Educational Technology International
2011, Vol. 12, No. 1, 1-20

A Multimedia Case-based Environment: Teaching Technology Integration to Pre-service Teachers

Insook HAN Won sug SHIN*
Korea University
Korea

The study described in this paper examined the effectiveness of a multimedia case-based learning environment to teach technology integration to Korean pre-service teachers. The structure and philosophy behind the use of embedded video in an online, multimedia system and the data collected from 103 pre-service teachers are presented and discussed. The overall finding shows that there was no significant difference from pre- to posttest among the lecture, the case-based, and the mixed environment groups. However, low prior knowledge students improved more when they learned about technology integration with the mixed method than with the case-based method alone. Discussion about this result and its educational implications conclude the paper.

Keywords : Case-based instruction, Multi-media learning, Technology integration, Pre-service education

* Higher Education Policy Research Institute, Korea University
wss2105@gmail.com

Introduction

Fostering preservice teachers' competency to integrate technology into their instructional practice has become an essential component of preservice teacher education. In Korea, there is a strong belief that computers in classrooms are not being effectively used by teachers to enhance education. This is attributed to preservice teachers not being adequately prepared to use technology when they begin teaching in classrooms after graduation. Many researchers point out that pre-service teachers lack an ability to use their knowledge learned in methods courses in classroom teaching, but there is not much research about how to effectively teach technology integration.

Preservice teachers need opportunities to learn with the technology by being exposed to authentic, learner-centered activities that allow them to construct contextual understanding of learning outcomes. A multimedia, case-based system can provide a way for preservice teachers to see effective technology integration in practice, within a contextualized instructional system.

To offer preservice teachers this opportunity, we developed a multimedia Case-based Environment for Technology Integration (CETI). In this environment, preservice teachers can learn how to integrate technology by observing other teachers' technology uses in anchored video cases and reflecting on them based on their knowledge from methods courses. The purpose of this study was to examine the effectiveness of this learning environment compared to two others: the CETI environment and a lecture, and a lecture alone. We hypothesized that the combinatinon of the lecture and CETI environment would result in the most learning, followed by the CETI environment alone and then the lecture alone.

The Need to Teach Subject-Matter Technology Integration in Korea

From 1996 to 2000, Korea implemented a nationwide plan called "Adapting ICT into Education Master Plan I." As part of this Plan, computer labs were equipped in schools and a computer with an Internet connection became available to every teacher (KERIS, 2005). Thus, there was a dramatic increase in the infrastructure for Information and Communication Technology (ICT), which then led to the implementation of "The Adapting ICT into Education Master Plan II (2001-2005)," with the specific mission of adapting and integrating ICT into subject-matter education. According to this plan for second phase, teachers were asked to use ICT throughout all of their subjects for up to ten percent of their instructional time.

At about the same time (2002), the Korea Education and Research Information Service (KERIS) developed ICT Skill Standards for Teachers (ISST) to ensure that teacher's ICT skill would improve to levels specified in the standards, so that teachers could use technology to enhance the quality of education by integrating technology into their subjects. However, efforts have not been made to expand preservice teachers' abilities to utilize ICT in university teacher preparation programs. According to Lee and his colleagues (2000), most of the emphasis during university teacher education courses was placed on mastery of basic computer skills rather than on teaching the preservice teachers to integrate technology into classroom teaching. Thus, researchers have acknowledged shortcomings in teachers' preparation to use technology as an effective instructional tool and emphasized that Korean preservice teachers who graduated since 2000, after the two Master Plans have been implemented, must still receive rich opportunities to learn to use technology.

