three kinds of peer response with incomplete sentence. When students response to other students' writing article, they could use scaffolding peer response to present their thoughts more clearly and detail. Therefore, the purpose of this study is to investigate the effects of scaffolding peer response on Tomorrow's Writing Platform (TWP) to enhance writing performance of elementary students.

## 2. Case Study

### 2.1 Participants and Experimental Environment

The participants included 28 three to fourth grade students who joined to a summer school. The summer school hold a serial of writing instructions in the period of three weeks, continuing 15 days, on August in 2014. The writing instruction was applied a writing model with an online writing system, TWP. The participants were recruited from neighbor 7 elementary schools and the instructors of the summer school were the principals of the 7 elementary school. All participants have learned basic computer skills at least one year but all of them do not have the experience about writing on an online writing system. Therefore, at the beginning of summer school, we conducted an instruction to teach students how to use the writing system and writing model. The writing instructions were conducted in a computer classroom so every participant could use one computer. Every instructor taught a lesson in turn which the participants complete a writing article through the writing model.

### 2.2 Writing Model and System Design

The writing model was entitled" Tomorrow's Writing" and all writing activities were happened on the online writing system. The writing model includes four main steps: 1) syntopical reading: the system

presents three or four texts relevant to a writing topic for participants to read and learn how to write through different viewpoints. The texts were selected by the instrctor. The system provides marking function which participants use to highlight beautiful words or sentences and learned how to use these words or sentences. 2) Free writing: the system provides idea notes function which participants could freely generate a lot of ideas and organize those ideas to produce a draft. 3) Peer response: the system provides scaffolding peer response function which participants could use the incomplete sentence to present their thoughts and to response a writing draft of the same group. Scaffolding peer response includes three categories: affective response, suggesting response and editing response. 4) Paper revising: the participants could according to peer responses to revise their draft and further to give their feedback to the responses. The participants could re-revise their draft. In the final, the participants could publish their draft to be an article and share to other group participants.



Figure 1. The screen of scaffolding peer response.

## 2.3 Procedure

This study was divided into three phases: baseline, intervention, and evaluation phases. 1) Baseline phase: In order to evaluate the participants' typing skill, reading comprehension ability and writing performance, Chinese text typing test, reading comprehension test and pre-sentences combining test were conducted for all participants before the summer school started. 2) Intervention phase: In these three weeks, the participants received 5 instructions on using the writing model and practice writing 5 articles. To complete one instruction need 2.5 days, per 1.5 hours a day. The system recorded the participants' all version of writing drafts, and the comments from their peers. The writing topics and syntopical reading materials were selected by the instructions and were ensured grade-appropriate to the participants. 3) Evaluation phase: Post-sentences combining test and one questionnaire were conducted in order to determine the effectiveness of the instruction on students' writing performance in the end of summer school. We also interviewed ten students selected by their grade to understand their thoughts about the writing model and the writing system.

## 3. The preliminary results

### 3.1 Writing Performance

We analyzed the participants' writing performance until the third lesson because the writing instructions are still continuing. This study analyzed and examined the two indicator of students' writing performance: number of Chinese character and number of type token. Both these two analysis indicator showed the higher the number, the better the writing performance.

Table 1. Students' writing performance.

| Writing topic | Number of characters | Number of  type token |
|---|---|---|
| 1. The experience of joyful traveling (n=18) | 240.36 | 74.03 |
| 2. The convenience of technology (n=20) | 184.03 | 61.41 |
| 3. the first time of A special life experience (n=22) | 245.80 | 73.50 |

When a participant absent in one lesson, his/her writing article in that lesson were excluded from the analysis. Moreover, the incomplete writing article was also excluded from the analysis. The preliminary results showed that comparing to the other two topic articles, the participants wrote less Chinese characters and used less type toke in the topic, the convenience of technology. We speculate that the explanations for the results could be the writing structure and writing experience. The first and the third topic articles were narrative and the second was expositive. Elementary school students usually write narrative in school and lack of experience to write an expository. Further, to compare the two narrative articles and find the participants' write more Chinese characters in the second narrative article.

