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Message from the Editor-in-Chief

Dear Colleagues,

I am pleased to announce you that the January 2012 volume 11 issue 1 of The Turkish Online Journal of Educational Technology (TOJET) is published. There are international papers in this issue. TOJET is an open Access journal and provides free Access to all articles. Open access gives a worldwide readers larger than that of any subscription-based journal and thus increases the visibility and impact of published works. It also increases indexing and impact factor.

TOJET is a multidisciplinary peer-reviewed journal in the field of educational technology. TOJET welcomes the submission of manuscripts that meets the general criteria. TOJET is dedicated to increasing the depth of the subject across disciplines with the ultimate aim of expanding knowledge of educational technology. Therefore, I am pleased to publish this issue which different papers from various fields are shared with professionals.

TOJET is seeking for qualified and high profile researchers to join its editorial team as editors or reviewers. We have a guest editor from Taiwan for this issue. Our guest editor is Prof.Dr. Gwo Dong Chen from the National Central University in Taiwan.

TOJET thanks and appreciates the guest editor and the editorial board memebers who have acted as reviewers for one or more submissions of this issue for their valuable contributions. As always, this new issue features contributions from many countries.

Any views expressed in these publications are the views of the authors and are not the views of the Editor and TOJET.

TOJET will organize IETC-2012 (www.iet-c.net) with the cooperation of National Central University in Taiwan. IETC series is an international educational activity for academics, teachers and educators. This conference is now a well known educational technology event. It promotes the development and dissemination of theoretical knowledge, conceptual research, and professional knowledge through conference activities. Its focus is to create and disseminate knowledge about the use of instructional technology for learning and teaching in education.

Call for Papers

TOJET invites article contributions. Submitted articles should be about all aspects of educational technology. The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to TOJET. Manuscripts must be submitted in English.

TOJET is guided by it's editors, guest editors and advisory boards. If you are interested in contributing to this journal as an author, guest editor or reviewer, please send your cv to tojet.editor@gmail.com.

January 01, 2012

Editors,
Prof. Dr. Aytekin İŞMAN
Sakarya University
Prof. Dr. Jerry WILLIS
Manhattanville College

Message from the Guest Editor

Dear Readers,

It is my honor to be the Guest Editor again. I am very grateful to so many experts in submission to this journal. This time I had fifty papers to be reviewed, and very thank to have so many world-class members to help review. There is considerable pressure on space in the journal and we are only able to include the very best of the articles that are submitted. I want those good works which could not be included to express regret. I hope that this will not deter you from submitting your work in the future.

Many people helped me complete this work. Especially Editor Aytekin IŞMAN, Dr. Eric Zhi Feng Liu, Dr. Chun-Hsiang Chen, Dr. Chin-Yeh Wang, Dr. Liang-Yi Li, and Miss Yu-Ling Chi, they help me very much. I would like to thank them all. I would also like to thank all reviewers of this issue for their hard work.

Hope those works reported in this issue will trigger new ideas and research questions; furthermore, put the ideas into practice and change the world.

All the best,

Gwo-dong Chen (Guest Editor)
Chair Professor, Department of Computer Science and Information Engineering
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January 2012

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A CASE OF WEB-BASED INQUIRY LEARNING MODEL USING LEARNING OBJECTS

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ABSTRACT
This research seeks to (1) implement a model for an inquiry based learning environment using learning objects (LOs), and (2) apply the model to examine its impact on students' learning. This research showed that a well-designed learning environment can enhance students learning experiences. The proposed model was applied to an undergraduate course offered by the Faculty of Education, Sultan Qaboos University, in 2009. Results indicate that the implementation of the web-based inquiry-learning model was successful and adequate to the learning setting. This model of learning helped most students to manage the tools and techniques used during the course; freedom on the construction of presentations allowed students to explore creatively the subject domain; independent learning together with presentations contributed to preserve the uniqueness and value of each student's production. Finally, the open educational resources used as support were of fundamental importance.

INTRODUCTION

The learning object (LO) concept is stimulating so much interest, research and investment currently. The need arises from the arrival of the "knowledge economy", where lifelong learning is vital to individual and national success, and knowledge is proliferating and changing at an unprecedented rate. The main idea of LOs is to break educational content down into small chunks which can be reused in various learning environments, in the spirit of object-oriented programming. LOs present the information, provide the student with an infinite amount of practice, and provide a test that allows the computer to provide feedback. Our view of LOs fits Wiley's definition, "any digital resource that can be reused to support learning" (Wiley, 2000). The "materials" in a learning object can be documents, pictures, simulations, movies, sounds, and so on. They are digital in nature. These LOs can be delivered or accessed over the Internet or across a network. LOs can also include metadata, which is information about the learning object itself (Johnson, 2003).

LOs open up possibilities that traditional materials may not offer. Within a single learning object, information can be presented in several different ways, allowing students to explore a topic from various perspectives responding to their individual needs and learning styles. Engaging interactive elements give learners a chance to practice what they are studying.

Three most compelling reasons for using LOs are that they are flexible, they are cost effective, and they can be combined in customized ways (Smith, 2004):

> *Flexibility*: A well-designed learning object — or a combination of several that deal with the same topic — can offer access to knowledge through multiple modes of learning. Students who learn particularly well by auditory means, for example, may find an interactive learning object with voiceover instruction to be effective.
> *Cost effectiveness*: As non-consumable resources, LOs can be used in a course from one semester to the next. Some can be repurposed for different courses or even different disciplines. Many are available free of charge.
> *Customizability*: Lecturers may select LOs to suit their course material and particular instructional style. With a minimum of online research, faculty can assemble an array of ready-made support materials to offer their students.

Individual LOs can be designed to present a complete learning experience. LOs can offer interesting new possibilities to implement constructivist learning environments and engage learners with meaningful learning activities. However, although LOs can provide stimulating opportunities to improve educational practices, to extend the use of digital technologies in schools and to reduce the time required to prepare technology enhanced teaching, many associated problems and practical shortcomings can arise (Li, et al., 2006; Akpinar & Simsek, 2007; Kay & Knaack, 2007). The LO approach holds tremendous promises but also considerable problems. The problem of LOs is the same than with every new educational technology innovation. They offer novelty, economic benefits and motivating potential that can, if used carelessly, lead to flawed teaching and learning practices that are ignoring the true essence of human learning.

The detractors of the LOs approach say it is a "dumbing-down" of the learning process and they claim that the LOs focus on content rather than discussion or dialogue in the learning process (Mason, et al., 2005). Learning object research has also addressed instructional design issues such as the model of behavioristic-content learning is largely presented, students are asked questions, and then evaluated and rewarded based on the content they remember (Krauss & Ally, 2005). Within the last ten years, several learning object theorists have advocated the use of more constructivist-based metric (Kay & Knaack, 2009).

LOs themselves are not good or bad, but their pedagogical value is determined through the context of use. Implementation of LOs needs a sound pedagogical grounding, and only using LOs according to the principles of contemporary learning theories can LOs fulfill those promises (Nurmi & Jaakkola, 2006). It is important to remember that LOs and their content is not knowledge, but just means to engage learners and give rise to various learning processes and experiences. The content of the LOs can only be regarded as information – as raw material from which one can construct meaningful and mindful subjective knowledge structures (Sveiby, 1997).

The current movement in education today calls for students to develop information age skills rather than build content bases. Critical thinking, problem solving skills, and communication skills are more important than simply knowing the content itself. In response to these calls there are many varieties of inquiry-based, constructivist learning environments being developed. The inquiry approach is more focused on using learning content as a means to construct knowledge and develop critical thinking skills. Meanwhile, learning has moved towards more student-centered, problem-based, challenge-based, or cooperative learning.

Inquiry Based Learning is a pedagogy that engages students in finding solutions to important and meaningful questions through investigation and collaboration with others (Blumenfeld, et al., 1991). Well-designed inquiry-based learning environments can enhance students learning experiences (Bereiter & Scardamalia, 1993; Dede, 1998; Chang, et al., 2003). Blumberg (2000) argues that inquiry can nurture critical thinking and information processing skills. He states that inquiry tends to improve students' self-regulated learning abilities. Through such an approach, students acquire an understanding of key principles and concepts, develop important habits of mind, and learn to communicate their knowledge to others (Brown & Champione, 1995). Discussion forums have been used for educational purposes as a tool for promoting different modes of learning that can lead to enhanced learning outcomes for students (Montero, et al., 2007).

In practice, an inquiry-based learning environment supports the development of understanding in many ways. The environment should be based around an authentic problem that provides a motivating context for learning. These problems should be open-ended, allowing students to tackle situations in authentic ways to solve a problem with no one right answer. The inquiry-based learning environment should allow for social negotiation so students can test their understandings against others' and readily share information. Finally, the environment should be designed to help students construct knowledge. This is supported by the social negotiation and through the context, but also depends on modeling and scaffolding to help students become successful learners as well as provide them with opportunities for reflection (Jonassen, 1999). Inquiry Based Learning is often described as a cycle or a spiral, which involves formulation of a question, investigation, creation of a solution or an appropriate response, discussion, and reflection in connection with results (Bishop et al., 2004). Research suggests that using inquiry-based learning can help students develop critical thinking skills, become more creative, more positive and more independent (Kühne, 1995). Other academic research shows that inquiry-based learning improves student achievement (GLEF, 2001).

The dissemination of Internet technologies in recent years has fostered the development of technology enhanced inquiry-based learning models. For example, Chang, Sung and Lee (2003) proposed a web-based collaborative inquiry-learning model where students used: the web as information source; concept mapping software as a tool for anchoring and representing knowledge during the inquiry process; notepads to help compile, edit and share information; and chat sessions for synchronous group discussions. Abdelraheem and Asan (2006) used concept-mapping software, web search, and MS PowerPoint as tools for students to create their maps and class presentations. In order to assess students' learning experiences, these authors employed pre-post assessments, rubrics and informal interviews to evaluate students´ concept maps, presentations, and self-reflective reports. Tractenberg, Struchiner, and Okada (2009) presented a case study of web-based collaborative inquiry-learning using OpenLearn technologies. They adopted a web-based collaborative inquiry learning model supported by UK Open University's OpenLearn technologies: a community-led virtual learning environment based on

Moodle called *LabSpace*, and a knowledge mapping software called *Compendium*. Their results indicated that the implementation of the web-based inquiry-learning model they have proposed was relatively successful and adequate to the learning setting. These three studies pointed out the benefits of integrating collaboration and inquiry as pedagogical strategies supported by appropriate technologies.

This study describes the application of inquiry based learning theory to the use of LOs and how doing so can help learners achieve outcome goals. In inquiry-based learning environments as in others, students need access to good content, ways of measuring their understanding, and the ability to have multiple exposure opportunities when confronted with new information. Because of these needs, LOs seem to provide an excellent support tool in these inquiry-based learning environments.

THE CASE STUDY

Instructional and Learning Technologies Department at the College of Education of Sultan Qaboos University has been offering a course entitled: "Introduction to Educational Technology" (TECH3008) as a service course to all departments of the College of Education. This course involves information about the role of information technologies and resources in instruction, with emphasis on computer applications' software and utilization of materials in schools. Students in this course explore the basic components of the instructional development process and the instructional methods by which instruction is delivered. They identify and apply the major terms and theories underlying the design of instructional materials and they learn how to review, evaluate, and develop technology-based instructional materials.

However, there are important issues confronting faculty when teaching this service course such as developing and using quality content, standardization, sharing and exchanging of learning materials, and creating effective environments where students are active learners, sharing and discussing their ideas, constructing their own knowledge and developing critical thinking skills. To face this challenge, ‘Introduction to Educational Technology' is modified for delivery in hybrid mode and the authors decided to develop LOs to support learning.

The authors anticipated that LOs would not only help faculty deliver high-quality, sharable, and reusable learning materials but also have a positive effect on students' learning especially when used in an inquiry based learning environment.

For the pilot study, the project team selected the ‘Basic Principles of Visual Design’ unit from the course content. The content of the unit is constructed of 20 LOs presented over five phases. The unit was taught four weeks. The format of instruction for the unit was fully online.

The ‘Basic Principles of Visual Design` unit introduces the visual communication principles and concepts of successful visual design. Topics include form, color palettes, text and image relationships, typography, grid structures, and layout design.

A part-time specialized multimedia designer was hired and a cutting-edge computer workstation was bought to produce the LOs. The project team members convened with the designer on a continuous basis to provide formative feedback on both the technical and instructional design of the objects.

Each object is autonomous so that it can be re-used, removed or altered with relatively little consequence for the remaining objects. Each object is sufficiently rich and complex to achieve a specific learning outcome.

Each learning object contained the essential components of an effective learning experience such as a discursive element (the key issues and follow up readings), an interactive element (group or individual activity or online discussion), an experiential element (the activity) and a reflective element (choice of readings and level of engagement).

The objects were validated by reviews of an academic expert in Educational Technology. Final modifications were then made and were set for upload on the Moodle system. Moodle is a free Learning Management System (LMS) that educators can use to create effective online learning sites. LMSs are widely used for distance education, but can also be effectively used for blended or hybrid education, where they offer a complementary role to traditional classroom instruction.

Moodle is grounded in a philosophy of collaborative learning, often referred to as social constructionist pedagogy. This approach views learning as a creative social process, as much as it is an individual one, where people learn together by investigating, analyzing, collaborating, sharing, and reflecting. Moodle provides a suite of tools to promote interaction and social networking among people, so that they can share ideas, collaborate in small groups, discuss, and reflect upon experiences. By presenting LOs with the communication tools of Moodle and applying inquiry based learning, the researchers anticipated to overcome limitations of LOs use in learning.

Spiral path of inquiry has been used when designing the unit activities: asking questions, investigating solutions, creating new knowledge, discussing discoveries and experiences, and reflecting on new-found knowledge. The evaluation process incorporated a number of methods to provide field data.

As an organizing framework, a social format was chosen, which is less formal and more discussion- focused. LOs are placed in five phases in social format of Moodle:

1. Ask phase: Inquiry-based learning began with the inquirers' interest in or curiosity about a topic. Four LOs were used in this phase. LOs were designed to provide students with background information about the visual design. Through LOs several questions were presented to the students to initiate the thinking process among them. Moodle's communication tools such as chat, discussion and dialogue were included in this phase. After a discussion period, students were asked to determine what questions will be investigated such as 'How are visual design principles and elements used to capture a learner's attention? 'How are visual design principles and elements utilized in a design?', and 'What are the main elements used in web design?'
2. Investigate phase: In this phase twelve LOs were used. Through LOs, each principle of visual design was explained and useful references and related internet sites were presented to students. Students mainly used the Internet to find and locate information that would be useful for answering the questions that they have determined in the first phase. Some off-line and online resources were available to the students to find and locate information. By using Moodle's communication tools, students had opportunities to discuss, compare and contrast the information and data that they had located. Also by including Moodle's evaluation tools, students were able to test their own knowledge.
3. Create phase: Four LOs were used in this phase. Learners were introduced with guided activity to create digital instructional material for K12 students. Organizing the information, putting the information into one's own words and creating a presentation format were the next tasks in the process. After finishing the guided activity, students were asked to create PowerPoint presentations about the topic of their interest and apply visual design principles to their presentations. After designing their own digital presentations, they have uploaded their work into Moodle environment by using its assignment module.
4. Discuss phase: By using Moodle's assignment module students presented their final product to their classmates. In this phase, students shared their ideas and their own experiences and investigations to each other. Knowledge-sharing was the slogan for the process of knowledge construction. In this way, students began to understand the meaning of their investigations.
5. Reflect phase: In order to make sense of the inquiry process, they need to understand and question the evaluation criteria, to identify the steps in their inquiry process, and to share their feelings about the process. In this phase students were asked to write reflective report on their own learning process.

