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PREFACE

The Work-In-Progress Poster (WIPP) session was held in conjunction with the conference: 21st International Conference on Computers in Education (ICCE 2013) which took place during November 18 and 21, 2013, in Bali, Indonesia. 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 2013 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 Technology, Pedagogy and Education

This year, each of the seven theme-based sub-conferences set up its own program committee for selecting WIPP papers for their respective themes. All submissions for the WIPP presentations were reviewed by the program committees and 11 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 2013 local organizers for their effort in organizing the session and to make this happen.

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Note-Rebuilding Based on Lecture Structure and Application in a Learning Support System

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Abstract: In the presentation-type lectures which is performed using presentation software, learners are provided well-structured slides which are useful to understand the structure of the lecture. They, however, don't need to construct their note because of the given slides. In this paper, we propose a task called "note-rebuilding" which is based on a kit-build method. We also report a learning support system with note-rebuilding and its experimental evaluation.

Keywords: Formative Assessment, Reflective Learning, Presentation Software

1. Introduction

Lectures in recent years have increasingly incorporated presentation software. Learners don't need to consider deeply information structure in the lectures because well lectures' slides structured well by teachers and they are not required to note-taking[1,2]. Especially, it is effective to reflect and rearrange the note. The reflection is called note-reflection[3,4]. In the presentation-type lectures, it is therefore necessary to propose tasks that confirm learners' understanding as note-reflection. Here we propose a "note-rebuilding" method expanding note-reflection by adapting a kit-build method[5]. In addition, we report our developed learning support system with note-rebuilding and its experimental evaluation.

2. Design of Learning Support System with Note-Rebuilding

a. Note-Rebuilding Method

In order to facilitate effective learning, we need to design adequate learning activity and individual diagnosis. Kit-build method is useful to control learners' activities and learning contents and to diagnose learners' answers. In kit-build method, teachers divide prepared learning materials into parts, which learners reconstruct. Because all learners and teachers use same material, their answers can be compared correct answer and other learners. Here we propose a note-rebuilding method as follows. First, the teacher uses presentation software to create structured slides as he/she always does for his/her class. Second, the slide is divided into several parts. Third, learners are require to reconstruct the original slide based on the parts. This method promotes learner understanding of the lecture structure.

When confirming understanding of the lecture structure, it is inappropriate to make learners summarize all the data presented; understanding the information and its structure is sufficient. We refer to structures in lecture data as "structure notes." In our note-rebuilding method, learners construct structure notes, examples of which are shown in Figure 1. Structure notes include important informational elements and the important informational structures. In the proposed note-rebuilding method, pieces of information (mainly words and phrases) included in a structure note are called elements, and the informational framework of the structure without elements is called a skeleton. The two together are called parts. A skeleton and an element are given to a learner, who assembles them appropriately, thus promoting understanding of the lecture. Figure 2 shows an example of structure note parts with a layered structure for the skeleton and its elements.

![Fig. 1. Layered structure form](image)

![Fig. 2. Skeleton and elements](image)
b. Learning Support System with Note-Rebuilding

c. Structured note data

Our system manages the data of structured note as JSON format. First, teachers construct slides as he/she always does for his/her class using presentation software. And then, our system convert the slide to JSON format file which is used to note-rebuilding interface and diagnosis and comparison functions.

d. Note-Rebuilding Interface

Learners use this interface to rebuild the deconstructed note. This interface shows element cards at random by loading element information from structure note data. Reconstructed notes are sent to the server by pressing the "Send" button. Figure 3 shows an example layered structure in the interface of the actually developed system.

e. Diagnosis and Comparison Function

Learners' answers are sent to and collected at a server. Our system diagnose the answer and specify where is incorrect. Furthermore, the result of having superimposed two or more learners' notes are accumulated and displayed. Learners can then reflect on their own answers by comparison with other answers and the correct answer. In addition, teachers can reflect on their lecture to improve teaching. Moreover, teachers can immediately respond to inadequate learner understanding immediately following a lecture by providing supplementary explanation. Figure 4 shows an example of collected learners' answers in the layered structure.

3. Use in Practice and Evaluation

We report the results of experimental use of the proposed system in lectures for a university programming course. The lectures concerned following two contents: how to use MySQL and how to control MySQL with PHP, which was content for review. Participants were 70 university undergraduates majoring in engineering. First, the teacher taught a lesson using presentation software for reviews for 6 min. This corresponds to a usual class. Second, learners took pre-test for 6 min. Thirdly, they learned how to use our system for 6 min. The teacher again taught with comparison function for 6 min. The learners took post-test for 6 min. The items on both pre- and post-tests were the same: subjects freely described the process of manipulating MySQL alone and manipulating MySQL using PHP. Both responses required describing five steps. Adequate description of the procedure was scored as a right answer.
First, we report the results of using our system. Figure 4 in 2.2.2 shows the results of the practice. In this lecture, the teacher explained that learners should run MySQL, check databases, and then select a database. More than half the subjects misunderstood, however, thinking they should select a database first, and then check it. The teacher emphasized this point using the comparison function. Next, we report the results of pre- and post-tests. In these tests, learners freely described the five steps for running MySQL to control a database. Incorrect answers were missing steps, or steps given in the wrong order. Items given in the wrong order were corrected. For example, if a learner described the order as step 1, step 3, step 2, we marked this as step 1/step 1, step 3/step 2, and step 3/step 2. When a step was missing, the place for the step was left blank, for example: step 1/step 1, [ ]/step 2, and step 3/step 3. The results are shown as Tables 1, 2, 3, and 4.

Table 1 shows that a majority of subjects (53) described Step 1 (starting MySQL) in the correct order in the pre-test. However, only 15 subjects correctly described Step 2 (database check), and 9 subjects mistook Step 3 (database selection) for Step 2. This was also checked with the system’s comparison function as described in Section 2.2. Table 2 shows that the number of subjects who could describe all the steps appropriately increased. Table 3 shows that PHP was a weak point for many learners, and lectures alone were insufficient for understanding. However, table 4 shows that the number of subjects who adequately understood the steps increased when our system followed the lecture. Subjects were asked whether they could use our system effectively, and responded using a four-point Likert scale.

<table>
<thead>
<tr>
<th>Subject Correct</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Step 4</th>
<th>Step 5</th>
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<td>28</td>
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</tbody>
</table>

4. Conclusion

We focused on lectures that use presentation software. In such lectures, learners are not required to conduct tasks for understanding the lesson structure. We therefore proposed a note-rebuilding method and developed a learning support system with the method. We focus on slides that many teachers make usually in lectures using presentation software. In note-rebuilding method, the slide is divided into several parts. Learners are required to reconstruct the original slide based on the parts. Actual implementation revealed that the method promotes the learner understanding of lecture structure.

In our system, learners' note are collected to diagnose and to compare. In our future work, we plan to add analysis function which clusters learners' answer and reveal common errors. The function enable teachers to improve lectures' information structure based on structure of learners' errors.

Acknowledgements

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References

Initial Use of a Flexible Open Learner Model

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Abstract: This paper gives an overview of the Next-TELL open learner model and initial levels of student use of this competency-based open learner model. It is sufficiently flexible to allow use in different ways, taking data from a range of sources. Levels of use suggest that the approach would be taken up by students, if adopted by their teachers.

1. Introduction

Open learner models allow users to see visualisations of learners’ knowledge, skills, competencies, etc., to help them understand a system’s inferred model of them – traditionally as would be used by the system to personalise the interaction. There are various reasons for opening the learner model to the learner (and teachers, etc.), including facilitating metacognitive behaviours such as reflection, planning, self-regulation, and so on (Bull and Kay, 2013).

Our previous work suggests that teachers may be open to adopting an open learner model that can be used flexibly in the classroom according to their existing or desired teaching approaches, and which may include manual teacher and student self-assessment as well as automated data combined potentially from a wide range of sources (see Johnson et al., 2013). In this paper we present an indication of the features that students and teachers used in early introductions and deployments.