### 3.2 Scaffolding Peer Response

The category of scaffolding peer response was analyzed in order to know how the participants use the scaffolding peer response. First, we analyzed whether the participants would give comment to their own group's participants. The results showed that one article would be gave comments by average eight participants. The participants gave their comments not only to their own group, but also cross to other group participants. Second, this study analyzed the using ratio of three kinds of scaffolding peer response in the three articles. The results showed as Table 2. The findings showed that the affective response were used the most and the editing response were the least in three writing topic atricles. We speculated the reason is to present the emotional comment is easier for the participants. For example, they usually commented the writing article as "You wrote well," "You wrote a great article because you described very clear" and so on. The editing response need participants to check the correctness of Chinese character and punctuation, the length of a writing article, grammar, and so on. The participant may lack of experience to make the judgment. Regarding the quality of response, we found the participants still described unclearly and just used a part of scaffolding peer response sentence.

Table 2: The using ratio of three scaffolding peer response.

| Writing topic | Affective response | Suggesting response | Editing response |
|---|---|---|---|
| 1. The experience of joyful traveling | 52.70% | 29.73% | 17.57% |
| 2. The convenience of technology | 41.30% | 32.61% | 26.09% |
| 3. the first time of a special life experience | 52.17% | 30.43% | 17.39% |

The further work of this study is to investigate the effect of writing instruction and the progress of writing performance after the end of summer school. Comparing the writing performance of participants' before and after peer response to know the benefit of scaffolding peer response.

## Acknowledgements

## References

Fitzgerald, J. (1987). Research on revision in writing. *Review of Educational Research*, *57*(4), 481–506.
Fitzgerald, J., & Markham, L. R. (1987). Teaching children about revision in writing. *Cognition and Instruction*, *4*(1), 3–24.
Paulus, T. M. (1999). The effect of peer and teacher feedback on student writing. *Journal of Second Language Writing*, *8*(3), 265–289.
Strijbos, J.-W., Narciss, S., & Dünnebier, K. (2010). Peer feedback content and sender's competence level in academic writing revision tasks: Are they critical for feedback perceptions and efficiency? *Learning and Instruction*, *20*(4), 291–303. doi:10.1016/j.learninstruc.2009.08.008

# A Computerized Assessment System for Chinese Reading in Grade One

**Chen-Huei LIAO[a]\*, Bor-Chen KUO[b] , Kai-Chih PAI[c] & Chieh-Ju TSAO[d]**
[a]*Department of Special Education, National Taichung University of Education, Taiwan*
[b]*Graduate Institute of Educational Information and Measurement, National Taichung University of Education, Taiwan*
[c]*Graduate Institute of Educational Information and Measurement, National Taichung University of Education, Taiwan*
[d]*Graduate Institute of Educational Information and Measurement, National Taichung University of Education, Taiwan*
\*chenhueiliao@gmail.com

**Abstract:** The present study aims to develop a computerized assessment system for Chinese reading. The purpose of study was to collect data conveniently and efficiently. The study investigated the relation between literacy skills (word recognition and reading fluency) and reading-related skills for grade1 students by using Structural Equation Modeling (SEM). Two hundreds and six Chinese-speaking Taiwanese children were assessed on phonological awareness, rapid naming speed, orthographic knowledge, morphological awareness and visual perception skills. The results of structural equation modeling (SEM) showed the goodness-of-fit of the proposed model. The proposed system is adaptive to assess students' Chinese reading skills.

**Keywords:** Chinese, reading, computerized, assessment

## 1. Introduction

Reading is an important skill for children to construct knowledge in their own language. There are components of reading instruction that are essential to successfully teach children how to read, including phonemic awareness, phonics and word study, fluency, vocabulary, and comprehension (National Reading Panel, 2000). Previous studies have pointed out that the word recognition and reading fluency were related to phonological awareness, rapid naming speed, orthographic knowledge, and morphological awareness (Chow, McBride-Chang & Burgess, 2005; Chik, Ho, Yenng, Chan, & Luan, 2011; Ho, Chan, Tsang, & Lee, 2002; Ho, Chan, Lee, Tsang, and Luan, 2004; Shu, McBride-Chang, Wu, & Liu, 2000).