Multimedia case-based instruction has great potential to enhance preservice teachers' understanding about a real classroom environment, and to address the call for continued teacher education in the use of technology in teaching. Because learning how to teach is an ill-structured domain (Shulman, 1992), it is difficult to learn contextualized applications from a lecture and textbooks. Kwak (2002) emphasized that Korean preservice teachers hardly have opportunities to see inservice teachers' teaching practice, and noted that the needs of preservice teacher education requires bridging the gap between school practice and curriculum in universities. To meet this need, we developed learning experiences embedded in multimedia cases that enable preservice teachers to learn principles based on various classroom contexts, and to reflect on how to link principles from textbooks to real practices. Additionally, to learn how to use technology as embedded in subject-matter curriculum, viewing and analyzing the experiences that other teachers have as they try to integrate technology into curriculum is critical. Multimedia case-based methods can effectively embed such analysis.

Multimedia Case-based Instruction for Teacher Education

Case-based instruction is an instructional method that has been used for professional development in areas such as law, medical and business education, and is closely related to situated cognition, anchored instruction and cognitive flexibility (Shulman, 1992; Williams, 1992). According to a theory of situated cognition, learning can be meaningful and effective when instruction is based on specific situations rather than presented in decontextualized activities. Therefore, anchored instruction offers video clips to contextualize learning and to give learners a common reference point for discussion (CTGV, 2000). Because cases are examples of specific situations and have narrations situated in those contexts, learners may find it far easier to remember and use ideas that are located in video cases than facts or principles presented out of context. Especially for complex and ill-structured domains, case-based instruction may be effective because contextualized problem solving requires cognitive flexibility—the necessity to see problems from various perspectives. Spiro and his colleagues (1987) also argued that the best way for attaining cognitive flexibility was by a method of case-based presentation, which treats a content domain as a landscape to be explored by "criss-crossing" it in many directions.

Others have argued that case-based instruction can overcome instructional deficiencies in teacher education because teaching is also an ill-structured and complex domain that requires analysis of content and process, thought and feeling.

Teaching and learning should not be addressed theoretically as distinct constructs, but occur simultaneously (Shulman, 1992). Because classrooms are dynamic and changing environments, the importance of understanding the context within which teachers make their instructional decisions cannot be overemphasized (Kinzer et al., 2006a). However, traditional lecture-based preservice education experiences do not adequately prepare future teachers because these intertwined aspects are usually dealt with as separate factors, not as a whole. Kawk (2002) also stated that, in Korea, preservice teachers hardly have opportunities to see inservice teachers' teaching practice. He emphasized that Korean preservice teacher education should bridge the gap between school practice and curriculum in universities. Case-based instruction in education provides preservice teachers with a contextual understanding of how complex teaching and learning can be (Bowers et al., 2000) and when and how to apply instructional principles at critical decision points.

Multimedia cases appear to better capture a classroom's complexity compared to print-based cases that often present a single viewpoint and lay out events in a linear format (Kinzer et al., 2006a). In fact, there has been research showing advantages of multimedia case-based instruction in preservice teacher education. For example, Baker (2005) examined teachers' perceptions of their growth as literacy teachers, and multimedia case-based instruction was perceived as a useful tool to advance their pedagogical development. The common experience offered by cases made preservice teachers' divergent field experience more meaningful (Baker, 2005). Also, Case Technologies to Enhance Literacy Learning (CTELL) proved a potential vehicle to broaden preservice teachers' understanding. This project showed that teachers became more aware of the centrality of concepts related to the principles of effective reading instruction (Kinzer et al., 2006b) than did a control group taught using traditional methods. When using videos in inservice and preservice teacher education, teachers not only began to notice more significant aspects of teaching and learning, but they also began to focus more on interpreting what occurred based on evidence (Sherin & van Es, 2005). Even more, teachers used what they learned from multimedia cases when they designed their own activities (Van den Berg, Jansen, & Blijleven, 2004).