2. The Next-TELL Open Learner Model

The Next-TELL open learner model has a range of visualisations, as shown in Figure 1. These each represent information about a user’s competence levels from slightly different perspectives using, for example, colour, skill meters, text size, area. This example shows competencies for facilitating meetings – commonly seen as an important 21st Century skill. As suggested above, accessing their learner model aims to provide a focus for student reflection. If students choose (optionally) to release their learner model to their peers, it may also promote collaboration or discussion.

Table 1 contains some basic statistics of the open learner model usage. During the 2012-13 academic year, the OLM had 338 users (303 students, 35 teachers). These figures include some ‘test’ accounts that were available to those working with end users to demonstrate the software. The 35 teachers worked with 426 different competencies and in total 3640 items of evidence were added to the learner model in the form of teacher assessments, student self-assessments, peer-assessments, and data from integrated software tools. This is supplemented with 389 text appraisals of student strength and 299 items of guidance that add supporting information that is collated alongside the learner model (but does not contribute to the modelling algorithm). The learner model was viewed on 2567 occasions, and additional items of guidance were viewed on 683 occasions. Teachers and students showed preferences for which learner model views they inspected. The most frequently used for both teachers and students/peers were skill meters (455 and 275 occasions) and the treemap (254 and 217 occasions). The least frequently used for teachers was the histogram (131 occasions) and smileys for students/peers (148 occasions).
3. Initial Use of the Next-TELL Open Learner Model

Johnson et al. (2013) gives examples of how teachers might take up their open learner model within their existing teaching practices. The above results suggest that students will use the open learner model when it is deployed on a voluntary basis. In the previous version of the open learner model, the last two visualisations in Figure 1 were not available. In forthcoming work we plan to track their use also. But from the above data in Table 1, it can be seen that of those visualisations that were deployed, both students and teachers did use the complete range – except for the two visualisations that were specific to one of the groups of users only. In addition, all types of information were received and consulted: self, teacher and peer assessments; evidence for model data; and information filtered from the model or seen fully. Thus we aim to explore use and flexibility of use in more detail in upcoming work.

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References


Designing Collaborative Learning Activity for the Abstract Knowledge Creation

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Abstract: This study demonstrates that collaborative learning for the abstract knowledge creation involves three conditions: (1) the sharing of various representations, (2) the discussion of solutions, and (3) the absence of teacher interventions. We found that when these conditions are embedded in the design of a lesson, students are able to gain knowledge, even if they do not find solutions. Our research design involved two classes of sixth-grade students. In mathematics lessons, a teacher asked students to come up with the number of games of a round-robin football tournament. One classroom used a Jigsaw method and the other did not. One or five months later, students were required to write what they remembered of specific lessons on a retrospective test. Students in the non-Jigsaw classroom included those who retained knowledge and those who did not. However, students in the Jigsaw classroom recalled what they had learned, except for a certain group. Through a dialogue analysis of each group with KBDeX, we found that certain types of discourse were promoted by lesson designs. In the first type, students shared various representations (e.g., concrete scenes, symbols, computations, diagrams or tables) and discussed solutions. In the second type, they pooled single representation and only discussed answers. In the third type, students shared various representations but only discussed answers. In the Jigsaw classrooms, in which most of the first type of group was located, students with different ideas discussed solutions. In contrast, in the non-Jigsaw classrooms, with the first and second types of groups, those with differing ideas did not discuss solutions. In addition, we found that the third type of group did not consider solutions with a teacher’s intervention. In order to enhance activities of sharing representations, now we are designing the activities that students use tablet devices.

Keywords: Collaborative learning, abstract knowledge creation, jigsaw methods, retrospective test

1. Introduction

It is clear that knowledge building through collaboration is better than knowledge acquisition through instruction, since the former method allows for the development of adaptive expertise and deep understanding. However, high quality collaborative learning usually depends on the intentions of each student. We must develop lesson designs that effectively promote constructive interaction among students. For example, “knowledge building” represents an attempt to refashion education in a fundamental way, one that introduces students to knowledge creation (Scardamalia and Bereiter, 2006). Brown and Campione (1996) develop a model called “fostering a community of learners” (FCL) for grades one to eight. The FCL project uses the “Jigsaw method” (Aronson, 1978). Students from each of the subtopic groups come together to form a Jigsaw group in order to share their knowledge of these subtopics and to work together on some consequential task. CoREF at the University of Tokyo in Japan has been striving to help teachers develop a network community of learner-centered classrooms with the Jigsaw method (Miyake, 2012). Our design research seeks to determine what activity encourages abstract knowledge creation. However, we employ a new measure because correct interpretation requires correct observation (Pellegrino et al., 2006). Schwartz and Martin (2004) focus on adaptive expertise, which has been called “preparation for future learning” (PFL). They developed a new measure called the double transfer assessment of PFL, and we came up with a new measure called the “Retrospective test.”
2. A Method of Evaluation

a. Retrospective Test

We carried out the Retrospective test one month or more after the students’ lessons. Students were required to describe all that they remembered of a specific lesson on the Retrospective Test. Test items are shown below.

1) With whom did you carry on a discussion?
2) What kind of lesson was it? Please write all that you remember of it.
3) What did you talk and think about?
4) Who talked about what?
5) What did the teacher talk about?
6) What did you learn?

2.2 Dialogue Analysis

We analyzed the patterns of dialogue through the results of the Retrospective test. We recorded the dialogue of each group and analyzed each protocol. The classifications are shown below. If necessary, we used the social network analysis tool called KBDeX (http://www.kbdex.net).

1) What type of a solution did the students explain?
2) Did students discuss how to solve a problem or to answer a question?
3) What was the rate of intervention by the teacher?

3. Design Experiments

a. Non-Jigsaw Classroom: Pre-research

In 2011, we collected data from the non-Jigsaw classroom, which had twenty-three students. First, the teacher asked the students, “What is the number of games of a round-robin football tournament?” In the first half, students solved problems in groups, after tackling them individually. In the second half, they reported their representations and solutions, and then the teacher explained the correct answers and solutions. Table 1 shows the results of each group. Student ideas determined if there were various representations. Therefore, students were divided between those who retained knowledge of the groups’ activities and those who did not.

Table 1: Results of non-Jigsaw classroom of 2011.

<table>
<thead>
<tr>
<th>Pattern of dialogue</th>
<th>At the end of group activity</th>
<th>Retrospective test (A month later)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sharing of various representations</td>
<td>Discussion of solutions</td>
</tr>
<tr>
<td>Group N1</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Group N2</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Group N3</td>
<td>No recorded data</td>
<td></td>
</tr>
<tr>
<td>Group N4</td>
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<td></td>
</tr>
<tr>
<td>Group N5</td>
<td>No recorded data</td>
<td></td>
</tr>
<tr>
<td>Group N6</td>
<td>No recorded data</td>
<td></td>
</tr>
</tbody>
</table>

b. Jigsaw Classroom: Designed Lesson

In 2012, we designed and practiced a lesson in the Jigsaw classroom, which had twenty-four students. First, the teacher asked the students, “What is the number of games of a round-robin basketball tournament?” In the first half, students solved problems with the selected specific representation (calculations, tree diagrams, object, or pictures) in expert groups, and then they shared each
representation and discussed solution in jigsaw groups. In the second half, they reported their representations and solutions, and the teacher explained the correct answers and solutions. Table 2 shows the results of each Jigsaw group. It indicates that almost all students knew the solutions to problems five months later, but those in half the groups could not write the episodes. Only Group J1 did not arrive at a solution because of intervention by the teacher in a Jigsaw activity. Figure 1 shows the differences in social networks of sharing of various representations between Group J1 and J4 by KBDeX.

Table 2: Results of Jigsaw classroom of 2012.