There are disadvantages and limitations in the conventional test versions, including: limited sample size, inaccurate response time and error scoring, inconsistent presentation, and higher chance of human error. Liao and Kuo (2011) developed the Web-Based Assessment for assessing phonological awareness, rapid automatized naming (RAN) and one-minute word reading. The results showed that traditional paper-pencil tests and web-based versions were equally predictive of Chinese reading measures. The system was originally developed for grade 6 students, in the present study, grade 1 reading test battery was developed using the system. To examine the contribution of different predictors on reading-related processing skills and literacy skills, structural equation modeling (SEM) was used.

## 2. Methods

### 2.1 Computerized assessment system for Chinese reading

Ten web-based tests were developed in the present study, including rapid automatized naming (colour naming, digit naming, Zhu-Yin-Fu-Hao naming), orthographic knowledge (two non-character recognition tests, radical position), morphological awareness (two morphological construction tests,

homophone recognition), and reading fluency test (one minute reading). The interface of one minute reading and RAN colours showed in Figure 1 and Figure 2. The visual perception tests include visual memory and visual spatial relationship. The phonological awareness has three tests: Tone Recognition, Onset Detection and Rhyme Detection.
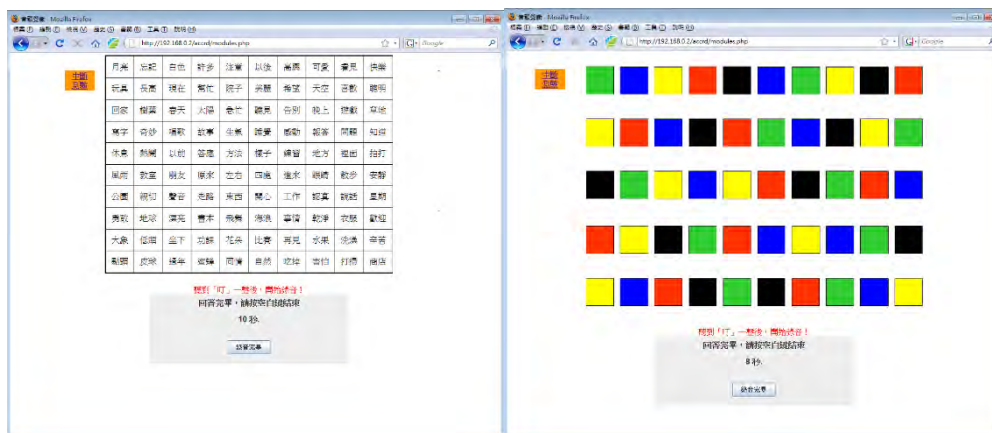


Figure 1. One minute reading and RAN Colours.



Figure 2. Morphological Construction.

## 2.2 Participants

Participants were 206 (109 boys, 97 girls) grade one students from 7 classes of an elementary school in Taichung, Taiwan. None of the children was previously diagnosed with any emotional, behavioral or sensory difficulties.