RESEARCH METHODOLOGY

Instruments

How well did this theoretical model work in practice? The impact on student learning and study processes was researched through the following three forms of data collection:

1. Students evaluation of LOs were analyzed by using Learning Object Evaluation Sheet (Alpha=0.77) (see Appendix A).
2. Students were interviewed by researchers to identify their opinions regarding to the inquiry based learning approach and their comments transcribed and compared. Four questions were formulated and asked to students to evaluate their experiences during study (see Appendix B).
3. Student's Power Point presentations were evaluated. Iowa Slide Show Rubric was used (see Appendix C) to evaluate students' Power Point presentations. This rubric was seven-Likert type and was consisted of eleven subscales (buttons and links, navigation, background, graphic sources, originality, content accuracy, sequencing of information, text-font choice, use of graphics, effectiveness, and documentation).

Sample
The sample was purposive since it includes all (44) students enrolled in the course entitled: "Introduction to Educational Technology" during the summer semester 2009 as listed by the Students' Registration Deanship.

Impact on Student Learning
1. Evaluations of learning objects by students

All of the students in the 'Introduction to Educational Technology' course have evaluated the LOs that have been used in the study of the unit.

The results of their evaluation provided important data related to the students' use of the LOs. Students indicated that LOs loaded quickly (94% of students), LOs were professional looking (81% of students), LOs were easy to use (85% of students), there was NOT too much reading required (52% of students), graphics/animations assisted learning (71% of students), LOs had good interactivity (80% of students), and feedback from interactions were clear and helpful (81% of students).

2. Students' opinions regarding the inquiry based learning approach
Cycles of inquiry based learning: Students generally found all the cycles of inquiry based learning to be very useful to discover their abilities and skills. However, most of them commented that they found the "discussion" the most difficult phase of the cycle. Positive comments about the inquiry based learning focused on relevance and understanding. Students repeatedly commented on their newfound abilities as learners and their ability to apply their knowledge to the real-world.

Strengths: The students mostly enjoyed the following about the theoretical model:

1. Learning objects
2. Learning independently without being forced to.
3. Creating their own media and using them.
4. Sharing information and experiences.
5. Thinking deeply to find creative ideas.

Here are some examples of their opinions:
'LOs were very helpful to understand the topic. They also included very useful links to search about the complicated topics'
'With the use of LOs I was able to learn by myself without receiving any help from teacher'
'I was responsible from my own learning and we learned without being forced to'.
'We asked many questions at the beginning and those questions lead us to activities and later on we developed our own materials'
'There were many discussions but finally we found creative ideas for our presentations'.
'It was difficult at the beginning but later on I found it very rewarding'
'I selected and used the material that I need. I discussed with my classmates and teacher about my observations and questions'
'We looked forward to learning and had to demonstrate more desire to learn more. Working cooperatively with other students was useful.'
'I feel more confident in learning'.
'We expressed our ideas in a variety of ways, including chat, discussion, journal and so forth'.
'We assessed our own work and other classmates, we reflected on our own learning'
'I reflected on my own learning and I reported my strengths and weaknesses'.

Weaknesses: The students did NOT enjoy the following about the theoretical model:
1. Lack of tutor's assistance to answer their questions.
2. Feeling shy to share information with other colleagues.
Here are some examples of their opinions:
'The instruction for the unit was totally online. I usually get motivated when real teacher is involved'
'It was difficult because the work requires one to arrive at resolutions to problems by brainstorming with other students'
'Sometimes I was unable to complete meaningful investigation. I also felt shy during chatting with my classmates and in discussion and tried to hide it'.

Prospective implementation: When asked if they will integrate this approach in their future teaching, their responses were generally positive. Here are some examples of their opinions:
"I will, but with some active instructor role on it as a facilitator to improve it"

"Of course, I will apply and use this learning approach in my teaching and I will also try to teach the topics that I learned in this course."
"Yes, but not all the time or all subjects, it depends on the subject and background which students have."
"It depends on the time, if there is enough time"

3. Evaluations of Power Point Presentations
Students were asked to create PowerPoint presentations about the topic of their interest and apply visual design principles to their presentations. All Power Point presentations were analyzed by the research team and scored according to the relevant rubric (see appendix C).

Iowa Slide Show rubric was used to evaluate students' presentations. Students' presentations were assigned scores ranging from one to seven on eleven subscales (buttons and links, navigation, background, graphic sources, originality, content accuracy, sequencing of information, text-font choice, use of graphics, effectiveness, and documentation. The results revealed that students generally were successful in applying visual design principles to their presentations. Most buttons and links were working correctly (M=4.11, SD=1.4), buttons were appropriately labeled (M=4.58, SD=1.53), choice of background was consistent from card to card (M=5.78, SD=1.39), a combination of hand drawn and graphics or other animated clip art are used and sources were documented in the presentation for all images (M=6.34, SD=1.69), presentation showed some originality (M=4.83, SD=1.51). The content and ideas were presented in an interesting way, most of the content was accurate, most information was organized in a clear, logical way (M=4.85, SD=1.56), font formats had been carefully planned to enhance readability (M=5.88, SD=1.72), a few graphics were not attractive but all support the theme/content of the presentation (M=5.11, SD=1.67), project included most material needed to gain a comfortable understanding of the material but there was lacking one or two key elements (M=5.46, SD=1.72). Students properly documented but less than four good sources for their topics (M=5.18, SD=1.46).

CONCLUSION
This study showed that a well-designed learning environment can enhance students learning experiences. Scores point to achievement of students' presentations, and reports on students' satisfaction with different aspects of the course were quite positive. These results are particularly exciting because they cast a whole new light on the issue of designing inquiry based learning environments for university courses in general, and enhancing this method by using LOs in particular.

The results of the study were consistent with the previous research on inquiry based learning and LOs. Previous research indicates that engaging in inquiry can improve students' learning in their disciplines (Blumenfeld, et al., 1991; Bereiter & Scardamalia, 1993; Brown & Champione, 1995; Dede 1998; Blumenfeld, et al., 2000; Krajcik, et al., 2001; Chang, et al., 2003; Brickman, et al., 2009**;** Abdelraheem & Asan, 2006; Montero, et al., 2007; Yasar & Duban, 2009; Tractenberg, et al., 2009). Learning through inquiry will increase students' ability to apply what they learn to new situations. Blumberg (2000) argues that inquiry can nurture critical thinking and information-processing skills. He finds that inquiry tends to improve students' self-regulated learning abilities. In short, inquiry-based learning enables students to be more reflective, self-regulated investigators who are capable of justifying their own learning processes and viewing inquiry process as a way to know the world (Windschitl, 2000). Inquiry based learning was perceived to develop students' thinking skills, and enable students to become more creative, more positive and more independent (Kühne 1995). These types of research results support the idea that inquiry-based learning is a valuable method for educational researchers and practitioners.

For students to engage in inquiry in a way that can contribute to meaningful learning they must be sufficiently motivated. When students are not sufficiently motivated or they are not motivated by legitimate interest, they either fail to participate in inquiry activities, or they participate in them in a disengaged manner that does not support learning. Some students showed their frustration from the little guidance offered to them. This result is corroborated in literature by Apedoe, Walker, and Reeves (2006) who state that "…these students experienced some frustration at the beginning of the course while engaged in inquiry, which they attributed to the lack of guidance they were receiving".

Students responded positively about LOs that have been used in this study. These findings are also consistent with previous research suggesting that learning objects are easy to use. Students even those who have limited computer-based skills, do not need to devote considerable blocks of time toward understanding how to use these straightforward tools (Kay & Knaack, 2007). Results were also similar to previous research as the team argued that learning objects, if carefully selected, have a considerable potential to aid student learning (Christiansen & Anderson, 2004; Reimer & Moyer, 2005; Akpinar & Bal, 2006; Nurmi & Jaakkola, 2006;). It is hypothesized that effective learning objects (a) require students to construct and manipulate information (Akpinar & Bal, 2006; Nurmi & Jaakkola, 2006), (b) provide rich feedback and interactive illustrations (Akpinar & Bal, 2006), and (c) help students understand abstract ideas with concrete representations (Akpinar & Bal, 2006; Reimer & Moyer, 2005). In addition, it is emphasized that instructional strategies supporting the use of learning objects are critical for success, regardless of the quality of the learning object selected (Akpinar & Bal, 2006; Clarke & Bowe, 2006; Nurmi & Jaakkola, 2006; Reimer & Moyer, 2005).

Nevertheless, we believe that the implementation of this model we have proposed was relatively successful and adequate to the learning setting: tasks proposed were sufficiently stimulating to the majority of the class. This model of learning helped most students to manage the tools and techniques used during the course; freedom on the construction of presentations allowed students to explore creatively the subject domain; independent learning together with presentations contributed to preserve the uniqueness and value each student production. Finally, the open educational resources used as support were of fundamental importance.

REFERENCES

Abdelraheem, A., & Asan, A. (2006). The effectiveness of inquiry-based technology enhanced collaborative learning environment. *International Journal of Technology in Teaching and Learning,* 2(2), 65-87.

Akpinar, Y. & Bal, V. (2006). Student tools supported by collaboratively authored tasks: The case of work learning unit. *Journal of Interactive Learning Research, 17*(2), 101-119.

Akpinar, Y., & Simsek, H. (2007). Should K-12 teachers develop learning objects? Evidence from the field with K12 students. *International Journal of Instructional Technology and Distance Learning, 4*(3), 31-44.

Apedoe, X., Walker, S., & Reeves, T. (2006). Integrating inquiry-based learning into undergraduate geology. *Journal of Science Education and Technology*, 15(5-6), 321-330.

Bishop, A.P., Bertram, B.C., & Lunsford, K.J. (2004). Supporting community inquiry with digital resources. *Journal of Digital Information*, 5 (3).

Blumenfeld, P.C., Soloway, E., Marx, R, W., Krajcik, J. S., Gudzial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning, *Educational Psychologist*, 26(3 &4), 369-398.

Blumberg, P. (2000). Evaluating the evidence that problem-based learners are self-directed learners: A review of the literature. In D. H. Evensen & C. E. Hmelo. (Eds.), *Problem based learning: A research perspective on learning interactions* (pp. 199-266). Mahwah, NJ: Lawrence Erlbaum Associates.

Bereiter, C., & Scardamalia, M. (1993). Surpassing ourselves: An inquiry into the nature and implications on expertise. Chicago: Open Publishing.

Brickman, P., Gormally, C., Armstrong, N., & Hallar, B. (2009). Effects of Inquiry-based Learning on Students' Science Literacy Skills and Confidence. *International Journal for the Scholarship of Teaching and Learning.* 3(2).

Brown, A. L. & Campione, J.C. (1995). Psychological theory and the design of innovative learning environments: on procedures, principles, and systems. In L. Schauble & R. Glaser (Ed.), *Contributions of instructional innovation to understanding learning*. Hillsdale, NJ: Erlbaum.

Chang, K., Sung, Y., & Lee, C. (2003). Web-based collaborative inquiry learning. *Journal of Computer Assisted Learning*, 19, 56-69.

Christiansen, J. A. & Anderson,T. (2004). Feasibility of Course Development Based on Learning Objects: Research Analysis of Three Case Studies. *International Journal of Instructional Technology and Distance Learning*, 1(3), 21-38.

Dede, C. (Eds.). (1998). *ASCD Yearbook: Learning with Technology.* Alexandria,VA :Association for Supervision and Curriculum Development.

GLEF. (2001). *Project-based learning research.* Retrieved July 12, 2005, from http://www.glef.org/php/article.php?id=Art_887

Johnson, L. (2003). *Elusive vision: Challenges impeding the learning object economy*. Retrieved from http://www.nmc.org/pdf/Elusive_Vision.pdf.

Jonassen, D. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional design theories and models: A new paradigm of instructional technology* (Vol. II, pp. 215-239). Mahwah, NJ: Lawrence Erlbaum Associates.

Kay, R. H., & Knaack, L. (2007). Evaluating the use of learning objects for secondary school science. *Journal of Computers in Mathematics and Science Teaching*, *26*(*4*), 261-289.

Kay, R., & Knaack, L. (2007). Evaluating the learning in learning objects. *Open Learning: The Journal of Open and Distance Learning*, *22*(1), 5–28.

Kay, R., & Knaack, L. (2009). Assessing learning, quality and engagement in learning object: the learning object evaluation scale. *Education Tech Research Dev*, 57, 147-168.

Kühne, B. (1995). The Barkestorp project: Investigating school library use. *School Libraries Worldwide*, 1(1), 13–27.
Krajcik, J. S., Blumenfeld, P. C., Marx, R. W., & Soloway, E. (2000). Instructional, curricular, and technological supports for inquiry in science classrooms. In J. Minstrell & E. H. v. Zee (Eds.), *Inquiring into inquiry learning and teaching in science* (pp. 283-315).
Krauss, F., & Ally, M. (2005). A study of the design and evaluation of a learning objectand implications for content development. *Interdisciplinary Journal of Knowledge and Learning Objects*, 1. Retrieved July 15, 2011 from http://ijklo.org/Volume1/v1p001-022Krauss.pdf
Li, J. Z., Nesbit, J. C., & Richards, G. (2006). Evaluating learning objects across boundaries: The semantics of localization. *Journal of Distance Education Technologies, 4*(1), 17-30.
Mason, R., Pegler, C., & Weller, M. (2005). A learning object success story. *JALN*, 9(1).
Meyerson, P., & Secules, T. (2001). Inquiry cycles can make social studies meaningful learning about the controversy in Kosovo. *Social Studies, 92*(6), 267-271.
Montero, B., Watts, F., & Garcia-Carbonell, A. (2007). Discussion forum interactions: Text and Context. *System*, 35, 566-582.
Nurmi, S., & Jaakkola, T. (2006). Effectiveness of learning objects in various instructional settings. *Learning, Media, and Technology*, *31*(3), 233-247.
Reimer, K., & Moyer, P. S. (2005). Third-graders learning about fractions using virtual manipulatives: A classroom study. *Journal of Computers in Mathematics and Science Teaching, 24*(1), 5-25.
Smith, S.R. (2004). *Guidelines for authors of LOs*. NMC: The New Media Consortium.
Sveiby, K.E. (1997). *The new organizational wealth: Managing and measuring knowledge-based assets.* San Francisco, CA: Berrett-Koehler Publishers.
Wiley, D. A. (2000). Connecting LOs to instructional design theory: A definition, a metaphor, and a taxonomy. In D. A. Wiley (Ed.), *The Instructional Use of LOs: Online Version*. Retrieved from http://reusability.org/read/chapters/wiley.doc
Windschitl, M. (2000). Supporting the development of science inquiry skills with special classes of software. *Educational Technology Research & Development, 48*(2), 81-95.
Yasar, S., & Nuban, N. (2009). Students' opinions regarding to the inquiry-based learning approach. *Elementary Education Online*, 8(2), 457-475.