<table>
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<th>Retrospective test (5 months later)</th>
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<tr>
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<td>Yes</td>
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<td>Yes</td>
</tr>
<tr>
<td>Group J6</td>
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</tr>
</tbody>
</table>

Figure 1. Social networks of sharing of various representations (Left: Group J1, Right: Group J4)

4. Discussion

We found that collaborative learning for abstract knowledge creation requires three conditions: (1) the sharing of various representations, (2) the discussion of solutions, and (3) the absence of teacher interventions. In future, we want to support students’ activities of sharing various representations using one-to-one tablet devices in order to enhance the discussion of solutions.

References


Development of a New Smart Learning Project - Rainbow Fun

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Abstract: This paper proposes a new smart learning project- “Rainbow Fun” for K-12 education system. The framework of “Rainbow Fun” is composed of four parts: 1) “Learning Lab” is designed for learners to better understand their own learning styles; 2) “Teaching Lab” enables teachers to apply interactive technologies to create more effective ways of teaching; 3) “Integrative Pedagogy” helps teachers develop their role as facilitators to lead their students to explore their potentials; and 4) “Education Cloud” generates a learner’s learning record instantly, continues to maintain his/her e-portfolio, and creates a ubiquitous learning environment for everyone. The goal of this project is to equip the next generation with the ability to learn actively and solve problems.

Keywords: 21st Century Skills, challenge-based learning, interactive technology, education cloud.

1. Introduction

The learning and innovation skills which are proposed by the Partnership for 21st Century Skills [1] are what separate students who are prepared for increasingly complex life and work environments in today’s world and those who are not. They consist of creativity and innovation, critical thinking and problem solving, and communication and collaboration. In addition, people's creativity is the main key of improving the national competitiveness, and lack of creativity causes the sluggishness of national social development. Therefore, under this situation, enhancement people’s 21st Century Skills has become an important goal of education. Recently, challenge-based learning (CBL) [2], [3] is an emerging issue, and CBL can let students leverage the innovative technologies they use in their daily life to inspire their creativity to solve complex, real-world problems. After the CBL implementation study, the major findings are concluded: 1) it is effective in building 21st Century Skills including creativity, collaboration, critical thinking, communication, innovation, and so on; 2) over three-quarter of joined students feel that they worked harder than before, and learned more than expected; 3) CBL can help students master the materials and a good use of their limited time; 4) CBL is suited to teach in a technologically rich environment.

Due to advance of technology and aforementioned advantages of CBL, this paper proposes a smart learning project-“Rainbow Fun”, and it fuses the concept of CBL and innovative interactive technologies to develop various innovative teaching and learning systems. The framework of this project includes “Learning Lab”, “Teaching Lab”, “Integrative Pedagogy”, and “Education Cloud”. The developed innovative teaching and learning systems have four core ideas: 1) analyze learners’ learning behaviors and learning styles to advise on learning plans; 2) integrate interactive technologies with various learning activities to provide learners with better learning methods; 3) identify infrastructure/hardware required for teaching strategies to design challenging theme-based curricula; 4) introduce this system to the market with two focuses: teacher training and total-solution licensing. The remainder of this paper is organized as follows. In Section 2, we introduce the content of this smart learning project, and a conclusion and future work of our proposed project is given in Section 3.

2. Smart Learning Project – Rainbow Fun

The innovative smart learning project, “Rainbow Fun”, is developed for K-12 education system, and the framework of “Rainbow Fun” which is composed of “Learning Lab”, “Teaching Lab”, “Integrative Pedagogy” and “Education Cloud”. The goal of this project is to develop an interactive smart classroom...
and to foster students’ skills with “5C” and “5I”. 5C are communication, critical thinking, collaborative, connected, and creativity. 5I are innovation, informal learning, information, interaction, and intelligence.

a. Learning Lab

“Learning Lab” is designed for learners to better understand their own learning styles, train their brain, and inspire their creativity. One of the developed learning systems is “GyriGym” [4] which is an online game-based platform for brain training. It can assess students’ cognitive abilities and provides in-depth game-based training accordingly. The platform includes eight parts of the brain which are attention skills, language, executive skills, orientation, psychomotor, visual-spatial perception, memory, and problem solving, as shown in Figure 1.

![Figure 1. The platform of GyriGym.](image)

b. Teaching Lab

The core idea of the “Teaching Lab” is to develop innovative interactive human-machine technologies for educational applications and enable teachers to apply new technologies to create more effective ways of teaching. Here, research areas such as multi-touch, augmented reality/virtual reality (VR), motion sensing technology are focused. For instance, an interactive VR teaching system with multi-screen devices and motion-sensing technology for earth/space science, geography, and history teaching has been developed, and it can create an interactive and immersive virtual environment with high resolution multi-media materials, such as panorama pictures and historical paintings.

![Figure 2. The interactive VR teaching system.](image)

c. Integrative Pedagogy

Integrative Pedagogy helps teachers develop their role as facilitators to lead their students to explore their potentials. In addition, it encourages the learner to interact with the teacher, making learning more flexible and immediate.

d. Education Cloud

Education Cloud service functioning with all kinds of learning and teaching applications connects to users devices at anywhere. The advantages of developing the Education Cloud for teachers and students are: 1) before class: students can preview teaching materials, and teachers can prepare lessons; 2) in
class: Teachers use computers or tablet computers for e-teaching; 3) after class: students can study by
self-learning at home. In addition, parents can trace children’s grades and learning statuses from the
cloud platform, and also increase interaction with theirs children.

e. Curricula and Products

Various theme-based courses based on a modified CBL module and multiple-learning testing modules
are designed. The modified CBL module complete process includes: identifying problems, analyzing
available resources, exchanging ideas, finding solutions, demonstrating results, and teacher and student
feedbacks. The multiple-learning testing modules include attention diagnosis, learning style diagnosis,
and learning workload diagnosis. The curricula of “Science Camp” which is one of our designed
theme-based courses include five parts: 1) explore your brain power and stimulate your brain with
technology; 2) learning by exploring: study the principle of machinery; 3) learning by simulating: copy
and redesign teachers’ samples; 4) learning by evaluating: hypothesizing & verifying by manipulating
machinery; 5) integration & cooperation: innovate their own devices and build team’s masterpieces.
After project completion, students can use an iPad to control the masterpiece.

3. Conclusion and Future Work

This smart learning project in our research aims at developing various modified CBL courses with
innovative interactive technologies, and functions of this project are: 1) to train students’ brain and
inspire their creativity; 2) teachers can apply new technologies to create more effective ways of
teaching; 3) to help teachers develop their role as facilitators to lead their students to explore their
potentials, 4) to generate a learner’s learning record instantly, continue to maintain his/her e-portfolio,
and create a ubiquitous learning environment for everyone.

Acknowledgements

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Survey on Utilization Status of SCORM Specification in Japanese e-Learning Industry

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Abstract: We present the result of a questionnaire survey concerning the dissemination status of SCORM specification in Japanese e-learning industry. The survey targets are employees of e-learning vendor companies and e-learning users. The focus is the type of e-learning content, authoring tools, and LMSs. The survey results indicate that the SCORM specification provides benefits as a result of the ‘bandwagon effect’.

Keywords: e-learning standardization, SCORM, dissemination of standard technology

1. Introduction

Fallon and Brown (2003) have described how e-Learning standards have become an indispensable component in implementing and operating e-learning activities in the academic and industry sector. These standards are also important to enhance e-learning business because they facilitate novel value-added products which can help companies get into the market (Nakabayashi, 2004). Among various e-Learning standards, the SCORM specification (Advanced Distributed Learning, 2006) may be the most widely accepted one. The e-Learning Consortium Japan (eLC) has promoted SCORM in the Japanese market (Nakabayashi, 2007).

This paper describes the survey results regarding the dissemination and utilization status of the SCORM specification in the Japanese e-learning industry. The focus is how this specification can be best used to activate the e-learning industry. The survey results indicate that SCORM specification brings some benefits to the industry by fostering an introduction of new tools and content as well as the creation of value as a result of the ‘bandwagon effect’.