## 3. Results

The results of Structural Equation Modeling (SEM) showed in Figure 3. As indicated by the fit indices, CFI, TLI, RMSEA, SRMR, the model yielded a good fit to the data (CFI＝0.937, TLI＝0.921, RMSEA＝0.044, SRMR＝0.061). Moreover, the finding showed that orthography processing, visual perception skills, and phonological awareness were the strongest predictors for reading-related processing skills in grade 1 (factor loadings= .857, .762, .688). Moreover, the standardized coefficients showed that the relation between reading-related skills and literacy skills was strong, in which reading-related skills explained 91.2% of the variance in literacy skills. The result indicts that the reading-related skills assessed in the present study were significant predictors in Chinese literacy skills.
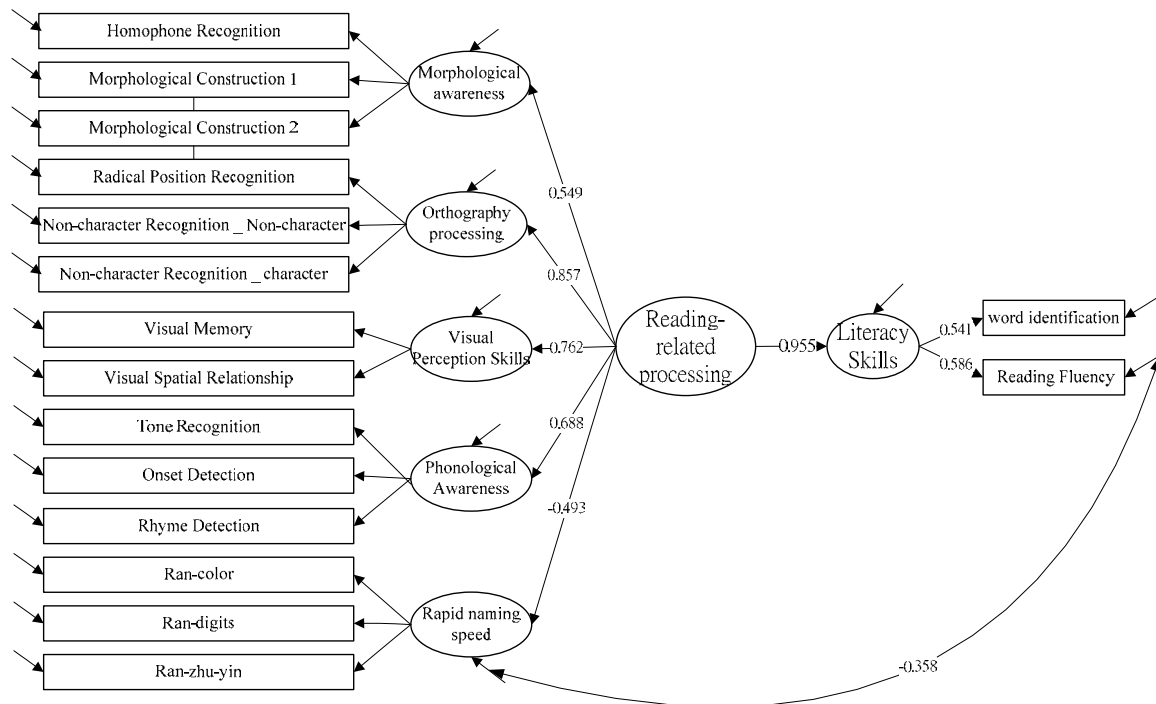
Figure 3. The relations between reading-related processing skills and literacy skills.

## 4. Conclusions and future works

The presented study developed a computerized assessment system for Chinese reading in grade 1 and examined the contribution of different predictors on reading-related processing skills and literacy skills by using SEM. The results showed that reading-related skills assessed in the present study were significant predictors in Chinese literacy skills. With the system, larger sample size will be able to be collected conveniently and efficiently. Moreover, in the future, the system can also be used to assess and diagnose children with/without reading difficulties.

## Acknowledgements

## References

Chik, P. P, Ho, C. S, Yenng, P. Z, Chan, D. W., & Luan, H. (2011). Syntactic skills in sentence reading comprehension among Chinese elementary school children. *Reading and Writing: An Interdisciplinary Journal*, *4*,1-22

Chow, B. W., McBride-Chang, C., & Burgess, S. (2005). Phonological processing skills and early reading abilities in Hong Kong Chinese kindergarteners learning to read English as a second language. *Journal of Educational Psychology*, *97*(1), 81-87.

Ho, C.S.-H., Chan, D., Tsang, S.-M., & Lee, S.-H. (2000). The Hong Kong test of specific learning difficulties in reading and writing. Hong Kong: Hong Kong Specific learning Difficulties Research Team.