APPENDIXES

Appendix A: Rubric to evaluate LOs

Item	Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %
1. The Learning objects loaded quickly					
2. The learning objects were professional looking					
3. The learning objects were easy to use					
4. There was NOT too much reading required					
5. Graphics/animations assisted learning					
6. The learning objects had good interactivity					
7. Feedback from interactions were clear and helpful					

Appendix B: Interviews questions

1. In which cycle of inquiry based learning did you have difficulty?
□ ask
□ investigate
□ create
□ discuss
□ reflect
2. What TWO things did you most enjoy about this learning approach?
3. What did NOT you enjoy about this learning approach?
4. Do you think that you want to use this approach when you start teaching professionally

Appendix C: Rubric to Evaluate Power Point Presentations

Category	7 pts	5 pts	3 pts	1 pt
Buttons - navigation	All buttons and links work correctly	Most (99-90%) buttons and links work correctly	Many (89-75%) buttons and links work correctly	Fewer than 75% of the buttons work correctly
Graphics Sources	Graphics are hand drawn the Illustrator (s) are given credit somewhere in the presentation	A combination of hand drawn and Hyper Studio graphics or other clip art are used	Some graphics are from sources that clearly state that noncommercial use is allowed without written permission	Some graphics are borrowed from sites that do not have copyright statements or do not state that non-commercial use is allowed.
Originality	Presentation shows considerable originality and inventiveness. The content and ideas are presented in a unique and interesting way	Presentation shows some originality and inventiveness. The content and ideas are presented in an interesting way	Presentation shows an attempt at originality and inventiveness on 1-2 cards	Presentation is rehash of other people's ideas and/or graphics and shows very little attempt at original thought
Content - Accuracy	All content throughout the presentation is accurate. There are no factual errors	Most of the content is accurate but there is one piece of information that might be inaccurate	The content is generally accurate, but one piece of information is clearly flawed or inaccurate	Content is typically confusing or contains more than one error
Sequencing of Information	Information is organized in a clear, logical way. It is easy to anticipate the type of material that might be on the next card	Most information is organized in a clear, logical way. One card or item seems out of place	Some information is logically sequenced. An occasional card or item of information seems out of place	there is no clear plan for the organization of information
Text - Font Choice & Sequencing	Font formats (e.g. color, bold, italic) have been carefully planned to enhance readability and content	Font formats have been carefully planned to enhance readability and content	Font formatting has been carefully planned to complement readability and content. It may be a little hard to read	Font formatting makes it very difficult to read the material
Use of Graphics	All graphics are attractive (size and colors) and support the theme/content of the presentation	A few graphics are not attractive but all support the theme/content of the presentation	All graphics are attractive but a few do not seem to support the theme/content of the presentation	Several graphics are unattractive AND detract from the content of the presentation
Effectiveness	Project includes all material needed to gain a comfortable understanding of the topic. It is a highly effective study guide	Project includes most material needed to gain a comfortable understanding of the material but is lacking one or two key elements. It is an adequate study guide	Project is missing more than two key elements. It would make an incomplete study guide	Project is lacking several key elements and has inaccuracies that make it a poor study guide

A CONCEPT-MAP INTEGRATED DYNAMIC ASSESSMENT SYSTEM FOR IMPROVING ECOLOGY OBSERVATION COMPETENCES IN MOBILE LEARNING ACTIVITIES

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ABSTRACT
Observation competence plays a fundamental role in outdoor scientific investigation. The computerized concept mapping technique as a Mindtool has shown the potential for enhancing meaningful learning in science education. The purposes of the present study are to develop a concept map integrated mobile learning design for ecology observation and to examine the implementation effect for elementary school children. Also, the difference in growth slopes between gifted and average students is investigated. Eighteen gifted students and thirty average students were included in this study. A computerized dynamic assessment system which combines a Computerized Ecology Observation Competence Assessment (CEOCA) and a concept map integrated ecology observation learning design were implemented. The results of the hierarchical linear model (HLM) analysis reveal that the overall growth slope is significant ($\mu=0.27$, $p<.01$). The effect size is 0.53. The growth slope of the gifted students is a little higher than that of the average students. However, the slope difference between ability groups is not significant. The results suggest that a well designed concept map integrated learning system demonstrates very promising potential for enhancing both the gifted and average students' mobile observation competence. The system developed in this study could be a useful resource for elementary school outdoor learning design.
Keywords: concept map, dynamic assessment, observation competence, mobile learning, growth slope

BACKGROUND AND OBJECTIVE

The issue of ecological environmental protection becomes increasingly crucial for environmental education. Regrettably, passion in environment inquiry is rarely fostered in the majority of classrooms despite the clear interest in many children, especially those in the primary years in science. Science literacy is the creative exploration of meaning in the natural world. It requires both observing and thinking. Scientific observation is the process of gathering information about objects, events or processes in a careful, orderly way. Organisms are characterized by diversity and unity. Despite the diversity, biologists are able to group organisms based on shared similarities. Classification helps us understand diversity. Life has many levels of organization. Each level of organization is more complex and has more properties than the previous level. In other words, concept of hierarchy is important for ecology observation. Observation generally involves using the senses, particularly sight and hearing. Observations may lead to unanswered questions. Scientific discovery often takes place when a scientist observes something no one has noticed before (Hung, Lin, & Hwang, 2010).

Outdoor teaching is widely recognized as one of the best alternative teaching methods for scientific observation learning. However, some outdoor teaching approaches are ineffective because students lack expert guidance and appropriate outdoor learning tools. With the advantages of portability and easy information access, the use of mobile technology is a growing trend in education. Therefore, the application of information technology in outdoor teaching has become an attractive research topic (Hung, Lin & Hwang, 2009). Outdoor teaching provides an excellent opportunity for scientific observation and inquiry learning. The success of environmental science education is not only dependent on the knowledge and understanding of environmental challenges, but also on impassioned participation in environmental conservation activities. Observation competence plays a fundamental role in outdoor scientific investigation. Through well-organized observation activities on field trips, students became more motivated and engaged in science learning to enhance problem-solving competence and meaningful learning. However, the key point of effective teaching depends on validated instruction design.

In a conventional learning activity for outdoor teaching, the students are guided by a learning-mission sheet prepared by the teacher, and write down their findings on the sheet after visiting each of the learning objects. Such a learning activity allows the students to observe the real-world objects without personalized guidance or support; consequently, some students might fail to pay attention to the key features to be observed, or fail to complete the mission owing to a lack of sufficient information or guidance (Chu et al., 2008; Hwang, Kuo, Yin, & Chuang, 2010).

The rapid progress and advances in innovative mobile, wireless and sensor technologies have substantially revolutionized the ways in which outdoor learning activities for science education can be carried out (Hwang, Tsai, & Yang, 2008: Chu, Hwang, & Tsai, 2010). Mobile devices, e.g. mobile phones and Personal Digital Assistants (PDAs), have also become more popular as cognitive tools in science learning (Hwang, Yang, Tsai, & Yang, 2009; Hwang, Kuo, Yin, & Chuang, 2010; Vogel, Spikol, Kurti, & Milrad, 2010). Due to the attractive features of handheld computers such as portability, adaptability, flexibility, intuitiveness, and comparatively cheap prices, ubiquitous/mobile learning which integrates handheld computers with wireless networks in teaching and learning has become one of the leading topics in educational research (Chen, Hwang, Yang, Chend, & Huang, 2009; Hwang, Kuo, Yin, & Chuang, 2010; Liu & Hwang, 2010; Shih, Chuang, & Hwang, 2010; Hwang & Chang, 2011). Especially, with the advantages of portability and easy information access, mobile technologies are now used frequently in outdoor scientific investigation activities. Several studies have been conducted to investigate the effectiveness of mobile and ubiquitous learning which can provide an opportunity for students to keep accessing digital resources while learning in real-world scenarios (Chen et al, 2003; Westerlund, 2008; Chu, Hwang, & Tsai, 2010).

Although those new technologies seem to be promising, researchers have pointed out that the students' learning achievements could be disappointing without the aid of effective learning strategies or tools to engage them in improving their knowledge structure (Chu, Hwang, Tsai, & Tseng, 2010; Hwang, Shi, & Chu, in press), which is regarded as an important component of understanding in a subject domain, especially in science (Novak, 1990). The knowledge structure of experts and successful learners is characterized by elaborate, highly integrated frameworks of related concepts (Mintzes, Wandersee, & Novak, 1997). A knowledge structure, then, might well be considered as an important but generally unmeasured aspect of science achievement. In order to understand the advanced scientific concepts of the various disciplines, students cannot rely on the simple memorization of facts or the enrichment of their naive, intuitive theories. They need to be able to restructure their prior knowledge which is based on everyday experience and lay culture. The restructuring is known as conceptual change (Vosniadou, 2007). Concept mapping techniques are interpreted as representative of students' knowledge structures and so might provide one possible means of tapping into a student's conceptual knowledge structure (Mintzes, Wandersee, & Novak, 1997). A concept map is a graph structure containing nodes that are interlinked by labelled, directed arcs. Concept maps can be used as a knowledge representation tool to reflect relationships that exist between concepts that reside within an individual's long-term memory. When constructing a concept map, the focus is the relationships among concepts. The combination of two concepts connected by a linking line and labeled by a linking word creates a proposition, which is the smallest linguistic unit that carries meaning (Jacobs-Lawson & Hershey, 2002).

Generally speaking, in the practice of concept mapping, weighted scores are assigned based on the organization of a map's hierarchical structure, concept-links, and cross-links. Especially, the inclusion of cross-links is a significant characteristic of concept maps in representing creative thinking. Cross-links are important to show that the learner understands the conceptual relationships between the sub-domains in the map (Novak & Canas, 2008). The concept mapping tasks are categorized as either "fill-in the blank" tasks where learners are provided with a blank structure of a map and lists of concepts and linking phrases, or "construct a map" tasks where learners are free to make their own choices. Assessments based on "construct a map" tasks more accurately evaluate differences in learners' knowledge structures and elicit more high-order cognitive processes (Anohina, Graudina, & Grundspenkis, 2007). "Construct a map" tasks are better than "fill-in the blank" tasks for capturing students' partial knowledge. However, "fill-in the blank" tasks can be scored more efficiently than "construct a map" tasks. Based on their characteristics, if used as an assessment tool, "construct a map" tasks are more

suitable for formative assessment, while "fill-in the blank" tasks are a better fit for large scale assessment (Yin et al., 2005).
The inclusion of concept mapping in learning activities is also recognized as one way to summarize understandings acquired by students after they study instructional materials. Both summarization writing and construction of concept maps are appropriate ways to improve students' knowledge growth. They share a substantial common cognitive process in correspondence with concept mapping to select concepts, make propositions, and to hierarchize and structuralize the key concepts. It has also been found that training in concept mapping should be beneficial for enhancing text comprehension, summarization and writing skills (Chang, Sung & Chen, 2002; Riley & Ahlberg, 2004). Moreover, concept mapping creates less cognitive load than summarization and essay writing. However, when constructing concept maps in the conventional pencil-paper way, students could need extra effort in deletion and revision of partial or even whole maps (Anderson-Inman & Ditson, 1999). Researchers (Chang, Chen, & Sung 2001) have identified some weaknesses which make traditional style concept mapping inconvenient for interaction and feedback between learners and instructors. In contrast, computerized concept mapping assessment provides a number of advantages: greater flexibility of revision, instant feedback to learners, extensive feedback to teachers, reduced errors in comparison with human marking, as well as decreased time needed for supervising and marking of assessments (Akkaya, Karakirik, & Durmus, 2005; Tsai et al., 2001).

The purposes of this study are to develop a concept map integrated mobile learning system for ecology observation and to examine the implementation effects for elementary school children. The difference in learning growth between gifted and average students is also investigated.

CONCEPT-MAP INTEGRATED DYNAMIC ASSESSMENT SYSTEM

The Concept-map Integrated Dynamic Assessment System (CIDAS) combines the Computerized Ecology Observation Competence Assessment (CEOCA) and a concept map integrated ecology observation learning design. The concept-map is applied as a Mindtool to enhance students' ecology observation competence. The purpose of developing CIDAS is to investigate the characteristics of students' learning progress and the need for supportive feedback for students' knowledge construction. The system includes a worksheet-embedded PDA learning design, an e-library, and online feedback as scaffolding to guide, clarify, stimulate, and monitor students' observational inquiries. The CIDAS functions as both an instruction and an assessment tool. The online feedback and the e-library have been developed to facilitate effective learning.

The Computerized Ecology Observation Competence Assessment (CEOCA) is developed for assessing students' ecology observation competence. The test items are presented with real pictures, films or concept maps. The CEOCA consists of three facets, i.e. knowledge, observation and conceptual relationships. Totally there are 40 items in CEOCA. Table 1 shows the test specifications for CEOCA. The alpha coefficient of CEOCA is around 0.72. The correlations between CEOCA and school grades, i.e. science, mathematics and Chinese, are 0.54, 0.47 and 0.51, respectively. The CEOCA demonstrates moderate convergent and discriminant validity (Hung, Hwang, Lin, Hung, & Wu, 2010). Figure 1 provides an illustrative example of concept map task. The task is to measure students' competence on feature identifications of ecology system. Students can drag an alternative from right hand side to fill in the blanks of a structured concept map. The item format is also function as a model of knowledge structure.

Table 1. Test specifications for CEOCA

Content	Basic	Proficient	Advanced	Total
Knowledge	2	12	6	20
Observation	5	6	3	14
Relationship	5	1	0	6
Total	12	19	9	40

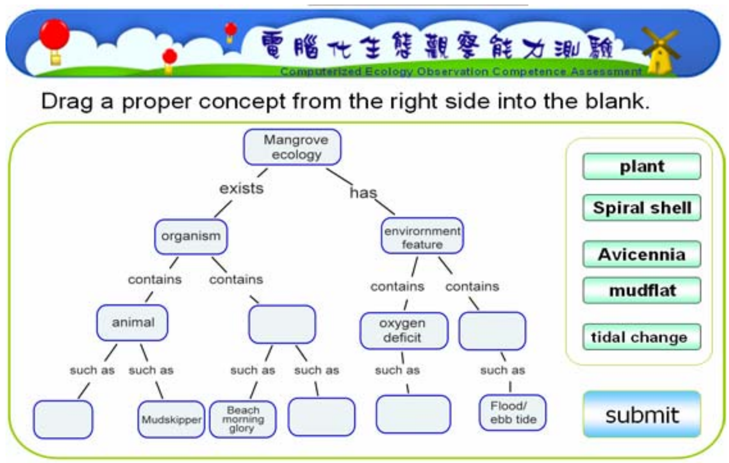

Figure 1. An illustration of concept map item on CEOCA

The concept map integrated ecology observation system was designed based on the three-layer framework of the cognitive load-oriented ecology observation approach proposed by Hung, Lin and Hwang (2010). The concept map was integrated into this system to scaffold students' knowledge structure. The learning tasks are transferred by wireless communication to students' handheld PDAs in the field. The students' responses to tasks and their observation records are also sent back to the learning system. In the learning system, the PDAs function as portable notebooks and walking encyclopedias. The learning system also provides guided tasks, immediate feedback, e-library search functions for mangrove wetland ecological systems, and an e-diary editor. Figure 2 presents the illustration of these supporting functions. The concept map tasks are embedded in the learning system to scaffold students' ecology conceptual schema. The tasks in activity I present a structured one-level concept map to clarify students' basic knowledge about the features and classifications of mangrove species. The tasks in activity II especially encourage students to take notes on two-level comparisons of different species. The tasks in activity III guide students to use what they have learned to draw three-level inferences about the relationships among species.

Figure 2. The illustration of the supporting functions on PDA

A preliminary **e-**library consisting of a database of various species in mangrove wetland ecological system was developed for CIDAS. The content of the e-library is divided into two parts, i.e. plants (e.g. main plants and associated plants) and animals (e.g. birds, crabs, fish, and shellfish). Table 2 provides illustrative examples of e-library entries for animals.