Multimedia Case-based Instruction for Technology Integration in Korea

In Korea, even though computers have entered every high school classroom, there is a strong belief that those computers are not being effectively used by teachers to enhance education (Kim et al., 2002). This is attributed to preservice teachers not being adequately prepared to use technology when they go into the real classroom after graduation. Kim et al. (2002) found that 33.1% of Korean third-year preservice teachers have insufficient understanding of ICT education, even though most of them (69.3%) acknowledge that ICT ability will be used in the future at school (Kim et al., 2002). Also, according to Lee et al. (2000), an average of two to six required credit points for ICT education (normal for Korean preservice teacher education programs) were not enough for preservice teachers to acquire all the necessary skills needed to integrate and manage technology effectively. Thus, Lee et al. (2000) insist that more courses for ICT education are required with clear, specific, and organized guidelines. However, simply to offer more courses may not the best solution. Preservice teachers need opportunities to learn with the technology by being exposed to authentic, learner-centered activities that allow them to construct contextual understanding of learning outcomes (Doering, Hughes, & Huffman, 2003; Wang, 2002;Wang, Ertmer, & Newby, 2004).

Multimedia case-based instruction can fulfill both requirements: to give preservice teachers an opportunity to learn with the technology, and to observe and analyze other teachers' technology use in the real classroom. Pope, Hare, and Howard (2005) summarized general findings of previous research on student teaching and stated that preservice teachers need to see good technology practices modeled not only by the university faculty who teach them, but also by their supervising classroom teachers when in their field-based preservice experiences. However, few inservice teachers have sufficient knowledge about technology integration to model effectively. A multimedia, case-based system may help to solve this problem as well, providing a way for preservice (and inservice) teachers to see effective technology integration in practice, within a contextualized instructional system.

A Case-based Environment for Technology Integration (CETI)

To test the effectiveness of case-based instructional method to teach technology integration to preservice teachers, a multimedia Case-based Environment for Technology Integration (CETI) was developed as a web-based tool. In this environment, preservice teachers can learn how to integrate technology by observing other teachers' technology uses and reflecting on them based on anchored video cases. Multimedia cases of effective ICT practices-in-use were selected from the EDUNET website (www.edunet4u.net). Video clips were created by KERIS and each city's Institute of Education Science and Education Research Institute in 2002 and 2003 for the purpose of training inservice teachers to use ICT-based teaching and learning modules (KERIS, 2005). They are available through EDUNET as resources for other teachers. We selected 25 video clips which showed middle school teachers teaching Korean (4 clips), English (3 clips), Mathematics (4 clips), Science (4 clips), Social Studies (4 clips), and Ethics (5 clips). These video clips are accessed and appear within our CETI web site; their average running time is 18 minutes each.

Once preservice teachers log in with an ID, they can access every element in the learning environment. The CETI design provides three central activities. The first is to watch a video case that provides contextual understanding of technology integration within a chosen subject area. The second is to write a reflection based on prompt questions to discuss technology use as seen in the video clip. The last is to create a lesson plan by adopting or revising technology uses, teaching strategies, and assessment strategies in the video clip to a specific classroom situation that is defined and thus is relevant to the individual user.

Preservice teachers can choose the subject of a video clip based on their interests. Each classroom practice shown in the video clip is based on teaching-learning modules (Table 1) using ICT that were developed by the Ministry of Education & Human Resources Development and research schools selected by the Metropolitan and Provincial Offices of Education since 2001. The video clip introduces each module in terms of concept, method, effectiveness, target group, and classroom environment (including technologies needed and classroom layout). After the introduction, the clip shows real classroom teaching with technology, followed by children's' interviews. By watching the video cases, preservice teachers learn about each module while observing teachers teaching each subject using ICT. Preservice teachers can learn how to use technologies appropriately in different phases of a lesson and reflect on various aspects of technology use. At the end of each video clip, interviews from children who appeared in that lesson are provided. These three elements (explanation of the ICT module, classroom teaching, and student interview) within the video cases offer a rich context while providing access to information about learning goals, the content area, student information, and information about the classroom environment. This additional information allows reflection and analysis leading to a deeper understanding of why technology is used in a specific way.