Ho, C.S.-H.,Chan,D.W.-O.,Tsang,S.-M.,& Lee,S.-H. (2002). The cognitive profile and multiple-deficit hypothesis in Chinese developmental dyslexia. *Developmental Psychology*, *38*, 543-553.

Liao, C. -H. & Kuo, B. -C. (2011). A Web-Based Assessment for Phonological Awareness, Rapid Automatized Naming (RAN) and Learning to Read Chinese. *Turkish Online Journal of Educational Technology (TOJET)*, *10*, 31-42.

Shu, H., McBride-Chang, C., Wu, S., & Liu, H. (2006). Understanding Chinese developmental dyslexia: morphological awareness as a core cognitive construct. *Journal of Educational Psychology*, *98*, 122-133.

# The Model of "Reading for Creating" and "Talking for Revising" to Improve Students' Writing Quality in Scaffolded Writing and Rewriting Environment

**Calvin C. Y. LIAO[ab*], Wan-Chen CHANG[b] , & Tak-Wai CHAN[ab]**

[a]*Graduate Institute of Network Learning Technology, National Central University, Taiwan*
[b]*Research Center for Science and Technology for Learning, National Central University, Taiwan*
*Calvin@cl.ncu.edu.tw

**Abstract:** In this paper, we proposed a scaffolded writing and rewriting model which combined 4 kinds of activities: reading, creating, talking, and revising. This scaffolded writing and rewriting process provides students plenty of various inspirational guidances in writing process and peer feedback prompts in rewriting process for building their composition skills. In particularly, students could arrange their self-ideas and combine relative sentences by using build-in organize of suggestions; students could give detailed corrections, comments, and reasons by using build-in revision of suggestions. Based on this model, we developed an on-line writing environment, entitled Tomorrow's Writing Platform (TWP). Next, we will examine the model in a primary school to understand the relationship between students' language competence for writing performance and the influence of TWP.

**Keywords:** Reading, Writing, Talking, Revising

## 1. Introduction

Previous research (Yang, Yeh, & Wang, 2009) investigated that 3051 elementary school 6th students' writing difficulties in Taiwan. Yang *et al*. (2009) indicated that 511 students are feared to receive negative comments from teachers; 520 students don't like handwriting; 819 students don't know how to write the beginning of article; 1173 students have no idea about the essay topic; 1272 students do not know how to arrange content of article; and 1514 students worry the poor or too little content of article. In other words, Taiwan elementary school students often lack ideas, confidence, and skills about writing.

Besides, researches about the writing process, skill, and knowledge have increased markedly in recent years (e.g., MacArthur, Graham, & Fitzgerald, 2006; Graham, McKeown, Kiuhara, & Harris, 2012). Graham and his colleague (2012) also attempted to identify effective instructional practices for teaching writing in elementary grade students and found that four writing interventions, for scaffolding or supporting students' writing procedure, produced statistically significant effects: prewriting activities, peer assistance when writing, setting writing goals, and assessing writing. Moreover, Rohman (1965) divided writing into three stages, including prewriting, writing, and rewriting.

Hence, this paper proposes a scaffolded writing and rewriting model which provides students plenty of various inspirational guidance in writing process and peer feedback prompts in rewriting process to develop students' writing skills. Students can arrange their self-ideas and combine relative sentences by using build-in organize of suggestions; students can give detailed corrections, comments, and reasons of grammatical errors by using build-in revision of suggestions.

## 2. Scaffolded Students' Writing and Rewriting Model

This paper proposed a model to scaffold students' writing and rewriting. This model mainly encourage students to write and rewrite by 2 composition strategies: 1) reading for creating and 2)

talking for revising. This study defined that the process of students composited an article divided into writing and rewriting process. Regarding composition strategy in writing process, students need to overcome the writers' block by free-writing (Elbow, 1973); and students also need to write the first draft by organizing relevant ideas and combining sentences. Regarding composition strategy in rewriting process, students need to revise and edit the content by refining oneself topic sentence or thesis statement, and reorganizing oneself material (Saddler, & Graham, 2005). In particularly, the composition strategy of reading for creating as a reading-based approach to writing; the composition strategy of talking for revising as a talking-based approach to rewriting. In other words, students can utilize in the system to record and then observe students' process of developing writing skills with scaffolds of ideas organization; students also can also give responses and comments about overall organization and perspective of written texts.