Table 2. An illustrative example of e-library entries for animals

No.	specie	behavior	feature	habitat	special note
B001	Black-faced Spoonbill	winter migratory	The length of the body is 74 – 85cm. The face and the beak are black. The end of the beak is wide and flat like a spoon. The feathers are mostly white. The wingspan is about 130-142 cm. Legs are also black.	fish farm, swamp	More than 1,000 birds immigrated to Chiku wetland this year.

METHOD

Figure 3 presents the experiment design for evaluating the effects of using CIDAS on the students' ecology observation competencies. The CEOCA is administered three times to generate the growth slope for participants. The growth slope of CEOCA is the criterion variable for examining the intervention effect of CIDAS. The tasks included in the worksheets are multiple-choice, short-answer, constructed responses and concept-map. The adaptive feedback is provided online to support the learning progress of CIDAS.

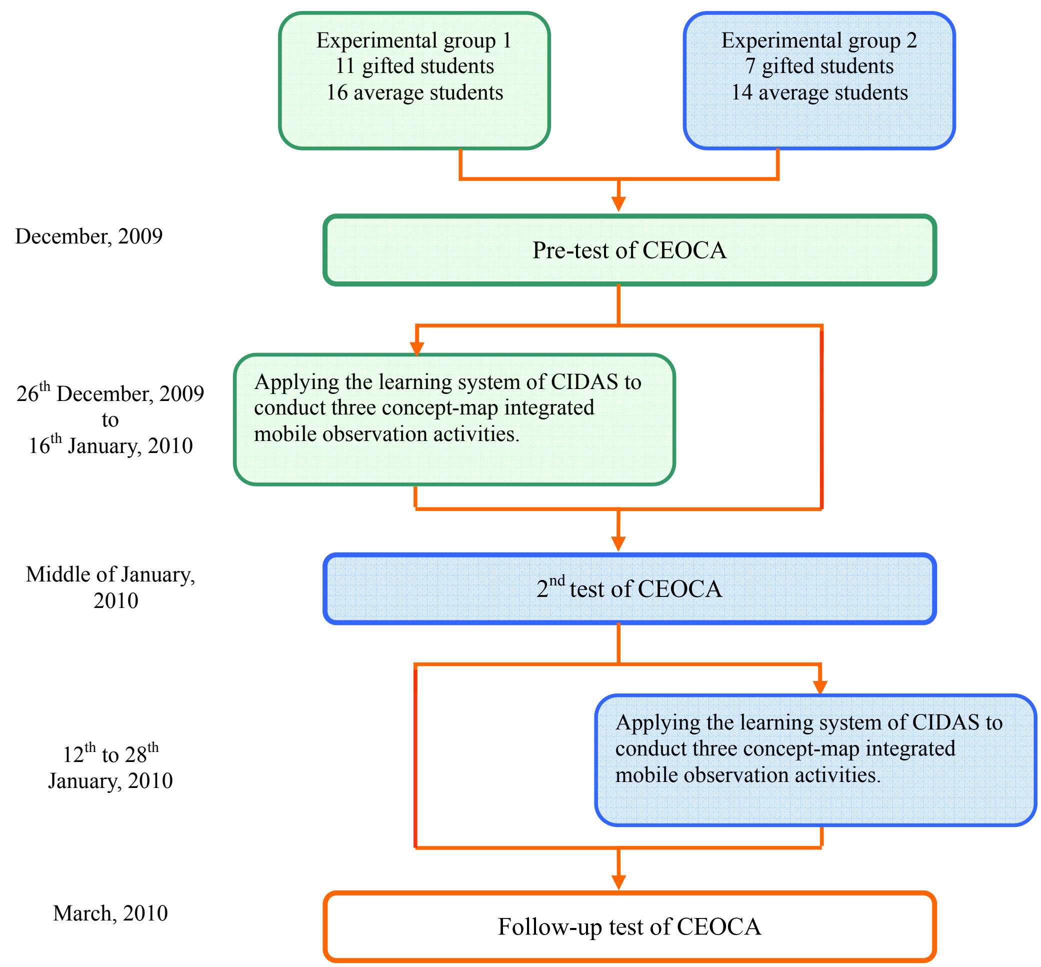

Figure 3. The CIDAS implementation flowchart

Participants and Procedures

Forty-eight fifth to sixth-grade students from six schools in Taiwan participated in this study. Eighteen participants were gifted students recruited from gifted classes while the other 30 were average students recruited from regular classes. Three mangrove wetland field observation trips were arranged within 3 months. During the field trips, each of the participants was equipped with a PDA, a digital camera, and a telescope. The observation learning objectives (Table 3) were mostly guided by the worksheets. On the first trip, the students were guided to carefully observe some target items. On the second trip, they were suggested to focus on comparison tasks.

On the last trip, they were encouraged to draw the links among the animals and plants they observed. The participants used the equipment to record what they observed, and completed the worksheet tasks using the PDAs in the field. After each field trip, the participants were asked to finish learning diaries on the websites, based on their observations, within a week. Due to a lack of equipment, participants were divided into two experimental groups. The gifted and average students were mixed in these two groups.

For each task completed on PDA, score or feedback will be provided immediately. Students are expected to conduct a scientific inquiry based on their observation records on PDAs after each field trip. They carried out further in-depth inquiry based upon the notes and questions raised autonomously during the field observations. The automatic scoring feedback system is developed to motivate students to elaborate their records, reflections and inquiries.

Table 3. The descriptions of three outdoor activities for CIDAS

Activity	Site	Time	Objectives	Tasks
1st	Chiku Wetland	6 hr	Observation on target items	Multiple choice Short answer Concept-map
2nd	Mangrove Pond	3 hr	Comparisons among targets	Multiple choice Multiple true-false Constructed responses Concept-map
3rd	Sihcao Wetland	3 hr	Relations of Ecosystem	Multiple-choice Multiple true-false Constructed responses Concept-map

Dynamic assessment instruments

The concept map integrated ecology observation worksheet design was revised from the three-layer framework of observation worksheet design (Hung, Lin, & Hwang, 2010). Based on the guided inquiry learning theory and concept mapping theory, tasks are developed to sequentially scaffold students' knowledge construction (Hung, Hwang, & Hung, 2010). The worksheet design arranged the learning objectives into three layers to balance the students' cognitive load and challenge step by step. The three layers consisted of a) guided observation with one-level concept map tasks, b) autonomous observation with two-level concept map tasks, and c) scientific inquiry with three-level concept map tasks. Table 4 provides the specification table for the ecology observation formative assessment. The scoring rubrics for these concept map tasks have also been proposed and validated by Hung, Hwang and Hung (2010).

Table 4. The specification table for ecology observation formative assessment

Item type	Feature and classification of species	Feature contrast of species	Conceptual connection and extension	Total
Multiple choice	25	11	7	43
Multiple true-false	0	4	3	7
Short-answer	3	3	3	9
Concept map	2	2	2	6
Total	30	20	15	65

FINDINGS AND DISCUSSION

The ecology observation learning potential is defined as the slope of students' performance on CEOCA in three month intervals. The hierarchical linear model (HLM) is applied for this analysis. Table 5 presents the descriptive statistics on three CEOCA z-scores for all students. For pre-test, the subjects included perform very close to the norm (0.04 vs. 0.00) of 5th and 6th graders with a smaller standard deviation□□vs.1.00). The results of student 2nd-test demonstrate substantial improvement on CEOCA. The follow-up test also suggests the subjects can maintain what they have learned quite well. In other words, after CIDAS intervention, students show persistent better observation competence. Table 6 provides the results of the students' growth slope on the CEOCA. The results demonstrate that the overall growth slope is significant (μ=0.27, p<.01). In other words, for all the students included in this study, the CIDAS is effective for promoting their ecology observation competence. The effect size is 0.53 (about one half standard deviation, see Table 5). Relatively speaking, the effect size is noticeable compared to the difference between grades, namely 0.04 (Hung, Hwang, & Lin, 2010).

Table 5. Descriptive statistics on three CEOCA z-scores for gifted and average students

	Gifted（N=18）		Average（N=30）		Total (N=48)	
	Mean	SD	Mean	SD	Mean	SD
pre-test	0.27	0.51	-0.10	0.55	0.04	0.56
2nd-test	0.76	0.68	0.47	0.65	0.58	0.67
follow-up test	0.98	0.71	0.33	0.85	0.57	0.85

Table 6. Final estimation of fixed effects of unconditional model on CEOCA slope (N=48)

Fixed Effect	**Coefficient**	**Std. error**	**T-ratio**	**df**	**Sig.**
INTRCPT, B0	0.13	0.08	1.67	47	0.10
TIME slope, B1	0.27	0.06	4.69	47	0.00

The contrast of the growth slopes for the two different ability groups on the CEOCA is provided in Figure 4 and Table 7. The growth slope of the gifted students is a little higher than that of the average students (about 0.14). However, the slope difference is not significant. Some concept mapping assessment has suggested that the concept maps constructed by high performing students are qualitatively and quantitatively superior to those of average performing students in science (Austin & Shore, 1993). Although gifted students inherently possess higher academic achievement, their scientific observation competence progress slopes may not significantly surpass those of the average students in a well-designed mobile learning system. However, the results of Table 7 also imply that the reservation effect between ability groups might be an important issue for further investigation. It seems that the average students forget some of the concepts or knowledge in follow-up test. On the other hand, the gifted students may keep on internalized what have been learned after the intervention.

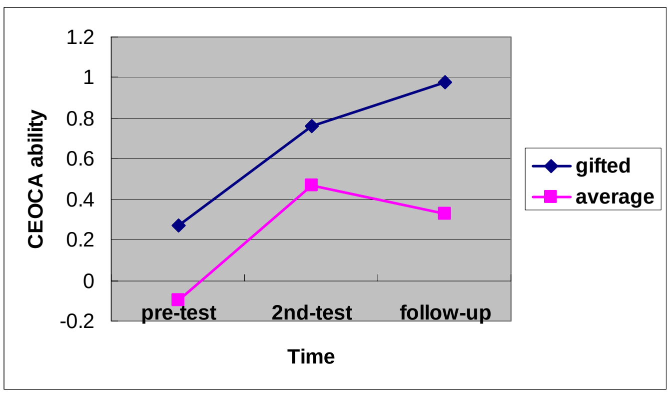

Figure 4. Contrast of the growth profiles on CEOCA z-score for gifted and average students

Table 7. Final estimation of fixed effects on CEOCA slopes for gifted and average students (N=48)

Fixed Effect		**Coefficient**	**Std.error**	**T-ratio**	**Df**	**Sig.**
INTRCPT, B0	Average student	0.02	0.10	0.17	46	0.86
	Gifted student	0.30	0.15	1.94	46	0.06
TIME slope, B1	Average student	0.22	0.07	3.00	46	0.00
	Gifted student	0.14	0.12	1.20	46	0.24

CONCLUSION

Scientific observation learning occurs through the learner's participation in a "community of practice". In other words, learners participate in complex, real world challenges. Outdoor observations are usually fun but superficial for most elementary school students. Any innovative instruction that ignores the structures which constitute human cognitive architecture is not likely to be effective. Novice observers should be provided with effective guidance on the concepts and procedures required for observations. To help learners understand the structure of what is to be learned is very crucial. Understanding leads to increased awareness and improved ability to remember. The interconnection of design of activity systems and learning cognition is very important. Formative assessment refers to assessment that is specifically intended to generate feedback on performance to improve and accelerate learning (Sadler, 1998). Black and William (1998) also claimed that well designed formative assessments have a great positive effect on students' learning. Online feedback given as part of formative assessment helps learners to focus on and achieve their leaning goals in field. In other words, concept map integrated formative assessment of mobile learning plays a supportive role for novice learners.

Ecology observation activity will be much more effective if mobile learning and assessment technologies could be appropriately integrated for elementary school students. In this study, a dynamic assessment approach is adopted to develop an ecology observation learning system for mobile learning. Moreover, concept map is integrated into three mobile observation activities to promote students' ecology observation competences. Students are guided to observe the critical features of targeted species, to compare the similar species and to relate the species to the environment sequentially. Students are also encouraged to take notes and to pursue their own learning goal besides responding to the worksheet tasks. Online scoring and feedback are provided to support and monitor students' learning progress. The results of this study suggest that the concept map integrated mobile learning design successfully enhances observation competencies for both average and gifted students. It is also found that the gifted students' scientific observation performance is superior to that of the average students through all learning stages. However, there is no significant difference in the growth slope between the gifted and the average students. This suggests that the concept map integrated mobile learning demonstrates very promising potential for all students. Generally speaking, the intervention effect of CIDAS is quite substantial for both the average and gifted students. Without any extra effort, the difference of observation competence between the 5th and 6th graders is minor (Hung, Hwang, & Lin, 2010). In other words, a well designed instructional innovation can be beneficial for all students. The preliminary results suggest CIDAS is a valuable resource for mainstream science education.

The structured concept map tasks are applied to demonstrate an effective way of knowledge organization. Students provide more scientific vocabularies, comparison and relational statements gradually in their diaries. The structural changes of students' knowledge are also worth detailed discussions to reveal the characteristics of different growth profiles. So, using the formative assessment results (such as worksheet or diary) to crossed validate the inferences made by objective tests will be a promising direction for further studies. Moreover, the larger gap on the follow-up test on CEOCA between the gifted and the average students reveals an important issue for further investigations on the reservation effect for different ability groups. The differential effect of concept map embedded learning design also needs larger sample and longer intervention to clarify.

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REFERENCES

Akkaya, R., Karakirik, E., & Durmus, S. (2005). A computer assessment tool for concept mapping. *The Turkish Online Journal of Educational Technology, 4*(3), 1-4.

Anderson-Inman, L., & Ditson, L. (1999). Computer-based concept mapping: A tool for negotiating meaning. *Learning and Leading with Technology, 26*(8), 6-13.

Anohina, A., Graudina, V., & Grundspenkis, J. (2007). Using Concept Maps in Adaptive Knowledge Assessment. *Advances in information systems development: new methods and practice for the networked society*, 469.

Black, P. & Wiliam, D. (1998) Assessment and classroom learning. *Assessment in Education. 5*(1), 7-75.

Chen, Y. S., Kao, T. C., & Sheu, J. P. (2003). A mobile learning system for scaffolding bird watching learning. *Journal of Computer Assisted Learning, 19*(1), 347-359.

Chang, K. E., Chen, S-F. & Sung, T. C. (2001). Concept mapping system with scaffolding and guided learning. *Journal of Computer Assisted Learning, 17(*1), 21-33.

Chang, K., Sung, Y. & Chen, I. (2002). The effect of concept mapping to enhance text comprehension and summarization. *Journal of Experimental Education, 7*(1), 5-23.

Chen, C. H., Hwang, G. J., Yang, T. C., Chen, S. H., & Huang, S. Y. (2009). Analysis of a ubiquitous performance support system for teachers. *Innovations in Education and Teaching International, 46*(4), 421-433.

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

Chu, H. C., Hwang, G. J., & Tsai, C. C. (2010). A knowledge engineering approach to developing mindtools for context-aware ubiquitous learning. *Computers & Education, 54*(1), 289-297.

Chu, H. C., Hwang, G. J., Tsai, C. C., & Tseng, J. C. R. (2010). A two-tier test approach to developing location-aware mobile learning system for natural science course. *Computers & Education, 55*(4), 1618-1627.