2. Outline of Survey

The eLC asked its member companies’ employees, participants at exhibitions related to e-learning, and subscribers of an eLC mail magazine to answer a web-based questionnaire survey. There were 73 respondents including not only LMS engineers and content designers but also marketing staff in e-learning vendor companies and management responsible for e-learning operations in e-learning user companies?. In the following sections, results will be shown for 45 respondents who are actually using the SCORM specification in some way.

3. Results

a. Amount of Created Content

The number of items of SCORM content created by the respondents’ organization is shown in Table 1. It is categorized by content types. Here, ‘ready-made’ means the content created to be sold for multiple users; ‘custom-made’ means the content created in accordance with the order from a certain customer; ‘in-house’ means the content created for the organizations own use. There is a tendency for the amount of custom-made content is greater than that of ready-made content. One third of the respondent answered that their organization creates more than 50 SCORM content. Some respondents stated ‘My company creates more than 1000 custom-made content’ or ‘More than 100 custom-made content per year’. Concerning in-house content, there were respondents who created a few hundred SCORM
contents. This means that SCORM specification is widely accepted as a basic infrastructure in Japanese e-leaning industry.

Table 1: Number of created SCORM content (n=45)

<table>
<thead>
<tr>
<th>Content Type</th>
<th>0</th>
<th>~5</th>
<th>~10</th>
<th>~20</th>
<th>~50</th>
<th>51~</th>
<th>N.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready-made</td>
<td>14</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Custom-made</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>In-house</td>
<td>14</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>

b. Type of Authoring Tool and LMS

The type of authoring tool and LMS used for SCORM content operation are shown in Table 2 and 3. A variety of tools and LMSs with SCORM specification is used in practice. This indicates that the SCORM specification is implemented in the various e-learning products in Japan. The number of LMS types used by respondent is shown in Table 4; 17 respondents used only one type of LMS, but two used 6 to 9 types and other two used more than 10 types. This means that SCORM specification make it possible for e-learning engineers to efficiently use numerous LMSs.

Table 2: Type of SCORM authoring tools (n = 45, multiple answers)

<table>
<thead>
<tr>
<th>Type of Tools</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Only for SCORM (Commercial product)</td>
<td>21</td>
</tr>
<tr>
<td>Only for SCORM (Free software)</td>
<td>8</td>
</tr>
<tr>
<td>Equipped with LMS</td>
<td>14</td>
</tr>
<tr>
<td>General purpose tool (e.g., Flash)</td>
<td>31</td>
</tr>
<tr>
<td>In-house (e.g., Converter, Template)</td>
<td>22</td>
</tr>
<tr>
<td>N.A.</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3: Type of SCORM LMS (n = 45, multiple answers)

<table>
<thead>
<tr>
<th>Type of LMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial/Japanese</td>
</tr>
<tr>
<td>Commercial/Overseas</td>
</tr>
<tr>
<td>Open source/Japanese</td>
</tr>
<tr>
<td>Open source/Overseas</td>
</tr>
<tr>
<td>In-house</td>
</tr>
<tr>
<td>ASP</td>
</tr>
<tr>
<td>N.A.</td>
</tr>
</tbody>
</table>

Table 4: Number of LMS types used by respondent (n = 45)

<table>
<thead>
<tr>
<th># of LMS Types</th>
<th>1</th>
<th>2~3</th>
<th>4~5</th>
<th>6~9</th>
<th>10~</th>
<th>N.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Respondent</td>
<td>17</td>
<td>17</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

c. Type of Content and Medium

Created content types and medium types used are shown in Table 2 and 3, and indicate that the users create various types of content by using various media. This implies that the SCORM specification can be adapted for a variety of user requirements: from simple lecture type content using Power Point to complicated simulation type content using Flash animation.

Table 5: Type of created content (n = 45, multiple answers)

<table>
<thead>
<tr>
<th>Type of Content</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainly Lecture</td>
<td>29</td>
</tr>
<tr>
<td>Mainly Exercise</td>
<td>20</td>
</tr>
<tr>
<td>Mixture of Lecture and Exercise</td>
<td>32</td>
</tr>
<tr>
<td>Simulation</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 6: Type of medium used for content (n = 45, multiple answers)

<table>
<thead>
<tr>
<th>Type of Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Point</td>
</tr>
<tr>
<td>Video</td>
</tr>
<tr>
<td>HTML (Text and Figure)</td>
</tr>
<tr>
<td>Animation (e.g., Flash)</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

d. Intention and Effect of introducing SCORM

The users’ intention before introducing SCORM products and the achieved effect after its introduction is shown in Table 7. The most common reason was the ‘requirement of customer’ then ‘compliant LMS was already introduced’. The next common reason was ‘reliability of standard’ and ‘content reusability’. Both are technical reasons. The fact that the value is stable before and after implementation means the SCORM specification works in a practical environment and fulfills users’ expectations.
Table 7: Intention and Effect of introducing SCORM (n = 45, four-point Likert scale)

<table>
<thead>
<tr>
<th>Intention and Effect</th>
<th>Before introduction</th>
<th>After introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Av.</td>
<td>S.D.</td>
</tr>
<tr>
<td>Requirement of customer</td>
<td>3.21</td>
<td>1.01</td>
</tr>
<tr>
<td>SCORM-compliant LMS introduced</td>
<td>3.07</td>
<td>1.01</td>
</tr>
<tr>
<td>Reliability of standard</td>
<td>3.02</td>
<td>0.73</td>
</tr>
<tr>
<td>Content reusability</td>
<td>2.84</td>
<td>0.82</td>
</tr>
<tr>
<td>Content development efficiency</td>
<td>2.62</td>
<td>0.86</td>
</tr>
<tr>
<td>Standardization of development process</td>
<td>2.57</td>
<td>0.70</td>
</tr>
<tr>
<td>Variety of compliant product</td>
<td>2.47</td>
<td>0.83</td>
</tr>
<tr>
<td>Variety of technical information</td>
<td>2.09</td>
<td>0.71</td>
</tr>
<tr>
<td>Outsource content development</td>
<td>2.14</td>
<td>0.93</td>
</tr>
<tr>
<td>Recommended by vendor</td>
<td>1.71</td>
<td>0.87</td>
</tr>
</tbody>
</table>

4. Discussion and Conclusion

One of the most important effects of standardization is not to introduce new technology but to construct a common framework for ‘modules’ working on it (Baldwin and Clark, 2000). Each module can be operated with others through the standardized interface, but it can improve its performance and value independently from other modules. It is shown that the SCORM specification has such a characteristic. In fact, as described in 3.2 and 3.3, various tools and LMSs are practically used and a variety of types of content are created with diverse media. With the SCORM specification as a common technical framework, not only commercial systems and content but in-house tools are easily introduced to meet users’ requirement.

Another interesting issue observed in this survey is network externality or the “bandwagon effect” (Rohlfs, 2001). This effect is a phenomenon in which the value of the product is determined not by its own performance or quality but by the number of parties using the same type of product. It is shown in 3.4 that users use the specification since ‘the customer requires it’ or ‘LMS is already compliant with SCORM’. This implies that there is a network of SCORM products that exists between the vendor and client which work as a ‘bandwagon’. This effect can be also seen in the observation in 3.1 which shows that lots of custom-made and in-house content are created with the specification. These types of content were not necessarily created with SCORM since they are not intended to be distributed. Nevertheless, as they were built with SCORM, it brings some benefits as a result of the bandwagon effect.

Acknowledgements

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References

Graphical Tool for Formative Assessment with the Moodle Quiz Module

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Abstract: In this paper, we present a graphical tool that we have developed for the visualization of quiz results in Moodle; it is intended to assist in effective formative assessment. This tool helps to conduct cluster analysis and displays the results in the form of a line graph. In traditional classes, students attempt quizzes, and in each case, the teachers will, using formative assessment, analyze the quiz results and subsequently use the knowledge thus gained to improve their teaching. Although this approach is highly effective, it substantially increases the workload of a teacher. The graphical tool developed on Moodle enables a teacher to form views on a student’s comprehension of the material covered, by visualizing the quiz results.