To help a preservice teacher's reflection, prompt questions are provided after they watch a video clip. Preservice teachers can revisit the video clip as many times as necessary to recall what they have seen to answer questions. These questions lead them to reflect critically in order to evaluate other teachers' teaching in terms of technology use. Questions contain the following four aspects.

- Understanding of the respective teaching-learning module as linked to ICT
- Analysis of general teaching experience based on the ICT Skill Standards for Teachers
- Analysis of specific activities using ICT in terms of learning objective, motivation, interactivity, assessment.
- Rationale for improving teaching experience by using ICT

By writing reflections based on prompts within the above four areas, we expect preservice teachers will reinforce their understanding of the ICT module, build up the framework that they can use to evaluate others' technology use, critically examine the areas to be improved, and eventually use this knowledge in their own teaching.

Research Hypothesis

In order to examine the effectiveness of Case-based Environment for Technology Integration (CETI) in teaching technology integration to preservice teachers, three different instructional methods were compared. The first was CETI with a lecture from an instructor. The second and the third were CETI alone and a lecture alone. Students with CETI alone will learn more about how to integrate technology in teaching practice than those with a lecture alone. However, to analyze inservice teachers' teaching practice shown in video clips, students need a theoretical background taught by an instructor's lecture from a class. Thus, it is also hypothesized that students with CETI and a lecture will learn the most about technology integration in practice.

Methods

Participants

Subjects were 107 students who enrolled in a 'Teaching and Learning Methods' course that was required for students in a College of Education, in South Korea. Most were in their third year in college and some were in either the second or the fourth year. The course had three sections; students signed up for a section according to their schedules. All sections were taught by the same instructor. Students participated in this experiment as a part of their coursework.

One section served as a control group (N=29). The control group learned about technology integration from an instructor's lecture, as usual. Another section, the CETI group (N=31), learned about technology integration by exploring the CETI environment. The third section (N=47) learned about technology integration with both CETI and the instructor's lecture, and was designated the "mixed" group.

Measures

Students were asked to create a lesson plan before and after learning about technology integration as a pre and a post tests to measure their abilities of applying knowledge to teaching practice. Since CETI was developed for improving students' awareness of contextualized teaching practice, and their application of knowledge to teaching with technologies, a creation of lesson plan was considered a more appropriate measure than a factual knowledge test commonly used. A lesson plan is a blueprint of teacher's teaching practice and reflects an overall flow and activities with detailed instructional strategies. Especially, when using technologies in their practice, teachers plan on what kinds of technologies and how they should be used in accordance with a learning topic and activities and document their plan as a form of lesson plan. Thus, by analyzing students' lesson plans, their levels of understanding theories learned and applying them to teaching in a context of real classroom setting could be captured.

Students' lesson plans were analyzed based on a coding scheme presented in Table 1. There were seven categories on the lesson plan for students to complete. The first and the second categories asked for basic information about the topic they chose, such as subject, topic, target grade level, timeline, and learning goals. The third category was a teaching-learning module using ICT which was felt most appropriate to achieving designed learning goals. The other categories addressed learning materials, activities, teaching strategies, and assessment. Students were asked to mention appropriate technologies to improve each category. For general information and learning goals, one point was given for each category when students' answers were presented. For teaching-learning module, when students answered which one they chose, they got one point and also when they describe why they chose it, additional one point was given. For materials and resources, learning activities, teaching strategies, and assessment, students were specifically asked to select appropriate technologies for each category and also to describe how the chosen technologies would be used to enhance teaching and learning activities in each category. Each technology and description mentioned was given one point.