Hung, P. H., Lin, Y. F., & Hwang, G. J. (2010). The formative assessment design for PDA integrated ecology observation. *Educational Technology & Society, 13*(3), 33-42.

Hung P. H., Hwang, G. J., & Hung, X. T. (2010). *A Concept Map Embedded Formative Assessment Design for Assessing Students' Knowledge Structure in a Mobile Ecology Learning Environment.* Paper presented at Asia-Pacific conference of Technologies Enhanced Learning (APTEL2010), Kansai University, Osaka, Japan.

Hung P. H., Hwang, G. J., & Lin, I. H. (2010). *The Implications of cognitive component analysis to the Computerized Ecology Observation Competence Assessment for Mobile Learning Design.* Paper presented at Asia-Pacific conference of Technologies Enhanced Learning (APTEL2010), Kansai University, Osaka, Japan.

Hung, P. H., Hwang, G. J., Lin, I. H., Hung, X. T., Wu T. H. (2010). The Development of a Computerized Ecology Observation Competence Assessment. *Advanced Materials Research*, *108-111*, 860-865.

Hwang, G. J., Tsai, C. C., & Yang, S. J. H. (2008). Criteria, Strategies and Research Issues of Context-Aware Ubiquitous Learning. *Educational Technology & Society*, *11*(2), 81-91.

Hwang, G. J., Yang, T. C., Tsai, C. C., & Yang, Stephen J. H. (2009). A context-aware ubiquitous learning environment for conducting complex experimental procedures. *Computers & Education, 53,* 402-413.

Hwang, G. J., Kuo, F. R., Yin, P. Y., & Chuang, K. H. (2010). A heuristic algorithm for planning personalized learning paths for context-aware ubiquitous learning. *Computers & Education, 54*, 404-415.

Hwang, G. J., Shi, Y. R., & Chu, H. C. (2010). A concept map approach to developing collaborative Mindtools for context-aware ubiquitous learning. *British Journal of Educational Technology*. doi: 10.1111/j.1467-8535.2010.01102.x

Hwang, G. J., & Chang, H. F. (2011). A formative assessment-based mobile learning approach to improving the learning attitudes and achievements of students. *Computers & Education, 56*(1), 1023-1031.

Jacobs-Lawson, J. M., & Hershey, D. A. (2002). Concept maps as an assessment tool in psychology courses. *Methods & Techniques, 29*(1), 25–29.

Liu, G. Z., & Hwang G. J. (2010). A key step to understanding paradigm shifts in e-learning: Towards context-aware ubiquitous learning. *British Journal of Educational Technology, 41*(2), E1-E9.

Mintzes, J. J., Wandersee, J. H., & Novak, J. D. (1997). *Teaching science for understanding*. San Diego, CA: Academic Press.

Novak, J. D. (1990). Concept mapping: A useful tool for science education. *Journal of Research in Science Teaching, 27*(10), 937–949.

Novak, J. D. (2002). Meaningful learning: The essential factor for conceptual change in limited or appropriate propositional hierarchies (liphs) leading to empowerment of learners. *Science Education, 86*(4), 548-571.

Novak, J. D., & Canas, A. J. (2008). *The theory underlying concept maps and how to construct and use them.* Florida Institute for Human and Machine Cognition Pensacola Fl, Retrieved from http://cmap.ihmc.us/Publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps.htm.

Riley, N. R., & Ahlberg, M. (2004). Investigating the use of ICT-based concept mapping techniques on creativity in literacy tasks. *Journal of computer assisted learning, 20*(4), 244-256.

Sadler, D. R. (1998). Formative assessment: Revisiting the territory. *Assessment in Education: Principles, Policy & Practice, 5*(1), 77-84.

Shih, J. L., Chuang, C. W., & Hwang, G. J. (2010). An inquiry-based mobile learning approach to enhancing social science learning effectiveness. *Educational Technology & Society, 13*(4), 50-62.

Tsai, C. C., Lin, S. S. J., & Yuan, S. M. (2001). Students' use of web-based concept map testing and strategies for learning. *Journal of Computer Assisted Learning, 17*(1), 72-84.

Vosniadou, S. (2007). Conceptual change and education. *Human Development, 50*(1), 47-54.

Vogel, B., Spikol, D., Kurti, A, & Milrad, M. (2010, April). *Integrating Mobile, Web and Sensory Technologies to Support Inquiry-Based Science Learning*. Proceedings of the 6th IEEE International Conference on Wireless, Mobile and Ubiquitous Technologies in Education (WMUTE 2010), Kaohsiung, Taiwan.

Westerlund, J. (2008). Class size and student evaluations in Sweden. *Education Economics, 16,* 1928.

Yin, Y., Vanides, J., Ruiz-Primo, M. A., Ayala, C. C., & Shavelson, R. J. (2005). Comparison of two concept mapping techniques: Implications for scoring, interpretation, and use. *Journal of Research in Science*

Teaching, 42(2), 166-184.

AN ONLINE TASK-BASED LANGUAGE LEARNING ENVIRONMENT: IS IT BETTER FOR ADVANCED- OR INTERMEDIATE-LEVEL SECOND LANGUAGE LEARNERS?

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ABSTRACT
This study investigates the relationship of language proficiency to language production and negotiation of meaning that non-native speakers (NNSs) produced in an online task-based language learning (TBLL) environment. Fourteen NNS-NNS dyads collaboratively completed four communicative tasks, using an online TBLL environment specifically designed for this study and a chat tool in WebCT-Vista. Seven dyads were at intermediate-level language proficiency and the remaining seven dyads were at advanced-level language proficiency. Language production was investigated in terms of fluency, accuracy, and complexity including lexical and syntactic complexity, and negotiation of meaning was examined using the ratio of negotiated turns to total turns. The data from the chat-scripts showed that intermediate-level NNSs get involved in more negotiation of meaning than advanced-level NNSs, and advanced-level NNSs produced more accurate language than intermediate-level NNSs.

INTRODUCTION

Negotiation of Meaning and Language Production for SLA

Understanding messages and receiving comprehensible input is the only way and essential ingredient for second language acquisition (Krashen, 1985), and a considerable evidence for a causal relationship between comprehensible input and second language acquisition was reported by Long (1983). However, comprehensible input should not be conceived as simplified input adjusted to non native speakers; instead, the input should be modified by interactants in conversation through negotiation of meaning so as to ensure that it is modified to exactly the level of comprehensibility students can manage (Long, 1983; Long and Porter, 1985). In addition to negotiation of meaning, language production has also been reported to serve important functions in second language acquisition that complement the role of input (Shintani, 2011; Swain, 1985). Language production especially within a meaningful context and through interaction has been demonstrated to assist second language acquisition (Ellis and He, 1999; Morgan-Short and Bowden, 2006).

TBLL for Negotiation of Meaning and Language Production

Task-based language learning (TBLL) method promotes negotiation of meaning using 'meaning-focused' and 'communicative' task completion activities (Doughty & Long, 2003, Willis, 1996) and gives students the chance to practice language extensively within a meaningful context, engaging students in the 'authentic,' pragmatic, and contextual production of language (Doughty & Long), where language production is not the aim but 'the vehicle for attending task goals' (Willis, p.25). Negotiation of meaning and language production through negotiated interaction and meaningful task-completion activities facilitate language acquisition (Anderson, 2000) and promote second language learning (Izadpanah, 2010).

Online TBLL

The advent of information technology has improved the quality of many scientific disciplines, including language education (Chapelle, 2001; Gonzolez-Lloret, 2003), and language learning through technology has become a fact of life (Chapelle, 2001). Computer-based activities for language learning offer capabilities that cannot be easily substituted by any other language teaching procedure within a traditional classroom environment. Some of these include rapid global access at any time from any computer with Internet access, integration of graphics, audio, and text; and ease and low cost of publication (Kern and Warschauer, 2000). These capabilities make it possible to create an optimal task-based language learning environment, which is interactive, motivating, highly contextualized (or real-world like), task-oriented, and authentic. Therefore, online task-based language learning with rich multimedia experience is increasingly being used (Doughty and Long, 2003), and has been reported to be effective by many studies (Arslanyilmaz, 2010; Blake, 2000; Freirmuth and Jarrell, 2006; Gonzolez-Lloret, 2003; Keller-Lally, 2006; Smith, 2003).

Previous Studies

Because of the aforementioned benefits of TBLL to second language learning, growing body of empirical research has been conducted in this field of interest. The primary goal of these researches has been to describe, analyze, and predict the factors influencing the amount of negotiation of meaning and language production that students engage in through TBLL. Some of the variables that have been reported by these researches focused on the task-type (Blake, 2000; Smith, 2003), feedback during task-completion (Iwasaki and Oliver, 2003; Pellettieri, 2000), learners' state anxiety (Baralt and Gurzynski-Weiss, 2011), psycholinguistic considerations (Doughty & Long, 2003), format of communication - synchronous vs. asynchronous - (Kötter, 2003; Sotillo, 2000), interaction with native speakers (Tudini, 2003), similar-task videos (Arslanyilmaz, 2010), and delivery method of instructions –online vs. face-to-face- (Chen, Belkada, and Okamoto, 2004; Chun, 1994; Gonzalez-Lloret, 2003). In addition to these variables, "it is important to investigate how proficiency may impact the quality and quantity of learner interaction so as to provide the optimal opportunity for learning." (Iwashita, 2001, p. 270) Thereupon, a few studies have explored language proficiency as another variable that may have influence negotiation of meaning and language production in TBLL (Belz, 2002; Collentine, 2009; Iwashita, 2001; Pica et al., 1996; Porter, 1986); however, the number of researches conducted in this area has been insufficient to make conclusive remarks and the results of these studies have been contradictory.

The few studies with respect to the proficiency level at which students get involved in more negotiation of meaning have been contradictory. Belz (2002) conducted an asynchronous network-based foreign language study between German and American students learning English and German respectively. Belz's study reported that when high level proficient students paired with high level proficient students, they felt more comfortable and got involved in deeper discussions and participation. Pica et al. (1989, 1996, cited in Iwahsita, 2001, p. 270) stated that when a low level learner is paired up with another low level subject, compared with dyads of higher level dyads, low level learner may not know what to ask for, and repeat part of a prior utterance which they did not understand. In addition Collentine (2009) found that learners at advanced-level proficiency as compared to the ones at intermediate-level proficiency were getting involved in more interactions and producing more language because the tasks were more difficult for intermediate-level dyads and they had more knowledge gaps. On the other hand, Iwashita (2001) found that high-high dyads produced less confirmation checks and clarification request than low-low dyads even though the difference was not significant. Iwashita stated that "tasks may not be challenging enough for learners who are more proficient; and hence, they may complete the tasks without much need for negotiation of meaning."

Studies about the effect of language proficiency on language production have been insufficient and inconclusive. In one study, Porter (1986) compared the language produced by students at two proficiency level during communicative and task-based activities. She reported the amount (number of words), accuracy, and fluency of speech among other variables. Six of the learners participated in her study were advanced and six of them were intermediate. Participants completed three communicative tasks. She found that the total number of words, the fluency of language, and accuracy of language produced by advanced learners and intermediate learners were not statistically significant. Therefore, she reported that there was no clear advantage of one level over another. In another study, Iwashita (2001) reported that there was no significant difference between the amount of c-units, a measure of language quantity, produced by high-high proficient dyads and low-low proficient dyads, which was contradictory to the results reported by Porter, who stated that advance-level dyads produced more total words than intermediate-level dyads.

Research Questions

The purpose of this study is to explore whether non-native speakers at advanced- or intermediate-level proficiency produce better language and get involved in more negotiation of meaning. The research questions for this study is as follows,

1. Do advanced-advanced dyads produce more fluent language than intermediate-intermediate dyads?
2. Do advanced-advanced dyads produce more accurate language than intermediate-intermediate dyads?
3. Do advanced-advanced dyads produce lexically more complex language than intermediate-intermediate dyads?
4. Do advanced-advanced dyads produce syntactically more complex language than intermediate-intermediate dyads?
5. Do advanced-advanced dyads get involved in more negotiation of meaning than intermediate-intermediate dyads?

METHODS

Participants

Participants in this study were 14 non-native intermediate- and 14 non-native advanced-level students in an English language institute in the southern United States during the fall semester of 2006. The intermediate-level students were recruited from two sections of an intermediate-level composition course, and had been taking other intermediate-level English courses for the previous three months. The advanced-level students were randomly recruited from all advanced-level English courses offered in the institute. The advanced- and intermediate-level students represented a variety of first language backgrounds, including Korean, Mandarin, Arabic, Spanish, and Japanese. They ranged in age from 18 to 29, with the majority in their early twenties. The participants were placed in the intermediate- and advanced-level composition courses by the institute at the beginning of the semester based on a combination of their scores on TOEFL (Test of English Foreign Language), ELPE (English Language Proficiency Exam administered by the University), two in-house assessments consisting of an interview with the director of the institute and a composition test (K. Clark, personal communication, November 7, 2006).

Online TBLL Environment
An online TBLL environment was developed for this research study (see Figure 1). The environment was designed to present four tasks for students to complete in dyads. "Your Task" button was used to display the instructions for each task, and "Similar Tasks" button was used to display subtitled videos. The dyads used the chat tool provided by WebCT-Vista to complete the assigned tasks.

Figure 1: Main framework of the online TBLL environment and subtitled similar task videos for the compare the maps task.

Tasks. The online TBLL environment was designed based on task-based language learning approach focusing on the successful use of language within context rather than learning the language as an end in itself through meaningful and communicative task-completion activities. The online TBLL was designed for four tasks: two split-information and two shared-information tasks, which were developed based on the task typology by Pica et al. upon founding it to be the most informative and clear among the other task typologies. In the split-information tasks, "Compare the Maps" and "Christmas Break Trip," each student in a dyad has one part of the complete information, requires communicating to the other student in the same dyad in order to exchange the information, both student have convergent goals toward task completion, and the tasks have more than one possible outcome. In the shared information tasks, "Gifts for a Family" and "Garage Sale," two students in a dyad have the same information body available, do not have to exchange information, have convergent goals, the tasks have more than one possible outcome, and task completion involves decision making, personal preference, feeling, and attitude. These tasks were designed and developed to provide the means for students to practice language in real-life-like context while engaging them in authentic, pragmatic, contextual, and functional use of language. Students were expected to learn the language while completing the tasks, during which engaging in increased negotiation of meaning, which would free up attentional and memory resources of students from language form and meaning resulting in paying more attention to negotiation of meaning and formulating language needed to express ideas during task completion.

In "Compare the Maps" split-information task (see Figure 2), both students in a dyad are provided with the same map containing 15 buildings along with trees, roads, and vehicles. Six of the buildings are clickable. Upon clicking one of them, one activity is displayed within the building. Three of the displayed activities are the same for both members of the dyads, and three of them are different. Descriptions of the same activities are (1) a person repairing his TV, (2) a lady studying, and (3) a child feeding her dog. Descriptions of different activities are (1) a child playing with a toy versus another toy, (2) a lady shopping for clothes versus another lady shopping for notebooks, (3) two teams playing basketball versus three people running. Dyads were asked to identify the similarities and differences between the activities.