Keywords: E-learning, Learning analytics, Formative assessment, Visualization, Moodle

1. Introduction

Formative assessment is renowned as an effective strategy that helps students achieve high standards (OECD, 2005). Many teachers make practical use of formative assessment; however, there have been only few systematic studies of such work. To realize an educational formative assessment, a tool that visualizes the current system of education is required, and whose usefulness is already known. Many graphical data mining tools that utilize the data of LMSs (learning management systems) have been developed (Dyckhoff, A. L., 2012, Pedraza-Perez, R., 2011, Romero, C., 2008). These tools are very useful to a teacher who specializes in data analysis, and to a teacher who studies a specific educational activity. However, these tools are not easy to use for all teachers. Therefore, we developed a tool that all teachers can use easily.

In the literature, many examples of the practical use of formative assessment with LMSs are available (Olle BäLter, 2013, C. Chen, 2009). That is because a quiz module is included, as a standard, in almost all LMSs, and it can easily be used by teachers; in particular, the grading of most questions can be automated. Nevertheless, gaining satisfactory knowledge of students’ understanding requires substantial time and effort. We have developed a graphical tool, based on Moodle as an example LMS, for reducing the time (and effort) involved in carrying out formative assessment. Moodle was adopted owing to its familiarity to the teaching community. The tool also increases the effectiveness of such an assessment.

2. Moodle Quiz Module

The Moodle quiz module has several types of questions, such as multiple-choice questions, true-or-false questions, and description-based questions. With the exception of description-based questions, most questions can be graded automatically, and the results can be made available to the teacher (Figure 1). In the example shown in Figure 1, four questions are solved by each student and graded. The student scores are then averaged.
3. **Formative Assessment using the Developed Graphical Tool**

   a. **Approach (Outline)**

      The method of formative assessment that we propose consists of three phases: (1) students attempt a quiz in a class; (2) the teacher analyzes the students’ results; (3) the results of this analysis are used to improve the next class. The visualization of students’ results is included in the second phase, with line graphs as a primary feature.

   b. **Visualization using Line Graphs**

      To find students who have made similar mistakes on a quiz, we conducted a cluster analysis. The crucial step in the application of this cluster analysis is the interpretation of the clusters obtained. By visualizing the patterns of similar mistakes as line graphs, one can validate the interpretation drawn from the analysis. Line graphs are used for visualizing the students’ results. Each student was given four questions, which were then described as a four-dimensional vector whose components are the students’ scores for each question. The X-axis of these graphs indicates the question numbers, the Y-axis shows the students’ scores, and a single line graph corresponds to one cluster (Figure 2). In the example in Fig. 2, 20 students were used in the cluster analysis and partitioned into three clusters using the k-means method. Students in the same cluster made similar mistakes. The average student scores in each cluster are displayed by the line graph. The number “9” in Cluster1(9) refers to the number of students classified into Cluster 1. These graphs provide multiple viewpoints that should help a teacher to analyze. For example, a teacher can readily identify patterns in the mistakes made by students in the same cluster.

   c. **Use of the Developed Graphical Tool**

      A brief explanatory example of the use of the graphical tool has been provided here. The tool alters the existing Moodle quiz module in a way that ensures that the method of using the Moodle quiz module remains unaltered (Jonathan Moore, 2010). As a standard function, the Moodle quiz module provides a
table (Figure 1) for teachers to obtain feedback from the students’ results. The graphical tool we have developed includes a line-graph display as an additional function (Figure 3).

Figure 3. Screenshot of the developed graphical tool

4. Conclusions

In this paper, we presented a graphical tool on Moodle to help teachers perform effective formative assessment. This tool identifies and visualizes patterns in the mistakes that students make. The tool supports visualization of students’ quiz results, and it is expected to aid teachers to easily measure the levels of comprehension amongst their students. The use of this tool may correspond to improvements in students’ achievement. For future work, we intend to use questionnaires and other means to verify the effectiveness of this graphical tool. We will also investigate the use of visualization in statistical pattern recognition and other fields.

Acknowledgements

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Character Development Through Mobile Integration Into Teaching and Learning

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Abstract: The use of ICT in teaching and learning for developing the students’ characters is an innovative way in this era. The research objective is to develop the students’ characters by integrating mobile technology into the learning process in the classroom. The mobile technology is used as a learning tool. The mobile learning system and the learning procedure of mobile technology integration into teaching and learning is developed as well. The repetition of this procedure is expected to generate the characters of discipline, honest, hard working, independent, creative and responsible. This learning procedure will generate individual and collaborative learning. It is an ongoing research project that takes place at the Educational Technology Department, Faculty of Education, State University of Malang, Indonesia.

Keywords: behaviorism, character development, mobile learning

1. Introduction

Referring to the one of Indonesian national education’s goal is to create graduates who have a strong personality and religious beliefs as well. Characters can not be built instantaneously, it takes time and needs synergy with the environment outside of school and also requires simultaneous implementation in teaching and learning activities in the classroom and other extra-curricular activities. The success of character education is expected to be a positive character for Indonesians young generations. Therefore, Indonesian Ministry of Education and Culture pays particular attention in implementing the character education in schools at all education levels in Indonesia, such as the new curriculum 2013 of Indonesian that encourages students to develop intellectual curiosity with habituation and intervention approach. According to Dougherty (2007), character traits is that they are habituated, stable dispositions that develop over time. She implies that a state of character results from the repetition of similar activities.

The use of ICT in teaching and learning for developing the students’ characters is an innovative way in this era. The research objective is to develop students’ characters by integrating mobile technology into the learning process in the classroom by utilizing mobile technology such as mobile phones, Smartphones, tablet PCs and so on. Particularly, these technologies that mostly owned by Indonesian people. These are the potential technologies that can be utilized for teaching and learning. In this research, the characters that will be developed are honest, discipline, creative, independent, hard working and responsible. The research is based on the Learning theory that promoted by Skinner (1958). Skinner says “learning is a change in behavior as a result of an individual's response to stimuli that called a reinforcing stimulus which occurred in the environment”. In this case, the reinforcer is a mobile technology. Skinner believes that an individual's behavior is influenced by the presence of a continuous interaction with the surrounding environment. Repetition and training during teaching and learning process by using mobile technology will be desired to behavior change of the students' habit. It is expected to be a positive character for students. There are two main works of this research; developing the mobile learning system and the learning procedure of mobile technology integration into teaching and learning.

2. Mobile Technology in Indonesia

Mobile technology is a pervasive technology in this decade. The technology is owned by almost all people without exception, such as mobile phones, Smartphones, tablet PC, iPod, iPad and
others. The mobile technology offers ease of use and rich in features. With low prices, we can buy a mobile device that equipped with a communication standard for multimedia features and internet access. Furthermore, The features of mobile technology today is almost like a computer. With a smaller size than a laptop, the technology is more portable or easy to carry anywhere.

Since the mobile technology is almost owned by everyone, mobile technology could be utilized as a learning tool that supports the concept of “equity” or it can be defined as an equal access of education to all people. As a fact that not everyone who has a mobile phone has a computer however almost everyone who has a computer has a mobile phone. The number of mobile phone users in Indonesia has reached 159,248 million with a total population of 242 million (MobileLife, 2013).

3. Research Methodology for Mobile Learning System

In order to develop the characters of students by integrating mobile technology into teaching and learning in the classroom, the mobile learning system is designed. It is a media for learning. The research of mobile learning system incorporates both Instructional System Design (ISD) and the model of System Development Life Cycle (SDLC). The Framework model was developed by Berking, et al (2012) and in analysis step is modified in this research, as shown Figure 1. This framework is intended to develop concepts, and specific guidelines for the integration of mobile technology. This study begins to determine technology acceptance of students, which will be used as a foundation in developing mobile learning.