This study proposes a scaffolded writing and rewriting model; and further implemented a Tomorrow's Writing Platform (TWP) for helping elementary school students to writing and rewriting, see Figure 1.

## 2.1 Reading for Creating

The composition strategy of reading for creating in writing process includes 3 steps: theme-based reading, association-stimulation freewriting, and composition. Specifically, students can gain domain knowledge about writing topics through theme-based reading in step 1 (Wiley, & Voss, 1999). The theme-based essay had to be convincing and based on authentic information sources; students can generate ideas with guidance extensively through association-stimulation freewriting in step 2. Elbow (1973) defined freewriting as writing without stopping and editing, and used as a powerful technique for developing student writing (Li, 2007); students can compose an essay based on written ideas through composition in step 3 (Cerdán, & Vidal-Abarca, 2008).
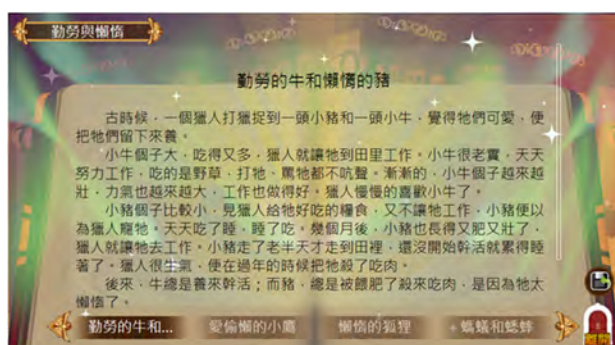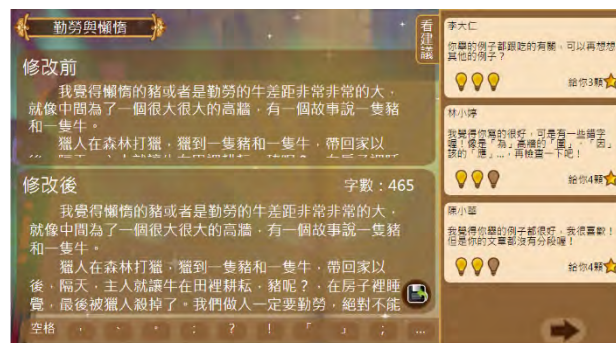


a) Students can gain domain knowledge about writing topics through theme-based reading.
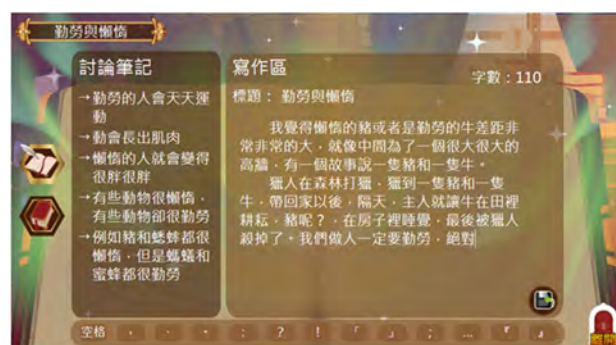
b) Students can compose an essay based on written ideas through composition.
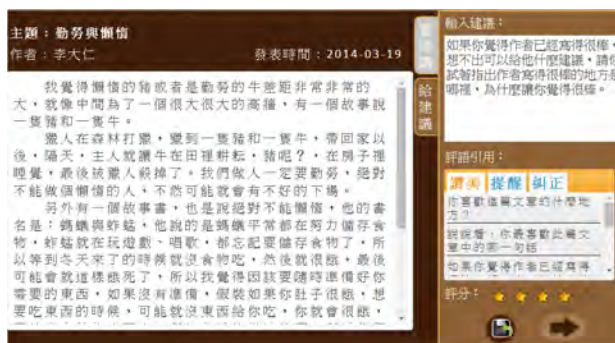
c) Students can provide textual and oral responses with scaffolding prompts to peer talking.

d) Students can revise an essay based on other students' suggestions through self-revising.