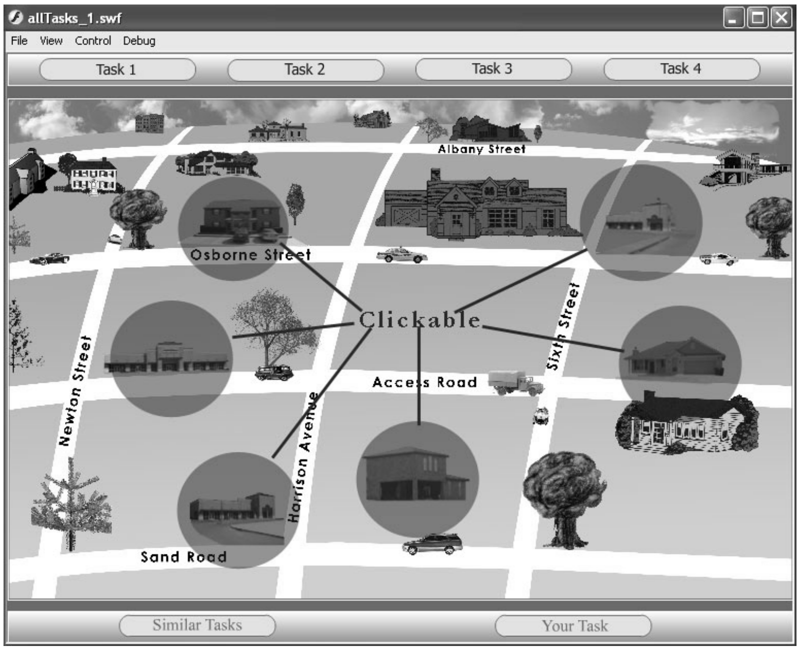

Figure 2: Compare the maps task.

In "Christmas Break Trip" split-information task (see Figure 3), dyads were asked to imagine that they have decided to take a trip during Christmas break. Each member of the dyads was provided with information about attractions, hotels, activities, and flights to three different cities. Dyads were asked to exchange information and decide which city to visit during Christmas break.

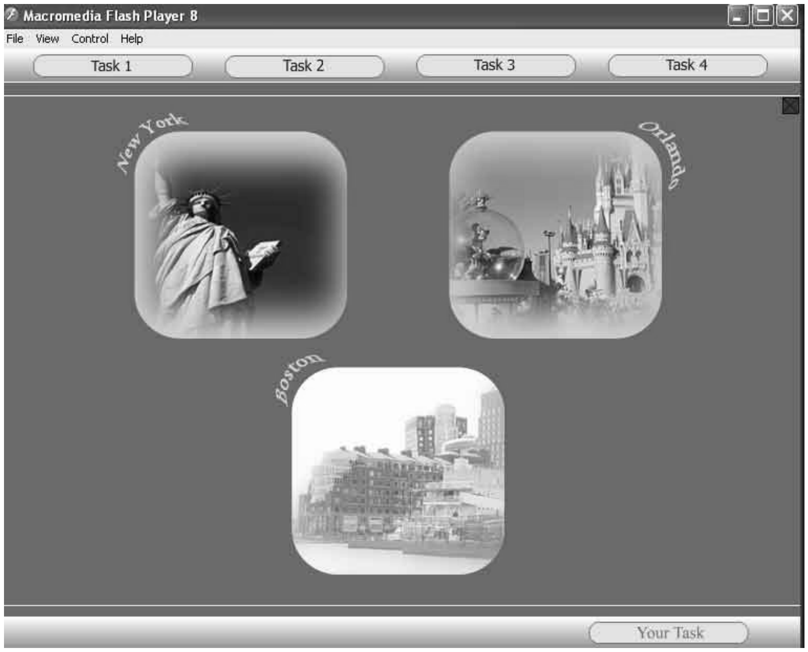

Figure 3: Christmas break trip task

In the “Gifts for a Family” shared-information task (see Figure 4), students in dyads were asked to discuss on what gift(s) to buy for each member of a family of four with whom they would be staying in the U.S. When students clicked on the house image marked with an arrow, a picture for each family member and their hobbies were displayed in the main content area. Students were then asked to discuss and decide on the amount of money to spend for each gift and what to buy for each family member based on his/her hobbies.

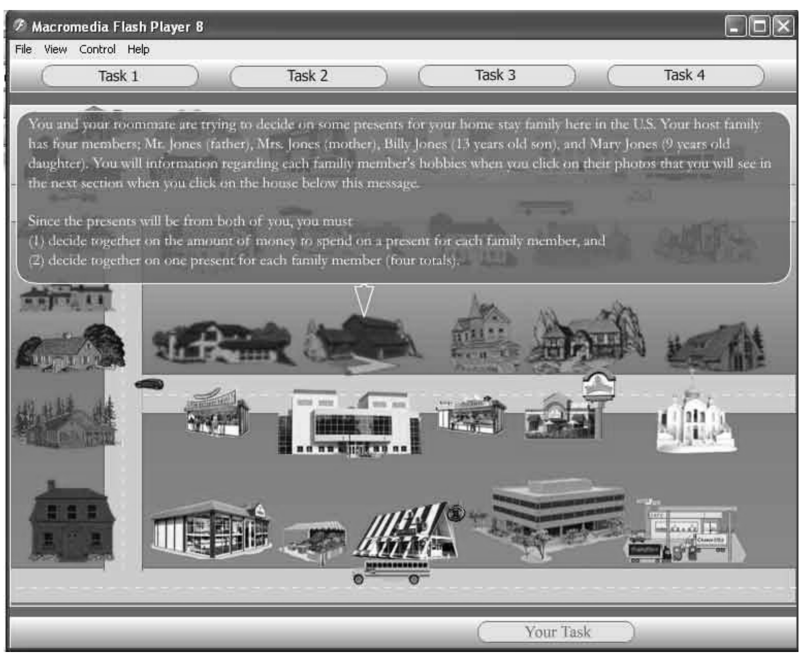

Figure 4: Gifts for a Family Task.

In the “Garage Sale” shared-information task (see Figure 5), students in the dyads were asked to imagine that they were roommates in a dormitory. Dyads are presented with their rooms and items in the room. When students click on the items, they are zoomed in and detailed information is given in the main content area. Students are asked to discuss and donate four items in their dorm room to sell at a garage sale in order to help their class raise money for a trip to Niagara Falls after talking about usefulness, value, condition, and transportation of the items, and how they would convince people to buy them.

Figure 5: Garage Sale Task.

Subtitled Videos. Each subtitled video presents a short dialog between two native speakers engaged in a task similar to – but not the same as – the one students are about to complete, see [Table 1] for brief descriptions. The videos were recorded in real-life settings, and subtitles were provided in the videos. The primary function of the videos were not to demonstrate the workings of language, nor to teach linguistic structure, but rather, as the authentic language use defined by Breen (1985), 'communicative,' 'to share experiences' (p.62) of native speakers in similar task situations with the ones the students were expected to complete. In addition, these videos were provided to the students so that they could create mental models by observing native speakers doing similar tasks in order to compare their own experiences to them to be later used in task phase. By comparing their mental models to native speakers', students would be able to fill gaps in their own linguistic resources. Furthermore, observing the videos would help students reduce cognitive processing load, facilitate conversational development, and make things less threatening (Skehan, 1998). Students who watch native speakers completing similar tasks to their assigned tasks would be motivated to pay attention to form so as to produce language like native speakers later in the task completion phase.

Table 1: *Description of Subtitled Videos*

Assigned task	Quantity	Topics of the subtitled videos
Compare the Maps	6	These focus on demonstrating and modeling an activity that is currently happening. These activities include playing a guitar, studying for an exam, making an omelet, getting ready to go home on a bike, and asking directions.
Gifts for a Family	2	Two native speakers play a couple who are deciding on gifts for their relatives, whom they are planning to visit.
Christmas Break Trip	3	Two native speakers play a couple who are making travel plans for a Thanksgiving trip.
Garage Sale	6	Speakers discuss items in their house in order to decide which to sell at a yard sale to raise money to save an endangered animal species. They talk about the value of each item, its condition, the use of each item, and reasons customers might buy them.

Treatment Conditions

Students at intermediate-level proficiency were assigned to the intermediate-level group (ILG), and students at advanced-level proficiency were assigned to the advanced-level group (ALG). As a safeguard against outliers or unbalanced groups, the director of the institute reviewed group membership and determined students belonged to their respective groups. Because students were not randomly assigned to ILG and ALG groups, but all students in the intermediate-level proficiency was assigned to ILG and all students in the advanced-level was assigned to ALG, this study should be characterized as a quasi-experimental rather than a strict experiment design. After the formation of the groups, students in each group were randomly paired to form dyads. There were 14 dyads in the study, seven in each group. Both groups were provided with the online TBLL environment, and dyads in both groups were asked to complete the same four tasks. Both groups had access to the subtitled videos.

Procedures
All dyads met twice, each of which lasted about two hours. While the dyads in the ILG met during regularly scheduled class meetings, the dyads in the ALG met over a weekend. Two computer labs were used for the study, and one member of each dyad was assigned to work in each computer lab to ensure that none of the dyads worked face-to-face. Dyads completed two tasks in each session. Before beginning the experiment, all students were given 10 minutes of instruction for each task. After the training, each student was sent to the randomly assigned computer lab. Students were given 50 minutes to complete each task.

After learning what they are supposed to do and what components the online TBLL environment consists of, students felt the need to be prepared for the task-completion phase. Although the students were not instructed to go through a specific sequence before starting to complete their tasks, many of them started with watching the subtitled videos, where two native speakers completed similar tasks to the ones that the students were assigned to complete. While watching these videos, students paid attention to the language used by the native speakers when completing the similar tasks, which helped students to activate the task related words, phrases, and form of the second language and bring them into the working memory so as not to require much cognitive resources to access them later in the task completion phase, and helped them to acquire necessary knowledge in order to use later in the task-completion phase. In addition, watching these videos also helped students understand the goals of the tasks, what they are required to do, and nature of the outcome they would reach. Other than the subtitled videos, students explored the information in the pre-task section related to the tasks that they are required to complete. For the “Compare the Maps” task, students clicked on each one of the buildings on the interactive maps provided to them in order to see what was going on in each one of the buildings and describe these events to their partners to be able to identify similarities and differences between the activities happening in these buildings. They also paid attention to the location of the buildings including the streets where they are located at so as to be able to tell their partners which specific buildings they were referring to. For the “Christmas Break Trip” task, students were provided with information about cities that they may want to visit during the break. Students read about these cities including the fee they would pay for the hotel, airfare, food, and saw photos of the attractions they would be able to visit and see in these cities. For the “Garage Sale” task, students clicked on each one of the items in their imaginary dormitory room paying attention to the functionalities, benefits, values, worth, conditions, dimensions of these items. They also noted where the item is located at within the room, which helped them when referring to the items within the room to their partners. For the “Gifts for a Family” tasks, students clicked on each one of the family member to learn about the hobbies of each family member in order to decide what gift would be perfect for each family member. Going through the information provided to the students in the pre-task phase eased the process load that students faced during task phase, and students were able to devote more cognitive resources for task completion activities.

Data Source
The chat tool that students used to complete the assigned tasks created a transcript of their written interaction. This transcript captured all language they produced during completion of the tasks, which was analyzed for comparison between the two groups.

Data Coding
Fluency. The fluency was measured by the number of words per minute (WPM) (Kellogg, 1996) produced in written language using the chat tool. The total number of words produced by each dyad in both groups was tallied and divided by 200, the total number of minutes spent to complete the four tasks. When counting the words, any orthographic unit bound by spaces, and including proper nouns and acronyms (e.g. TAMU) was counted as one word. ‘Concatenated forms (e.g. gonna, wanna, sorta) and contracted forms (I’m, we’re)’ (Andersen & Johnson, 1973, p. 151) were counted as one word. Hyphenated words (quarter-mile) were counted as two words. Back-channeling cues (e.g. hhhhh hh, um, oh, hey) were not counted as words. Repetitions resulting from an attempt to correct a lexical error were counted as one word (e.g., A:hotel pee and else, A:fee, not pee). To control the influence of computer proficiency on the results of fluency, before starting the experiment, all students were asked to fill out a background questionnaire designed to gather information about students’ computer proficiency. The results of an independent samples *t* test with the computer proficiency scores as the dependent variable and the groups as the independent variable shows that students in ILG were not significantly different than students in ALG in terms of their computer proficiencies ($p = .61$).

Syntactic Complexity. Syntactic complexity was measured by the number of subordinate clauses per 'C-unit' (Robinson, 2001). Following the definition by Rulon and McCreary (1986), any 'word, phrase, or sentence' that in some way contributed 'pragmatic or semantic meaning' to a conversation regardless of grammaticality were counted as a C-unit (e.g., Mine is a old woman (one C-unit), not a girl (one C-unit)). Elliptical answers to questions were counted as one C-unit (e.g., A:"Where are you going? (one C-unit)," B:"to the store (one C-unit)). Some words were included with the following or previous C-units and counted as one C-unit if they seemed to form one semantic unit (e.g., "Now (not a separate C-unit). I stop temporary. (one C-unit)"). Repetitions in an attempt to correct the previous C-units by the same speaker were not counted as separate C-units (e.g., "I know that on the fist school (one C-unit). First school (not a separate C-unit)"). When the speaker's turn is interrupted by the listener, both halves of the speaker's turn was counted as one C-unit if they are one clause (e.g. A:"like Walt Disney World (one C-unit)" B:"I like Walt Disney too" A:"and Discovery Cove (not a separate C-unit)"). When a speaker used more than one line for one communication unit, they were counted as one. If a single sentence was formed as a result of a combination of two simple sentences with a conjunction, they were coded as two separate C-units (e.g., "Yes, map is the same (one C-unit) but people inside are different (one C-unit)"). Sentences with correlative conjunctions were coded as one C-unit if they had a compound subject, object, adjective, or adverb (e.g., "it is close to many things and to the airport" (one C-unit)). However, if they linked two verbs, then they were coded as two different C-units (e.g., "a woman shopping (one C-unit) and buying a T-shirt" (one C-unit)).

The subordinate clauses reduced to a phrase by omitting the relative pronoun and the part of the verb were counted as one subordinate clause (e.g., "We are completely the same in the building with two cars"). If the subordinate was used as an answer to a question by the other student, it was not counted (e.g., A:"Why?" B:"because the children like music (no subordinate clause but one C-unit).

Lexical Complexity. Lexical complexity was measured by mean segmental type token ratio (MSTTR), 'an index that appears to have been originally recommended by Johnson' (Malvern & Richards, 2002, p. 88). To find out MSTTR, the students' written language products were divided into segments of 200 words, the type-token ratio (TTR) of each segment was calculated, and the average of the type-token ratios for the segments were taken. MSTTR was used because 'TTR is a function of sample size: larger samples of words will give a lower TTR' (Malvern & Richards, 2002), which has also been criticized by many other scholars. MSTTRs were calculated by the WordSmith tool (Scott, 2008). When calculating MSTTRs, this tool lists all unique words with the number of times they were used in the text and the context in which they were used. Each of these unique words was analyzed in context to see whether it was a real word because the tool considers every utterance bound by space as a real word. For example, some utterances (e.g., "T," "LL"), back channeling cues (e.g., "HHH," "HAHHAHA"), and typos within separate occurrences of the same word without typing error (e.g., "YOU^^") are considered as a separate word by the tool. These utterances were taken out from the list of unique words.

Accuracy. Accuracy was measured by the ratio of 'error-free T-units' to total 'T-units' (Bygate, 2001). A 'T-unit (terminable unit)' defined as an independent clause and subordinate clauses 'attached to or embedded in it' (Kern, 1995). The difference between T-units and C-units is that T-units are easily and objectively identifiable by identifying independent clauses and subordinate clauses attached to them. On the other hand, identifying C-units are more subjective because a C-unit may not be an independent clause or subordinate clause as long as it somehow contributes pragmatic or semantic meaning to a conversation (e.g. "to the store" as an answer to a question "Where are you going?" is a C-unit but not a T-unit), and this contribution can be subjective depending on how it is perceived by the rater based on the context in which the word or phrase is used (e.g., "I like Walt Disney World but not Discovery Cove" could be coded as one C-unit by one rater but as two C-units by another rater depending on whether they perceive the sentence contributes one meaning or two different meanings to the conversation).