![Figure 1. Research Methodology](image)

4. Mobile Technology Application in Characters Development

The research is an ongoing project that takes place in the Educational Technology department, Education Faculty, State University of Malang, Indonesia. Mobile technology integration into teaching and learning supports the concept of student centered learning. It will increase the students’ activities in the classroom. The mobile learning system will be used as a media for character development. For accessing this mobile learning, the students use their mobile devices. The procedure of mobile technology integration into teaching and learning in the classroom as shown in Figure 2 and described as follows: 1) Students’ attendance checklist by using mobile phone, 2) Lecturing, 3) Enriched learning
material including others printed material resources and web resources that can be accessed through mobile technologies, 4) Discussions, 5) Exercise/Task, 6) Online formative assessment/quiz, 7) Online questionnaire.

The repetition of this procedure during the learning process is expected to develop the characters of discipline, honest, hard working, independent, creative and responsible. This learning procedure will generate individual and collaborative learning. Since the students have their own mobile technology, the learning will generate the individual learning, in this case procedure number 1,3,6 and 7 and the remains procedure will support collaborative learning. These characters are expected to be a positive character in the students for short term and long term period.

5. Conclusions
Character development in Indonesian Education is a critical issue. There are many ways to develop the students’ characters in school, one of the examples is this research project that integrating mobile technology into teaching and learning. It is ongoing research in the Educational Technology Department, Faculty of Education, State University of Malang, Indonesia. The procedure of the learning by using mobile technology is developed in order to generate the characters of discipline, honest, hard working, independent, creative and responsible. These characters are developed academically and expected to be the positive characters of the students.

Acknowledgement
I would like to thank you the lectures and students of the Educational Technology Department, State University of Malang, Indonesia who have supported this research project.

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Development of Teaching Material in Tablet PC for Experiment of Nitration of Benzene Based on Computer Graphics by Quantum Chemical Calculation

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Abstract: The change in the structure of reactants about the transition state after the π-complex in nitration of benzene was visualized by CG based on the semi-empirical molecular orbital calculation. Teaching material could demonstrate the structural change of reactants with both space filling and ball-and-stick models along with the reaction profile, which can provide image of energy change during the reaction. The teaching material was tried to integrate with an electronic textbook of chemical experiment for the student’s laboratory.

Keywords: CG, visualization, chemical reaction, electronic textbook, tablet computer.

1. Introduction

Chemical education has the circumstances performed through an experiment. Understanding the observed phenomena, chemists use to imagine and explain observations in terms of molecules. Observable-level phenomena and molecular-level models are then represented in terms of mathematics and chemical equation, which is at the symbolic-level (Gilbert & Treagust, 2009). If these levels are introduced together, numerous opportunities should be given to relate them, so that linkages are formed in the long-term memory (Tasker & Dalton, 2010). Student’s difficulties and misconceptions in chemistry are from inadequate or inaccurate models at the molecular-level (Kleinman et al., 1987). Visualization based on quantum chemical calculations is great help for students to have images at the molecular-level. It is our aim to produce CG teaching material, which provides realizable images of the nature of chemical reaction (Ikuo, Nagashima, et al., 2012). If the CG teaching materials were combined with chemical experiments of student’s laboratory, students would observe the reaction from the three thinking levels. Our ultimate goal is to produce such an electronic textbook that can be used not only in the classroom but also in the experimental laboratory.

Nitration of benzene is one of typical reactions in organic chemistry, and the reaction is often adopted in teaching material on the curriculum of high school and the university, including many appropriate schemes (For example: McMurry, 2001). The scheme should be developed for student to acquire more realizable images of the nature of the reaction. The reaction proceeds via intermediates 1) π-complex and 2) σ-complex (Esteves et al., 2003. Queiroz et al., 2006.), and overall reaction is controlled by those intermediates. Recently, we developed CG teaching material of the reaction 2) σ-complex (Ikuo, Ono, et al., 2012). In this work, the change in the structure of reactants about 1) was followed by the semi-empirical molecular orbital method. Produced teaching material was tried to integrate with an electronic textbook of chemical experiment for the student’s laboratory.

2. Procedure

a. Quantum Chemistry Calculation
The semi-empirical molecular orbital calculation software MOPAC (Stewart, 1989) with PM5 Hamiltonians in CAChe Work System for Windows (ver. 6.01, FUJITSU, Inc.) was used to find the transition state and the reaction profile of chemical reactions. The structure of the reactants on the transition state was searched by use of the optimized structure of reactants. The optimized structure of the transition state was verified by the observation of a single absorption peak in the imaginary number
by the use of the program Force in MOPAC for vibration analysis. If the peak was observed, Intrinsic Reaction Coordinate (IRC) (Fukui, 1970) calculation was performed to verify the reaction profile.

b. Production of Teaching material of CG and Electronic Textbook
A movie of the reaction profile was produced by the software DIRECTOR (ver. 8.5.1J, Macromedia, Inc.) following the display of the structure of the reactants in each reaction stage, which was drawn by the CAChe (ver. 6.01, FUJITSU, Inc.). The movie file was converted to the Quick Time movie by the Quick Time PRO (ver. 7.66, Apple, Inc.). Electric textbook was produced with iBooks Author (ver. 2.0, Apple, Inc.) and was saved to iPad (Apple, Inc.) by using the iTunes (ver. 11, Apple, Inc.).

3. Results and Discussion

a. Validation of Teaching Material
From the result of the vibrational analysis of reactants on the transition state, single absorption peak in the imaginary region was observed at -343.29 cm\(^{-1}\); therefore, the structure of the transition state was verified. The reaction path from the reactants to the product via the transition state was searched by the IRC calculation, and molecular configuration of each step on the reaction profile was obtained. The activation energy was 25.96 kJ mol\(^{-1}\), which was within the estimated value (Esteves et al. 2003) of 29.29 kJ mol\(^{-1}\). Furthermore, bond length, \(\ell\), and angle of the product was in good agreement with reported value (Nihonkagakukai-hen, 1984) in parentheses, for example, \(\ell_{\text{CN}} = 149\ (147)\ \text{pm}\) and \(\ell_{\text{NO}} = 122\ (122)\ \text{pm}\), and angle of N-O-N = 123.5 (122.8) degree. Therefore, it was confirmed that the reaction profile and the molecular configurations obtained by the calculation were appropriate. The Quick Time movie file was produced as teaching material.

b. Electronic Textbook
Selected pictures of teaching material are shown in the figure 1. Left part of the material shows the reaction profile, potential energy vs. reaction coordinate, which indicates the degree of the reaction progress by the red ball on the profile. Right part shows structural change shown in space-filling model, which exhibits the existence probability of the electron of 90 %. While choreographed animation of chemical reaction are common (For example, Tasker & Dalton, 2010), CG based on theory in the present study could provide not only images of energy change but also images of dynamical structure change with more realistic shape. When student touches the material in the tablet computer, the Quick Time control bar appears and the red ball on the profile can move by student’s choice. Student can manipulate the reaction back and forth until they obtain the image of the reaction.

The teaching material was tried to combine with chemical experiments of student’s laboratory for the purpose of making electronic textbook of basic chemistry to provide experiment at the observable-level, CG visualization at the molecular-level, and chemical equation at the symbolic-level. The electronic textbook was inserted with images of experimental procedure in the flow charts and pictures, which can be enlarged by students touch. Figure of the reaction profile was also inserted. When student touches the icon on the profile, the teaching material appears to show image of the structural change during the reaction.

Tablet computer was covered with waterproof plastic-bag and was used for practice of five students of the third year in the chemistry course of the Tokyo Gakugei University. After explanation of

![Figure 1 Teaching material](image)
usage of the tablet, 5 tablets were distributed to the students. Students were able to start the experiment smoothly by watching experimental procedure in the tablet, and after 60 minutes they were able to finish the reaction safely. During the reaction, students had time to watch the teaching material repeatedly. These results indicated that the electronic textbook was able to provide information about experimental procedure sufficiently and that students were interested in watching the teaching material during the experiment.