Table 1. Coding scheme for lesson plan

<table>
<tr><th>Category</th><th>Criteria</th></tr>
<tr><td>General Information</td><td>Answered: 1 point
Not Answered: 0 point</td></tr>
<tr><td>Learning Goals</td><td>Answered: 1 point
Not Answered: 0 point</td></tr>
<tr><td>Teaching-learning Module</td><td>Answered: 1 point
Description of the reason why it is chosen: 1 point</td></tr>
<tr><td>Materials and Resources</td><td rowspan="4">Number of technology mentioned: 1 point/each technology
Number of technology described how it will be used specifically: 1 point/each technology</td></tr>
<tr><td>Learning Activities</td></tr>
<tr><td>Teaching Strategies</td></tr>
<tr><td>Assessment</td></tr>
</table>

Procedure

All participants were asked to access the CETI website (http://ceti.cafe24.com) to create a lesson plan that was used as a pretest. After three weeks learning about three topics of educational media, computers and multimedia education, and ICT use in education from the instructor, the control group logged on to CETI again and created another lesson plan as a posttest. The control group did not watch video clips or interact with the CETI environment. For that group, CETI was used only for pre and posttesting purposes. The CETI treatment group created a lesson plan as a pretest, watched two video clips of their choice, and created a second lesson plan as a posttest. The mixed treatment group logged on to the website to complete the lesson-plan pretest, and visited the website again after three-weeks of lectures to watch video clips and complete the posttest.

Results

Among 107 participants, data from 103 who completed all of the requirements was analyzed. In order to examine the effectiveness of three different instructional methods, an ANOVA was performed with a dependent variable of improvement score. An improvement score was calculated by subtracting a pretest score from a posttest score. The mixed group (M=1.52) improved the most followed by the lecture group (M=.48) and the CETI group (M=.43). However, this difference was not statistically significant, $F(2, 100) = .927$, $p = .399$ (Table 3).

Table 2. Means and standard deviations of improvement in posttest by groups

	N	Mean	Std. Deviation	Std. Error
Lecture	29	.48	3.60	.67
CETI	28	.43	3.04	.57
Mixed	46	1.52	4.59	.68
Total	103	.93	3.95	.39

Table 3. ANOVA result of improvement by groups

Source	SS	df	MS	F	Sig.
Group	28.947	2	14.474	.927	.399
Error	1561.577	100	15.616		
Corrected Total	1590.524	102			

By looking closely into the characteristics of participants to further examine the reason why there was no statistically significant difference, a significant difference in the pretest scores in terms of their academic major was detected. Students' pretest scores were re-coded into low (n=54) and a high (n=49) levels using a mean score of .93. As shown in Figure 1, many more students who got high scores were majoring in English, while students who got low scores were majoring in Social Studies. Also, the students in different majors were not equally distributed across the three groups, since they had the option to enroll in class sections by themselves. As a result, the mixed group included more English majors, most of whom had higher prior knowledge, while the CETI group included more Social Studies students than other two groups (see Figure 2).