Figure 1. System Interface of Tomorrow's Writing Platform.

## 2.2 Talking for Revising

The composition strategy of talking for revising in rewriting process includes 3 steps: evaluating other articles, peer talking, and self-revising. Specifically, students can access and aware of other students' content of articles through examining other articles in step 1. Students read the articles and give helpfulness and specificity suggestions; students can provide textual and oral responses with scaffolding prompts to peer talking in step 2 (Strijbos, Narciss, & Dünnebier, 2010), such as, supporting students (writers) by cueing them about their articles or about aspects of revision; students can self-revise an essay based on other students' suggestions in step 3 (Fitzgerald, 1987). We enabling students' meaningful revision activity, not just editorial actions.

## 3. Upcoming Work

The progress of this study so far is constructing the Tomorrow's Writing Platform (TWP). The upcoming work is to conduct the experiment in a 4th grade classroom as a pilot. In the experiment, we will practice our design in the writing class. In order to prove that the influence of peer talking on students' writing quality, we will collect students' writing records and the responses posted to each article. For future studies, applying this model to other graders may be possible. Hence, we will have an opportunity practically to examine the model in a primary school to understand the relationship between students' language competence for writing performance and the influence of TWP. We will also explore the relationships among reading, and writing, and re-writing in order to determine whether increasing students' writing motivation. We hope that future research will provide more detailed results.

## Acknowledgements

## References

Cerdán, R., & Vidal-Abarca, E. (2008). The effects of tasks on integrating information from multiple documents. *Journal of Educational Psychology*,*100*(1), 209–222.

Elbow, P. (1973). Writing without teachers. Oxford: Oxford University Press.

Fitzgerald, J. (1987). Research on Revision in Writing. *Review of Educational Research*, *57*(4), 481–506. doi:10.3102/00346543057004481

Graham, S., McKeown, D., Kiuhara, S., & Harris, K. R. (2012). A meta-analysis of writing instruction for students in the elementary grades. *Journal of Educational Psychology*, *104*(4), 879–896. doi:10.1037/a0029185

Li, L. Y., (2007). Exploring the Use of Focused Freewriting in Developing Academic Writing, *Journal of University Teaching & Learning Practice*, 4(1). Available at:http://ro.uow.edu.au/jutlp/vol4/iss1/5

MacArthur, C. A., Graham, S., & Fitzgerald, J. (2006). *Handbook of Writing Research*. Guilford Press.

Rohman, D. G. (1965). Pre-Writing the Stage of Discovery in the Writing Process. *College Composition and Communication*, 16 (2), 106-112.

Saddler, B., & Graham, S. (2005). The effects of peer-assisted sentence-combining instruction on the writing performance of more and less skilled young writers. *Journal of Educational Psychology, 97,* 43-54.

Strijbos, J.-W., Narciss, S., & Dünnebier, K. (2010). Peer feedback content and sender's competence level in academic writing revision tasks: are they critical for feedback perceptions and efficiency? *Learning and Instruction*, Unravelling Peer Assessment, *20*(4), 291–303. doi:10.1016/j.learninstruc.2009.08.008

Wiley, J., & Voss, J. E. (1999). Constructing arguments from multiple sources: Tasks that promote understanding and not just memory for text. *Journal of Educational Psychology*, *91*, 301–311.

Yang, S. H., Yeh, H. C., & Wang, H. P. (2009). The Development and Application of the Sixth Grade Student's Narrative Writing Assessment: A Study at the Middle of Taiwan Area. *Journal of Research in Education Sciences*, 54(3), 139-173. (In Chinese)