4. Conclusions
The change in the structure of reactants about the transition state after the π-complex in nitration of benzene was visualized by CG based on the semi-empirical molecular orbital calculation. Teaching material could demonstrate the structural change of reactants with both space filling and ball-and-stick models along with the reaction profile, which can provide image of energy change during the reaction. The teaching material was tried to integrate with an electronic textbook of chemical experiment for the student’s laboratory. The electronic textbook was able to provide information about experimental procedure sufficiently and that students were interested in watching the teaching material during the experiment.

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References
The Development of a Role-Playing Game for History Instruction and the Evaluation of Flow State and Learning Performance

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Abstract: This study developed a historical educational game - Romance at Dadaocheng©, combining a love story with a role-playing problem-solving plot. This game used authentic geographical space as the scene and adopted historical knowledge as problem-solving hints in the game exploration to enhance learners’ knowledge of Taiwan’s historical monument Dadaocheng. Through an empirical evaluation, this study preliminarily explored learners’ flow in this game and used pre-and post-tests to understand their learning effectiveness. The results indicated that learners have a certain degree of flow during the game; also, this game helps them learn the historical knowledge of Dadaocheng and its geographical location.

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

1. Introduction

Game-based learning can provide opportunities for repeated practices and trials under a challenging situation. In traditional instruction, the instructional content of history is mostly memorized declarative knowledge; thus, parts of the learners easily lose their learning motivation. However, the instructional game plans strategies, builds up hypotheses about the questions, and allows learners to try and solve problems continuously. Comparing to memorized instruction, learners will have higher-level thinking and they can understand the historical questions in the game situation (Dondlinger, 2007). Therefore, their learning effectiveness may be improved. Our research team, NTUST MEG, developed a historical instructional game- Romance at Dadaocheng©, combining a love story with a role-playing problem-solving plot. This game used authentic geographical space as the scene and adopted historical knowledge as problem-solving hints in the game mechanism to enhance learners’ knowledge of Taiwan’s historical monument Dadaocheng. This game adopted situated learning (Brown et al., 1989) as the learning strategy. The story and space of the game were designed based on the authentic photos of Dadaocheng, the knowledge of historical backgrounds, and the real geographical environment to provide problem-solving tasks for players (to resolve the mystery of the heroine’s birth). In addition, this game adopted role-playing instructional method (Shaftel & Shaftel, 1967) to make learners become a leading character in the game, which helps arouse learners’ empathy for the virtual role he plays. Learners can control and manipulate the role to involve them in the game situation, and make a survey of hints and have an adventure. This game combined a romantic plot, problem-solving process, and the tasks of fight as the background of the story to enhance players’ learning motivation. All scenes of the buildings in the game were painted based on the photos of the authentic scenes; also, regarding the geographical location, this game referred to the real distribution of the famous buildings to show the appearance of the geographical environment with the real proportion and position (as shown in Figure 1). Therefore, all of these will make learners to feel they are virtually there, which helps their cognition of the geographical environment in this area. Furthermore, the historical backgrounds and the corresponding
scenes of the geographical environment are involved in the character interaction and the hints of the plot in this game, which will promote learners to make a judgment on the accuracy of the related knowledge of history and geography during the searching process, and further strengthen learners’ cognitive processes (as shown in Figure 2). Learners have to choose the right answer to get the right feedback and then the continuous plot will go ahead.

In addition to developing this game, the objective of this study aimed to analyze learners’ flow in the experiment of the game to understand learner’s engagement in this game. Also, the pre-and post-tests were adopted to assess their learning effectiveness.

2. Method

There were 40 participants (including 20 males and 20 females), coming from a university in northern Taiwan, in this study. To analyze the learners’ flow, this study adopted the flow scale of Kiili (2006) to measure. The Chinese edition was translated and revised by the scholars Hou et al (Hou & Chou, 2012). This questionnaire included 23 items using a five-point Likert scale with two dimensions: flow antecedents and flow experience. After analyzing the samples’ data, the whole reliability was 0.92 (Cronbach’s α=0.92). This study used the same questions in pre- and post-tests, and the questions were set by a geographical expert. The content of the questions was about the knowledge of history and geographical location related to the place, Dadaocheng. There were totally 20 items. The procedures of this study were a 10-minute pre-test, a 10-minute introduction of the game and basic operation, 60-minute game time for students, and a 30-minute post-test and flow questionnaire.

3. Results and Discussions

In terms of the learning effectiveness, this study divided the items into history and geographical questions. This study conducted a paired-samples t test on the pre-and post-test scores. As shown in Table 1, the results indicated that after game-based learning, students’ knowledge of history ($t=15.52$, $p=.000$) and knowledge related to geographical location ($t=4.62$, $p=.000$) were significantly improved.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>posttest(n=40)</th>
<th>pretest(n=40)</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>History score post-test</td>
<td>12.58 1.32</td>
<td>6.55 2.28</td>
<td>15.52***</td>
</tr>
<tr>
<td>- pre-test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geography score post-test</td>
<td>2.58 1.11</td>
<td>1.75 1.03</td>
<td>4.62***</td>
</tr>
<tr>
<td>- pre-test</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

***$p<0.001$
As for the flow distribution, as shown in Table 2, the average of each dimension was above 3.00 (the median was 3.00). Among these values, the four dimensions flow antecedents, goals of an activity, control, action-awareness merging, and loss of self-consciousness were highly above 4.00. The dimension with the highest average was loss of self-consciousness (M=4.24). Consequently, this game has the elements to arouse learner’s flow experience as a whole.

<table>
<thead>
<tr>
<th>Factor</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>flow antecedents</td>
<td>4.06</td>
<td>0.62</td>
</tr>
<tr>
<td>challenge-skills balance</td>
<td>3.96</td>
<td>0.87</td>
</tr>
<tr>
<td>goals of an activity</td>
<td>4.11</td>
<td>0.75</td>
</tr>
<tr>
<td>unambiguous feedback</td>
<td>3.91</td>
<td>0.74</td>
</tr>
<tr>
<td>Control</td>
<td>4.18</td>
<td>0.78</td>
</tr>
<tr>
<td>action-awareness merging</td>
<td>4.13</td>
<td>0.76</td>
</tr>
<tr>
<td>flow experience</td>
<td>3.82</td>
<td>0.64</td>
</tr>
<tr>
<td>concentration</td>
<td>3.85</td>
<td>0.75</td>
</tr>
<tr>
<td>the transformation of time</td>
<td>3.68</td>
<td>0.79</td>
</tr>
<tr>
<td>autotelic experience</td>
<td>3.66</td>
<td>0.77</td>
</tr>
<tr>
<td>loss of self-consciousness</td>
<td>4.24</td>
<td>0.80</td>
</tr>
</tbody>
</table>

4. Conclusions

This study designed and developed a historical educational game- *Romance at Dadaocheng©*. Through a preliminarily empirical evaluation, the results indicated that this game is beneficial to students’ history and geography learning. In terms of flow, the averages of all dimensions were above the median, indicating that the content of this game can arouse learners’ engagement to a certain degree, which also reflects that a game with the game mechanisms of role-playing and fighting will satisfy learner’s needs for the game elements more (Prensky, 2007). The dimension, loss of self-consciousness, has a higher flow average, resulting probably from that while playing the game, learners need to understand the hints provided by the stories which will deplete their cognitive resources (Kiili, 2006), so that they concentrate on playing the game but not involve their cognitive resources in the things irrelevant to the game. We suggested that future studies analyze learners’ behavioral patterns in a game and also explore learner’s technology acceptance. Besides, a larger sample size in the experiment is suggested to explore the effect of this game on learning completely.

References


Linguistic Rules Based Chinese Error Detection for Second Language Learning

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Abstract: In this paper, we handcraft a set of linguistic rules with syntactic information to detect errors occurred in Chinese sentences written by SLL. Experimental results come the similar conclusions with well-known ALEK system used by ETS for English Learning. Our developed Chinese sentence error detection system will be helpful for Chinese self-learners.