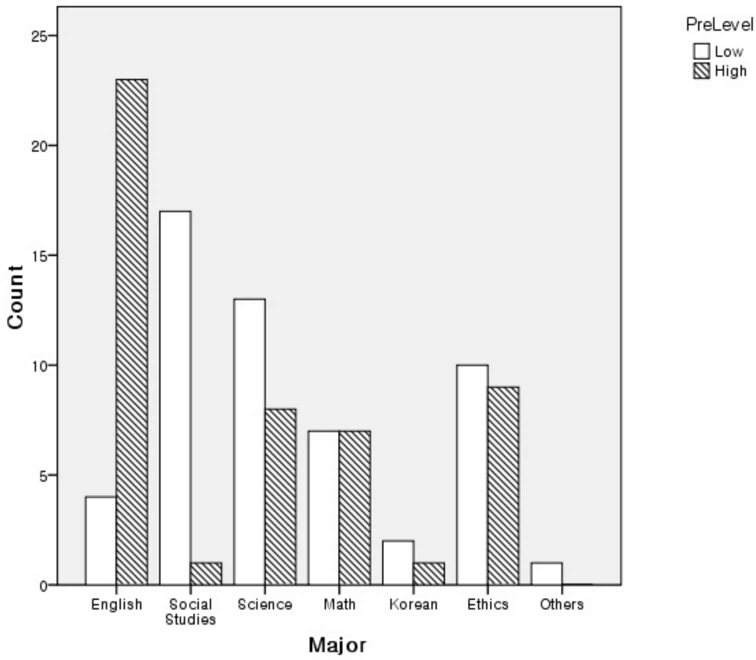

Figure 1. Number of low and high level students in pretest by majors

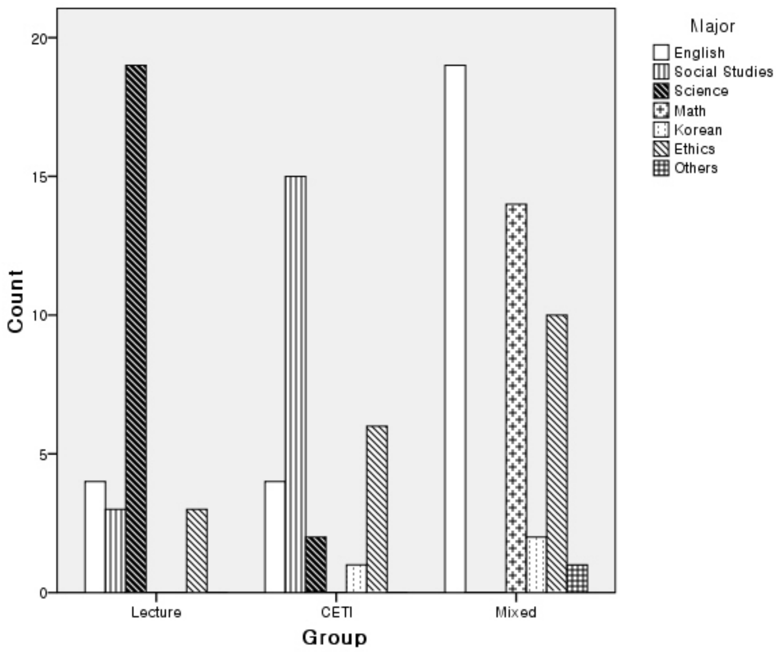

Figure 2. Number of students in each major in three groups

Based on this unequal distribution of students, further analysis was conducted to investigate how lower and higher prior knowledge level students differently improved after the implementation of three different instructional methods. Interestingly, lower level students showed improvement in the posttest in all three groups, while higher level students only improved in the mixed group (Table 4). More specifically, the higher level students benefited from the mixed instruction (M=.61) but their scores got even worse by the lecture (M=-1.55) and the CETI (M=-1.29). However, this difference was not statistically significant, $F(2, 100) = 1.208$, $p = .308$. Similarly, the lower level students benefited the most from the mixed instructional method (M=3.40) followed by the lecture (M=1.72) and the CETI (M=1.00). This difference was marginally significant, as presented in Table 5.

Table 4. Means and standard deviations of low and high students' improvement by groups

Prior level	Group	Mean	Std. Deviation	N
Low	CETI	1.0000	2.98329	21
	Lecture	1.7222	2.92666	18
	Mixed	3.4000	3.11219	15
High	Lecture	-1.5455	3.80430	11
	CETI	-1.2857	2.69037	7
	Mixed	.6129	4.95094	31

Table 5. ANOVA result of low students' improvement by groups

Source	SS	df	MS	F	Sig.
Group	51.326	2	25.663	2.850	.067
Error	459.211	51	9.004		
Corrected Total	510.537	53			

Table 6. Mean differences between two groups from Turkey post hoc analysis

(I) Group	(J) Group	Mean Diff. (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
CETI	Lecture	-.7222	.96385	.735	-3.0489	1.6045
	Mixed	-2.4000	1.01442	.056	-4.8488	.0488
Lecture	CETI	.7222	.96385	.735	-1.6045	3.0489
	Mixed	-1.6778	1.04905	.255	-4.2102	.8546
Mixed	CETI	2.4000	1.01442	.056	-.0488	4.8488
	Lecture	1.6778	1.04905	.255	-.8546	4.2102