The T-units and errors in the T-units were calculated based on the combination of two guidelines, one of which was used by Sotillo (2000) to calculate accuracy in synchronous and asynchronous communication and the other one was used by Polio (1997) to compare three different measures for linguistics accuracy (see the Appendix for error guidelines). The two guidelines are very similar to each other with trivial differences.

Ratio of negotiated turns to total turns. The negotiation of meaning was measured by the ratio of negotiated turns to total number of turns, which is chosen to remove the effect of the amount of talk on the amount of negotiation of meaning. In order to calculate the ratio of negotiated turns to total turns, it was first necessary to code the data and count the number of negotiation of meaning sequences (negotiated turns).

All negotiation of meaning sequences were identified using the model developed by Varonis and Gass (1985) and revised by Smith (2003). As defined in the model, negotiation of meaning sequences consists of two parts: trigger and resolution. The trigger <T> is the utterance or portion of an utterance on the part of the speaker that results in some indication of non-understanding on the part of the listener (Varonis & Gass, 1985, p. 74). Five types of triggers were found in this study: lexical (see Excerpt 1), content (see Excerpt 2), syntactic (see Excerpt 3), task complexity (see Excerpt 4), and discourse (see Excerpt 5).

The resolution part of a negotiation of meaning sequence consists of an indicator, and perhaps a response, the reaction to the response, a confirmation, and a reconfirmation (Smith, 2003; Varonis & Gass, 1985). Indicators, the written communication where the listener signals that there is a non-understanding, were coded <I>. Responses, where the original speaker attempted to clear up the non-understanding, were coded <R>. Reactions to the response in which the listener signaled a degree of understanding were coded <RR+> and those that indicated continued difficulty with the speaker's response were coded <RR->. Confirmations, which indicate a positive reaction to the response <RR+>, that is, that some degree of understanding was achieved by the listener, were coded <C>. Reconfirmations, where even a minimal response to the respondent's confirmation occurred were coded <RC>.

Excerpt 1	
H.Y.: shall we but it?	<T>
A.Q.A: what shall	
A.Q.A.: what is shall	<I>
H.Y.: shall we go to buy it?	<R>

Excerpt 2	
A.H.: I was looking for the attractions and that just make me be excited	<T>
L.Y.: What kind of attractions? Could you tell me?	<I>
A.H.: There we can visit Walt Disney World, Discovery Cove,Epcot Center and the Universal Studios	
A.H.: it could be fun	<R>
L.Y.: Yes, that sounds very good. How about the prices?	<RR+>Implicit<TAR>

Excerpt 3	
A.Q.A.: what do you thing about Brushed that machian do damage the papers	<T>
H.Y.: whats mean?	<I>
A.Q.A.: machian do damage the papers	<R>
H.Y.: what damage?	<RR->
A.Q.A.: it is next the referajrater	<R2>
H.Y.: ok	<RR+>

Excerpt 4	
S.K.: In book store building, a woman is looking around the shop, She has an aggi T- shirt.	<T>
C.D.: In my picture she has a black coat	
C.D.: Has she a back bag?	<I>
S.K.: No, she wears yellow coat.	
S.K.: She does not have any bag.	<R>
C.D.: Ok. They are different.	<RR+>Explicit
S.K.: OK.	<C>

Excerpt 5	
I.J.: do you know tori?	<T>
K.K.: tori	<I>
I.J.: she is in the video	<R>
K.K.: tori is a couch of Newyork Yankees	
K.K.: coach	<RR->Implicit<TD>

Negotiation of meaning sequences consisting of a T-I-R, a T-I-R-RR, a T-I-R-RR-C, or a T-I-R-RR-C-RC were identified and counted, and the ones consisting of only a T-I were not included in the data analysis. After identifying the negotiation of meaning sequences, the total number of turns and negotiated turns were counted. A turn is considered to occur whenever there is a transfer of the floor from one student to another. Negotiated turns are those turns that occur in negotiation of meaning sequences, the most widely used model of negotiation (Smith 2003, p. 39). Finally, a ratio of negotiated turns to total turns was calculated to find out the amount of negotiation of meaning occurred during completion of the tasks.

Reliability

A randomly selected 10% of the written interaction produced by dyads in ILG and ALG during completion of tasks was coded by an independent rater using the same procedures described in this study for identifying subordinate clauses, C-units, T-units, error-free T-units, and negotiation of meaning sequences. These subordinate clauses, C-units, T-units, error-free T-units, and negotiation of meaning sequences identified by the independent rater were compared to the ones identified by the researcher. The researcher and the independent raters examined the coding differences, and discussed these differences for clarification and making sure that they both coded the units with the same understanding of the criteria for the coding. They agreed on the coding for the 89% of the subordinate clauses, 91% of the C-units, 93% of the T-units, and 90% of the error-free T-units for the language produced by dyads in the ALG. They also agreed on the coding for the 90% of subordinate clauses, 93% of the C-units, 92% of the T-units, and 90% of the error-free T-units for the language produced by dyads in ILG.

Another random selection of 10% of the written language produced by dyads in ILG and ALG was coded by an independent rater to identify negotiation of meaning sequences. The independent rater used the same procedures as described in this study in identifying the negotiation of meaning sequences. After coding the negotiation of meaning sequences including total number of turns and the number of negotiated turns occurring within the negotiation of meaning sequences, the independent rater and the researcher came together to discuss how each one of them coded. They compared the coding by both of them, and clarified any misunderstandings in the way each one them coded. As a result, they agreed 88% of the negotiated turns for the language produced by the ALG and 89% of the negotiated turns for the language produced by ILG. The two rater agreed 100% of the total turns.

Data Analysis Techniques

Because language production and input comprehension are two different measures, two independent statistical analyses were executed to determine the effect of language proficiency on language production and negotiation of meaning. Analysis of multivariance (MANOVA) was used to analyze the effect of language proficiency on language production because the experiment affects all four dependent variables (fluency, syntactic complexity, lexical complexity, and accuracy) separately and in combination with each other. The level of significance (alpha) was set at.05. Hotelling T^2 was used to determine overall multivariate significance of dependent variables on the groups.

In order to analyze the effect of language proficiency on negotiation of meaning, this study used only one 2-tailed independent group t-test. The ratio of negotiated turns to total turns produced by ALG was compared to the ones produced by ILG, and these two sets of dependent variables are not related to each other in any way because the negotiated and total turns in the two groups are produced by different students in two different groups.

RESULTS AND DISCUSSIONS

Language Production

By looking at [Table 2], we are able to determine the relative amount of language that was produced while students were engaged in task-completion activities. In terms of fluency, students in ALG produced almost 1.42 times more words than students in ILG during the same time span. In terms of lexical complexity, students in the ALG produced almost 1.41 times more unique words, and 1.04 times more lexically complex language as measured by mean segmental type token ratio (MSTTR) than students in the ILG. In terms of syntactic complexity, surprisingly, students in the ILG produced about 1.22 times more subordinate clauses per C-unit than students in the ALG. In terms of accuracy, the ratio of error free T-units to total T-units were 1.59 times better with the students in the ALG than with the students in the ILG.

Table 2: *Total Number of Words, Unique Words, C-Units, Subordinates, and Total and Error-free T-units Produced across Groups*

Groups	Total words	Unique words	C-units	Subordinates	T-Units		SPC	MSTTR	WPM	EFT

					Total	Error-free				
ILG	11800	4312	2193	329	1477	644	0.61	51.96	33.71	0.41
ALG	16764	6119	2920	359	2138	1401	0.50	54.44	47.9	0.65

Note: SPC= Subordinate clause per communication unit; MSTTR= Mean segmental type token ratio; WPM= Word per minute; EFT= Ratio of error-free T-units to total T-units

A multivariate analysis of variance was conducted to assess if there were differences between the two groups (ILG, ALG) on four language production measures (words per minute, subordinate clause per C-unit, mean segmental type token ratio, and ratio of error-free T-units to total T-units) considered together. MANOVA multivariate test output as seen in [Table 3] shows a significant multivariate main effect for Group at .05 significance level, Hotelling's T = 5.22, F = 11.75, p=.001. This result suggests that students in the ALG based on the composite of the four dependent variables significantly differ from students in the ILG. Partial eta squared value of .84 reported in [Table 3] indicates that 84 percent of the variance in language output (the new combined dependent variable) can be accounted for by the two groups at two different proficiency level (the independent variable). Therefore, a large proportion of the variance, .84, is explained by the between groups SSCP matrix, or in other words by the experiment.

Table 3: *Comparison of Mean Number of WPM, SPC, MSTTR, and EFT across Groups*

Groups	Value	F	P	Observed power	Partial eta squared
Hotelling's T	5.22	11.75	.001*	.993	.84

Note: WPM = Word per minute, SPC = Subordinate clause per minute, MSTTR = Mean segmental type token ratio, EFT = Ratio of error-free T-units to total T-units* $p < .05$

Examination of the coefficients for the linear combinations distinguishing the two groups indicated that the ratio of error-free T-units to total T-units (F(1,12) = 9.93, Partial eta-squared = .45, p = .008), word per minute (F(1,12) = 5.33, Partial eta-squared = .3, p = .04), and mean segmental type token ratio (F(1,12) = 6.2, Partial eta-squared = .34, p = .028) contributed significantly. However, subordinate clause per communication unit (F(1,12) = 1.56, Partial eta-squared = .115, p = .23) did not contribute significantly to distinguish the groups. By partial eta-squared, the ratio of error-free T-units to total T-units effect appears stronger than the mean segmental type token ratio effect, which appears stronger than the word per minute effect, which appears stronger than subordinates per C-units effect.

Bonferroni correction was applied to the Univariate ANOVA test statistics by dividing 0.05 by 4 (number of dependent variables) in order to ensure against a Type I error. Hence the values need to be smaller than 0.0125 for the results to be significant. The Univariate ANOVAs indicated that ratio of error-free T-units to total T-units (p = .008) were significantly higher for students in ALG than students in ILG. Word per minute (p = .04), mean segmental type-token ratio (p = .028) were also significantly higher for students in ALG than students in ILG before the Bonferrroni correction is applied to the results but not after the Bonferroni correction is applied to the results. Subordinate clause per communication unit (p = .24) was not significantly higher for students in ILG than students in ALG both before and after the Bonferroni correction is applied to the results. The results suggest that students in advance-level proficiency group (ALG) produced significantly more correct language than student in intermediate-level proficiency group (ILG).

However, fluency and lexical complexity of the language produced by students in ALG was not statistically significant than students in ILG even though ALG students produced more fluent and lexically complex language than ILG students. In addition, although syntactic complexity of language produced by students in ILG was more complex than students in ALG, it was not statistically significant. It is therefore appropriate to report that online task-based second language learning is more beneficial to students in advanced-level course than students in intermediate-level course in the production of language in general when complexity, fluency, and accuracy are combined, and in the accuracy of language produced specifically.

Negotiation of Meaning

As seen in [Table 4], negotiated turns accounted for about 8.8% of the total turns generated by dyads in the advanced-level group (ALG). In contrast, negotiated turns accounted for about 25% of the total turns generated by dyads in the intermediate-level group (ILG). This result suggests that students at intermediate-level language proficiency engaged in more negotiated interaction than students at advanced-level language proficiency. These figures also suggests that students at intermediate-level language proficiency produced about 5.53 times more negotiation of meaning sequences, about 8.33 times more negotiated turns, and about 2.99 times more total turns than students in the advanced-level language proficiency. The ratio of negotiated turns to total turns was about 2.8 times more with the students at intermediate-level language proficiency than with students at the advanced-level language proficiency. Therefore, intermediate-level proficiency students got involved in negotiation of meaning more often than students at advanced-level proficiency during task completion activities.

Table 4: *Total Negotiation of Meaning Sequences, Total Turns, Negotiated Turns*

Groups	Negotiation of meaning sequences	Negotiated turns	Total turns	Ratio of negotiated turns to total turns
ALG	15	42	475	0.88
ILG	83	350	1422	2.46

[Table 5] shows the results of an independent samples t-test with the percentage of turns negotiated as the dependent variable and groups as the independent variable. This table shows that dyads at intermediate-level language proficiency produced a significantly higher percentage of negotiated turns than dyads at advanced-level language proficiency. One of the reasons for the significant result with a small number of participants is the low within group variance, variance between students prior to the experiment. This was undoubtedly partly a result of the sample selection procedure in that participants were chosen from a homogenous group of English language students. Another reason for the significant result is the high between group variance, mean differences between the ratios of negotiated turns to total turns for students who were in ILG and for students who were in ALG. This high between group variance is attributed mostly by the experiment.

The answer for our research question appears to be that non-native speakers at intermediate-level language proficiency produce more negotiation of meaning than students in advance-level language proficiency in an online task-based language learning environment.

Table 5: *Comparison of Mean Percentage of Negotiated Turns to Total Turns across Groups*

Group	N (Dyads)	M	SD	T	df	Sig. (2 tailed)	99% Conf. Int. Lower	99% Conf. Int. Upper
ALG	7	.10	.1	2.69	12	.02*	.024	.23
ILG	7	.23	.073					

*p<.05

CONCLUSION

This study demonstrated that students in advanced–level proficiency produce better language in general than students in intermediate-level proficiency in an online task-based language learning environment. One of the reasons for this result could be the fact that advanced-level students had more linguistic resources, task-related words, phrases, language forms in their working memory both as a result of higher level of proficiency they were at and as a result of the higher level of comprehension they were able to attain from the videos and information provided in the pre-task phase. Accordingly, they were able to access more diverse task related words, phrases, and forms into their working memory, bring them faster, and put them together more accurately. In addition, they were also able to fill more gaps in their own linguistic resource to help them produce better language when fluency, accuracy, and complexity combined. This result confirms the finding by Collentine (2009), who reported that learners at advanced-level proficiency as compared to the ones at intermediate-level proficiency produced more language. However, this result is contradictory to the result reported by Porter (1986), who claimed that "advance learners and intermediate learners bring comparable skills of interaction to their discussions and there is no clear advantage of one level over another." (Porter, 1986, pp. 212-212) One explanation for the discrepancy could be the fact that students in Porter's study completed the tasks face-to-face and the data consisted of oral language produced by students on paper-based tasks; on the other hand, students in this study completed online and interactive tasks communicating through an online chat tool. In addition, unlike the current study, participants in Porter's study were not provided with the similar task videos, which was reported to have a positive impact on the amount of language produced (Arslanyilmaz, 2010).

In addition, univariate test statistics showed that advanced-level students produced more accurate language than intermediate-level students in an online task-based language learning environment. This result is not surprising either because of the fact that students' language in advanced-level proficiency is supposed to be grammatically more accurate than students' language in intermediate-level proficiency. Furthermore, it is possible that advanced-level students were able to pick out more language produced by native speakers in the similar task videos than intermediate-level students resulting in more native-like language with less grammatical errors. This could be because advanced-level students were able to establish more relationships between the input provided by native speakers in the similar task videos and their prior linguistic resources. However, this result is not in congruence with the result reported by Porter (1986), who reported that the accuracy of language produced by advanced-level student dyads was the same as the accuracy of the language produced by intermediate-level student dyads. As mentioned above, this could be attributed to the difference in the presentation of the tasks, online and interactive vs. paper-based, and the mode of interaction between the students during task completion, face-to-face and oral vs. online and written.