Keywords: Computer-aided language learning, second language learning, computer education

1. Introduction

Second Language Learners (SLL) usually write ungrammatical sentences with various types of errors. SLL tends to make mistakes in writing Chinese sentences in their early stage of learning Chinese. For example, the learner may like to express: “這對夫妻很恩愛” (The couple is very affectionate to each other), where the “恩愛” (affectionate) was mistakenly written as another similar word “恩情” (kind) as observed in the learner’s corpora. Error detection systems that indicate different kinds of errors embedded in a given sentence are important and invaluable to SLL for self-learning.

Assessing LEXical Knowledge (ALEK) system (Chodorow and Leacock, 2000) adopted statistical analysis to detect the errors of an English sentence. Using 20 target words from the Test of English as a Foreign Language (TOEFL), it performed with about 80% precision and 20% recall. Izumi et al. (2003) detected English grammatical and lexical errors made by Japanese learners. Recently, relative position and parse template language models were proposed to detect various types of Chinese errors written by US learners (Wu et al. 2010). Different from most of the previous studies, which have focused on corpus-based statistical methods, we attempt to develop a rule-based system to detect the common errors embedded in Chinese sentences written by SLL.

In this work, we manually construct a set of linguistic rules with syntactic information to detect erroneous sentences that were frequently written by the SLL. If a sentence satisfies at least one syntactic-rule, the developed system will regard the input sentence as erroneous and response with suggestions to indicate the possible errors.

2. Linguistic Rules Based Chinese Error Detection

Chinese is written without word boundaries. As a result, prior to the implementation of most Natural Language Processing (NLP) tasks, texts must undergo automatic word segmentation. Automatic Chinese word segmenters are generally trained by an input lexicon and probability models. However, it usually suffers from the unknown word (i.e., the out-of-vocabulary, or OOV) problem. In this study, a corpus-based learning method to merge the unknown words as described in Chen and Ma (2002) is adopted to tackle the OOV problem. This is followed by a reliable and cost-effective POS-tagging method to label the segmented words with part-of-speeches similar to the approach proposed by Tsai and Chen (2004). Take the Chinese sentence “歐巴馬是美國總統” (Obama is the president of USA) for instance. It was segmented and tagged in the form of “POS:Word” sequence shown as follows: Nb: 歐巴馬 SHI:是 Ne:美國 Na:總統. Among these words, the translation of a foreign proper name “歐巴馬” (Obama) is not likely to be included in a lexicon and therefore is extracted by the unknown word detection method. In this case, the special POS tag ‘SHI’ is a tag to represent the be-verb “是”. The complete set of part-of-speech tags is defined in the technical report by CKIP (2003).
To represent the syntactic rules for employing them easily to detect errors embedded in Chinese sentences written by SLL, several symbols are defined. Some of them are explained as follows: 1) The symbol “*” means a wild card. For example, the whole subordinate tags of “Nh”, i.e., “Nhaa,” “Nhbb,” “Nhcc,” “Nhdd,” and “Nhee”, can be denoted as “Nh*”. 2) The symbol “..” means an exclusion from the previous representation. Take this expression “N*-Nab-Nbc” as an example, it denotes that the corresponding word should be any noun (N*) excluding countable entity nouns (Nab) and surnames (Nbc). 3) The symbol “/” means alternative (the “or” situation). The expression “一些/這些/那些” (some/these/those) represents that one of these three words satisfies the rule. 4) The rule mx[{W1 W2}] denotes that the two words W1 and W2 should not co-exist (should be mutual exclusive). 5) The symbol “<” denotes the follow-by condition. For instance, this expression “Nhbb < Nep” means the POS-tag “Nep” follows the tag “Nhbb” that can exist several words ahead of the “Nep”.

With the rule symbols like the above, we manually construct syntactic rules to cover frequent errors occurred in Chinese sentences written by SLL. We adopt the “Analysis of 900 Common Erroneous Samples of Chinese Sentences” (Cheng, 1997) as the development set to handcraft the linguistic rules with syntactic information. Based on these samples compiled by Chinese teachers in Beijing, we constructed 60 syntactic rules to detect errors in the samples. Table 1 shows some rules accompanying with their example sentences. If an input sentence satisfies any syntactic rule, our developed system will report the input as an erroneous sentence. This can be helpful to SLL for self-learning of Chinese.

### Table 1: Some developed syntactic rules and their detected erroneous sentences.

<table>
<thead>
<tr>
<th>Rule</th>
<th>Dfa</th>
<th>N*-Nab*-Ncc*/A/VA*/VB*/VC*/VD*/VE*/VF*/V_12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>Nhha:她 VK1:覺得 Nab:自己 DE:的 Nab:丈夫 Dfa:很 Nab:私入</td>
<td>(She feels that her husband is very private)</td>
</tr>
</tbody>
</table>
| Notes | “私人” (private) is an improper word in this sentence. The correct word should be 自私 (selfish). So the correct sentence is “她覺得自己的丈夫很自私”.
| Rule | mx[{Dbab:可以 Dbab:能}] |
| Example | VH11:舊 DE:的 Nab:雜誌 Dbab:可以 Dbab:能 VE:借 TD:嗎 | (Can old magazines be borrowed?) |
| Notes | “能” (able) is a redundant word in this sentence. This word cannot be collocated with another word “可以” (can). The correct sentence is “舊的雜誌能借嗎”.
| Rule | *=:被/:被 < Da/*Db*:來-去/Dc/Dd |
| Example | Nab:自行車 P02:被 Nb:力 Dc:沒 VC:騎走 | (The bicycle is not ridden by Dingli) |
| Notes | The word “沒” (not) is put in a wrong position. This sentence contains a word ordering error. The correct sentence is “自行車沒被丁力騎走”.

### 3. Experiments and Performance Evaluation

The test data comes from a set of real error sentences written by learners of Chinese as a second language at National Cheng Kung University in Taiwan (Wu et al., 2010). Each erroneous sentence (positive instance) is accompanied with a correct one (negative instance) in this test set. In total, there are 1,866 pairs of sentences collected in years around 2009.

Table 2 shows the confusion matrix of our approach. The results indicate that our linguistic rules for error detection achieved an accuracy of 58.47% (418/1764)/(1866+1866), while maintaining a promising precision of 80.38% = 418/(418+1102), and a recall of 22.4% = 418/(418+1448). The performance level is similar with that of the ALEK system used by Educational Testing Service (ETS) for erroneous English sentence detection (Chodorow and Leacock, 2000). In addition, maintaining low false-alarm rate (which is the ratio of correct sentences that are detected as erroneous ones) is important for a system to be practical. In the experiments, our approach achieved a false-alarm rate of 5.47% (among 1,866 correct sentences, 102 were detected as erroneous). This shows that our approach is feasible to detect errors while not causing much trouble to the users.
Table 2: Confusion matrix using our linguistic rule based detection.

<table>
<thead>
<tr>
<th>Confusion Matrix</th>
<th>Gold Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
</tr>
<tr>
<td>Detected Results</td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>418</td>
</tr>
<tr>
<td>Negative</td>
<td>1448</td>
</tr>
</tbody>
</table>

4. Conclusions and Future Work

This paper proposes a linguistic rule based Chinese error detection approach. The syntactic rules handcrafted based on a smaller development set achieve promising performance on a totally different and larger test set, while maintaining a favorably low false-alarm rate. The major contributions of this work include: 1) indicating the usefulness of common error samples manually analyzed/colllected by Chinese teachers in previous work; 2) demonstrating the feasibility of linguistic rules handcrafted from these samples; and 3) developing a system to help self-learning of Chinese for SLL.

This work is our first exploration to automatically detect Chinese erroneous sentences. The research result can be extended to automatic essay evaluation, which is especially useful for Massive Open Online Courses (MOOC), because manually evaluating a large scale of Chinese writing homework and exams is a very challenging issue.

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