In order to examine which pairs of groups contributed to the difference, Turkey post hoc analysis was performed. As shown in Table 6, it was confirmed that the main effect of group was due to the difference between the CETI and the mixed group. This difference was also marginally significant with a p value of .056. It means that the mixed instruction was significantly more effective in improving students' ability of technology integration than the CETI. However, the CETI and the lecture alone did not differ in helping students learn about technology integration.

Discussion and Implications

We initially hypothesized that the mixed group students who learned technology integration from both lecture and CETI would outperform the other two groups, followed by the CETI group and lecture group, respectively. However, there was no meaningful difference in improving students' abilities of integrating technologies in teaching practices depending on three different instructional methods. Instead, we gained an insight of how case-based instruction could be used for those who had different levels of prior knowledge about technology integration. Similar to previous studies that show the effects of prior knowledge level on teaching and learning (e.g., Rivet & Krajcik, 2008; Shin, Schallert, & Savenye, 2994), the effectiveness of three instructional methods used in this study also differed depending on students' prior knowledge level of technology integration.

Further analysis revealed that the lower prior knowledge students showed higher improvement in the mixed group than students in the two other groups. This difference was especially significant when we compared the mixed group and CETI group. The reason why mixed group students' scores improved much more than CETI group students' was because of the instructor's lecture. Since lower level students possessed less prior knowledge about technology integration, they needed to learn background knowledge about technology integration principles first before watching other teachers' technology uses. However, since CETI group students did not have an opportunity to accumulate factual knowledge to be applied in analyzing other teachers' practices, watching video cases may not have been meaningful enough to result in improvement. This argument is also supported by the fact that lower prior knowledge students gained more knowledge from lecture than from the CETI environment. This is very important for designing instruction to teach technology integration. We need to provide students basic principles about teaching and learning methods first, and the opportunity to gain contextual understanding by showing multimedia cases as well.

The result was different in the case of higher prior knowledge students. Interestingly, higher prior knowledge students' scores decreased in the lecture and the CETI groups. Only mixed group students showed a small gain from pre- to posttest. Even though this result was not statistically meaningful, it seemed to have a corresponding insight to lower prior knowledge students' case. Higher prior knowledge students already showed considerable amount of background knowledge about technology integration in the first lesson plan, and seemed not to get much benefit out of the lecture. In addition, since they were asked to create the lesson plan twice in the pretest and posttest with the same guidelines, they might have felt that the posttest was redundant and might not have put in as much effort as they did in pretest. Since CETI group students had to finish the pretest and posttest at the same time when they logged on the website with only about an hour gap (completing the posttest after watching the CETI videos). Meanwhile, higher prior knowledge students in the mixed group seemed to gain more knowledge from both the lecture and CETI environment. The combination of these two instructional methods might have given students new insights about how teaching and learning principles for technology integration could be used in real world contexts.

Multimedia case based instruction is unique in the Korean educational system, which relies heavily on transmission of knowledge largely in relatively decontextualized lecture formats. This study can provide a new perspective to approach various issues in teaching technology integration to Korean preservice teachers. Further research with a better design using randomization to better control variables is needed to examine the effectiveness of this new method of instruction.

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Insook HAN
Research Professor, the BK21 project group for globalizing teaching & research in education. Interests: Multimedia learning, Haptic simulation, Game-based learning, Case-based learning.
E-mail:

Won sug SHIN
Research Professor, Higher Education Policy Research Institute, Korea University. Interests: ICT utilization, Technology Integration, Technology Professional Development, School Environment.
E-mail: wss2105@gmail.com

Received: March 1, 2011 / Peer review completed: April 17, 2011 / Accepted: April 23, 2011