On the other hand, fluency and lexical complexity was not significantly better for students in advanced–level proficiency than students in intermediate-level proficiency. This result complies with the result reported by Porter, who stated that there was no significant difference between the fluency of language produced by the advanced- and intermediate-level student dyads, and by Iwashita (2001), who reported that there was no significant difference between the amount of c-units, a measure of language quantity, produced by high-high proficiency dyads and low-low proficiency dyads. This could be due to the limited number of participants involved in the study, which was also the case in Porter's study with a total of six participants in each proficiency level. In the current study, students at advanced-level produced 1.42 times more words and 1.41 times more lexically complex language than students at intermediate-level, and these were not enough to warrant a significant result, which could have been possible if there were more students participated in the study.

One interesting result of this study was that students in intermediate-level proficiency produced syntactically more complex language than students in advanced-level proficiency although it was not statistically significant. One possible explanation of this could be that intermediate-level students produced less language within the same time frame than advanced-level students. Therefore, students in intermediate-level proficiency took more time in constructing their sentences than students in advanced-level proficiency when completing the tasks.

The results showed that students in intermediate-level proficiency group got involved in significantly more negotiation of meaning that students in the advanced-proficiency group. This result was aligned with the finding by Iwashita (2001), who also found that high-level proficient students produced less negotiated interaction than low-level proficient students. This result also supports his reasoning that less negotiation of meaning could be as a result of tasks being too easy for them, who completed them without too much negotiation of meaning. But, it is also possible to suggest that advanced-level students did not have to prevent and repair breakdowns in communication and to sustain the conversation, called interactional modifications (Porter, 1986), as much as intermediate-level students did. In another words, students at intermediate-level had more trouble with communicating with each other than students at advanced-level, which is also supported by the aforementioned results of this current study. Students at the intermediate-level had to negotiate meaning of a linguistic form, conversational structure, or message content in order to achieve a mutual understanding before they move forward with the completion of the tasks. Advanced-level students on the other hand were able to understand each other better, and therefore did not need to negotiate the meaning of a linguistic form, conversational structure, or message content. Therefore, intermediate-level students had significantly more instances of negotiated meanings until they achieve an acceptable level of understanding (Long, 1996).

The result is contradictory to the report made by Pica et al. (1989, 1996, cited in Iwahsita, 2001, p. 270), who state that low level learner paired with another low level learner may not know what to ask for; therefore, may not get involved in as much negotiation of meaning as high level learner paired with another high level learner. The result also contradicts to the study results by Collentine (2009), who reported that learners at advanced-level proficiency as compared to the ones at intermediate-level proficiency were getting involved in more interactions.

The implication of this study is that online TBLL environment should be integrated into the second language classes for both intermediate- and advanced-level second language students. While advanced-level students enhance their language production in terms of fluency, accuracy and complexity, intermediate-level students get involved in more negotiation of meaning during task completion activities. Therefore, online task-based language learning environments will help advanced-level second language learners with their language production skills, intermediate-level students will benefit from it through input comprehension.

The online TBLL environment was designed for two task types: shared- and split-information tasks, and the effect of the task type that may have contributed to the result of this study was not investigated in this study. Therefore, future research studies should be conducted to explore whether task type had any contribution in the language proficiency's effect on language production and negotiation of meaning that second language learners produced in the online TBLL environment.

There were a few limitations in this study that needs to be identified and acknowledged. One limitation was the fact that the experiment for students in ILG group and for the students in ALG group was not conducted at the same time. While the dyads in the ILG met during regularly scheduled class meetings, the dyads in the ALG met over a weekend. Although there is no evidence, it is possible that the experimentation time might have had influence over the results of the study. Another limitation was the limited number of students involved in the study. Only 28 students, 14 in each group, involved in the study, which could have been more if there were more students enrolled in the English Language Institute, where the students were recruited from.

REFERENCES

Andersen, E.S., & Johnson, C.E. (1973). Modifications in the speech of an eight-year-old as a reflection of age of listener. *Stanford Occasional Papers in Linguistics, 3*, 149-160.

Anderson, J. (2000). *Learning and memory: An integrated approach*. New York: John Wiley and Sons.

Arslanyilmaz, A. & Pedersen, S. (2010b) Improving Language Production via Subtitled Similar Task Videos. *Language Teaching Research Journal, 14*(4).

Baralt, M., & Gurzynski-Weiss, L. (2011). Comparing learners' state anxiety during task-based interaction in computer-mediated and face-to-face communication. *Language Teaching Research, 15*, 201-29.

Belz, J. (2002). Social dimensions of telecollaborative foreign language study. *Language Learning & Technology, 6,* (1) 60-81.

Blake, R. (2000). Computer mediated communication: a window on L2 Spanish interlanguage. *Language Learning & Technology, 4*(1), 120-136. Retrieved May 26, 2003, from http://llt.msu.edu/vol4num1/blake/

Breen, M. (1985). Authenticity in the language classroom. *Applied Linguistics,* 6/1, 60-70.

Bygate, M. (2001). Effects of task repetition on the structure and control of oral language. In M. Bygate, P. Skehan, & M. Swain (Eds.), *Researching pedagogical tasks: Second language learning, teaching and testing.* Harlow: Pearson Education. 23-48.

Chen, J., Belkada, S., & Okamoto, T. (2004). How a web-based course facilitates for acquisition of language for academic purposes. *Language Learning and Technology, 8*(2), 33-49.

Chapelle, C. (2001). Computer applications in second language acquisition: Foundations for teaching, testing, and research. Cambridge: Cambridge University Press.

Chun, D. (1994). Using computer networking to facilitate the acquisition of interactive competence. *System, 22*(1), 17-31.

Collentine, K. (2009). Learner use of holistic language units in multimodal, task-based synchronous computer-mediated communication. Language Learning & Technology, 13, 68–87. Retrieved from http://llt.msu.edu/vol13num2/collentine.pdf

Doughty, C., & Long, M. (2003). Optimal psycholinguistic environments for distance foreign language learning. *Language Learning & Technology, 7*(3), 50-80.

Ellis, R., & He, X. (1999). The roles of modified input and output in the incidental acquisition of word meanings. *Studies in Second Language Acquisition, 21*, 285-301.

Ellis, R. & Yuan, F. (2004). The effects of planning on fluency, complexity and accuracy in second language narrative writing. *Studies in Second Language Acquisition.* 26 (1). 59- 84.

Freiermuth, M., & Jarrell, D. (2006). Willingness to communicate: Can online chat help? International Journal of Applied Linguistics, 16, 189-212.

González-Lloret, M. (2003). Designing task-based CALL to promote interaction: En Busca de Esmeraldas. *Language Learning & Technology,7*(1), 86-104. Retrieved February 3, 2003, from http://llt.msu.edu/vol7num1/gonzalez/default.html

Izadapanah, S. (2010). A study on Task-Based Language Teaching: From theory to practice. US-China Foreign Language, 8(3), 47-56. Retrieved from EBSCOhost

Iwasaki, J., & Oliver, R. (2003). Chatline interaction and negative feedback. *Australian Review of Applied Linguistics, 17,* 60-73.Pellettieri, J. (2000). Negotiation in cyberspace: The role of chatting in the development of grammatical competence. In M. Warschauer & R. Kern (Eds.), *Network-based Language Teaching: Concepts and Practice* (pp. 59-86). Cambridge, England: Cambridge University Press.

Iwashita, N. (2001). "The effect of learner proficiency on corrective feedback and modified output in nonnative-nonnative interaction". System 29, 2.267-287.

Kellogg, R. T. (1996). A model of working memory in writing. In C. M. Levy & S. E. Ransdell (Eds.). *The Science Of Writing: Theories, Methods, Individual differences and applications* (pp. 57-71). Mahwah, NJ: Lawrence Erlbaum Associates.

Kern, R. & Warschauer, M. (2000) Theory and practice of network-based language teaching. In: Warschauer, M. & Kern, R. (eds.) Network-based language teaching: Concepts and practice. New York: Cambridge University Press, 1-19

Keller-Lally, A. (2006). Effect of task-type and group size on foreign language learner output in synchronous computer-mediated communication. Unpublished doctoral dissertation. University of Texas, Austin.

Kern, R. G. (1995). Restructuring classroom interaction with network computers: Effects on quantity and characteristics of language production. *The Modern Language Journal, 79,* 457-476.

Kötter, M. (2003) Negotiation of Meaning and Codeswitching in Online Tandems. Language Learning and Technology, 7(2): 145–72

Krashen, S. (1985). *The input hypothesis*. London: Longman.

Long, M. (1983). Native speaker/nonnative speaker conversation in the second language classroom. In M. A. Clarke and J. Handscombe (Eds.), *On TOSEL '82* (pp. 207-225). Washington, DC: TESOL.

Long, M. H., & Porter, P. A. (1985). Group work, interlanguage talk, and second language acquisition. *TESOL Quarterly, 19*(2), 207-28.

Malvern, D. D., & Richards, B. J. (2002). Investigating accommodation in language proficiency interviews using a new measure of lexical diversity. *Language Testing*, *19*, 85–104.

Morgan-Short, K. & Bowden, H. W. (2006). Processing Instruction and Meaningful Output-Based Instruction: Effects on Second Language Development. *Studies in Second Language Acquisition, 28*(1), 31-65.

Pellettieri, J. (2000). Negotiation in cyberspace. The role of chatting in the development of grammatical competence. In M. Warschauer, & R. Kern (Eds.), Network-based language teaching: Concepts and practice (pp. 59-86). Cambridge, England: Cambridge University Press.

Pica, T., Lincoln-Porter, F., Paninos, T., and Linnell, J. (1996). Language learners' interaction: How does it address the input, output, feedback needs of second language learners? TESOL Quarterly 30, 1:59-84.

Pica, T., Holliday, L., Lewis, N., and Morgenthaler, L. (1989). Comprehensible output as an outcome of linguistic demands on learner. Studies in Second Language Acquisition, 11:63-90.

Pica, T. (1987). The impact of interaction on comprehension. *TESOL Quarterly 21*(4), 737-58.

Polio, C. (1997). Measures of linguistic accuracy in second language writing research. *Language Learning*, *47*, 101–143.

Porter, P. A. (1986). How learners talk to each other: Input and interaction in task-centered discussions. In R. R. Day (Ed.), *Talking to learn: Conversation in second language acquisition* (pp. 200-222). Cambridge, MA: Newbury House.

Robinson, P. (2001). Task complexity, task difficulty, and task production: Exploring interactions in a componential framework. *Applied Linguistics, 22*: 27-57.

Rulon, K. A., & McCreary, J. (1986). Negotiation of content: Teacher-fronted and small group interaction. In R. R. Day (Ed.), *Talking to learn: Conversation in second language acquisition* (pp. 182-189).

Cambridge, MA: Newbury House.

Scott, M. (2008). *Wordsmith tools version 5.0*. Oxford*:* Oxford University Press, Oxford, England.

Shintani, N. (2011). "A comparative study of the effects of input-based and production-based instruction on vocabulary acquisition by young EFL learners." Language Teaching Research 15(2): 137.

Smith, B. (2003). Computer-mediated negotiated interaction: An expanded model. *The Modern Language Journal*, *87*, 38-58.

Sotillo, S. M. (2000). Discourse functions and syntactic complexity in synchronous and asynchronous communication. *Language Learning & Technology*, *4*(1), 82-119.

Swain, M. (1985). Communicative competence: Some roles of comprehensible input in its development. In S.M. Gass, & C.G. Madden, (Eds.), *Input in second language acquisition* (pp. 235-53). Rowley, MA: Newbury House.

Tudini, V. (2003). Using native speakers in chat. Language Learning & Technology, 7, 3, 2003, pp. 141-159. http://llt.msu.edu/vol7num3/pdf/tudini.pdf - accessed May 29, 2009.

Varonis, E. M., & Gass, S. (1985). Non-native/non-native conversations: A model for negotiation of meaning. *Applied Linguistics*, *6* (1), 71-90.

Willis, J. (1996). *A framework for tasked-based learning.* London: Longman

Appendix: Error guidelines

1. Improper spellings of proper nouns were counted as errors (e.g. I want to go to new York city)
2. Spelling errors were not counted (e.g. The condition of thoes chairs is good)

3. Missing commas in restrictive clauses were counted (e.g. We must go to Orlando where we can visit the Walt Disney)
4. Inappropriately placed extra commas were counted (e.g. Hotel costs $72, per day)
5. Missing commas between clauses or after prepositional phrases were not counted (e.g. Because she likes to help with housework she needs to spent time with her mother in the kitchen)
6. Tense/reference errors were counted within the context of the preceding discourse (e.g. Why did not you make some omelet if you are hungry)
7. Overgeneralizations of –ed markers were counted (e.g. I did not remembered that I had a chocolate)
8. Plural –s to inappropriate contexts was counted (e.g. Have you visited Tori's houses)
9. Omissions of third person singular, -s marker, were counted (e.g. She enjoy playing with her car)
10. Article omissions were counted (e.g. I think it is not necessary us)
11. Syntax errors were counted (e.g. We do not need also the round table)
12. Morphology errors were counted (e.g. It is broken for a long time)

DEVELOPING AN ATTITUDE SCALE TOWARDS USING INSTRUCTIONAL TECHNOLOGIES FOR PRE-SERVICE TEACHERS

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ABSTRACT
The aim of this study is to develop an attitude scale towards using instructional technologies (USIT) for pre-service teachers. The research was carried out with 1235 pre-service teachers that 567(45.9%) were freshman; 401 (32.5%) were sophomore; 151 (12.2%) were junior and 116 (9.4%) were senior students at different universities in Turkey. The study consists of five parts including literature review, item pool, experts' opinions, administration of scale and computing the reliability and validity. While constituting the item pool, an interview was carried out with 15 pre-service teachers related to instructional technologies. Among from 55 items which are directly related with the subject of attitude or which are selected from the relevant interviews. 45 of them were edited by expert opinions the five point likert type. The draft scale was administered to 1235 pre-service teachers. As a result of factor analysis, the number of items was reduced to 37. After carring out factor analysis the Cronbach-Alpha internal integrity coefficient of the final version of the scale was found as 0.949. By computing the reliability of USIT, the scale was ready to be used.

INTRODUCTION
Education and technology are two key elements having an important role in human's life. The aim of the education is to help the people to know and find themselves (Başaran, 1994). Education is not preparation for life, it is the same of life (Varış, 1991). Technology helps individuals to take advantages of their knowledge and skills more effectively and efficiently. Technology is the discipline which consists of gathering machine, process, method, system, management, control system and bridges between science and applications (Alkan, 1998).

Nowadays technology has changed and developed quickly and by the way the place of technology in education system has expanded. Thus, using technology in education has become popular field and the field of science has been called '*Educational Technology'*. In literature there are a lot of definitions related to educational technology. Alkan (1998) has described educational technology as a whole system consisted of personnel, instruments and methods in order to apply educational technologies effectively and positively. Besides; educational technologies deals with how they can fulfil these. Teachers' roles are to create an effective, efficient atmosphere and a multimedia environment with the help of technologies. These environments are important for teacher-student interaction and communication. For this; teacher should use technological materials addressed both eyes and ears in learning and teaching process. Moreover; educational technology examines the reasons of students' failures, makes analysis and develops the precautions which can increase the success level and deal with the problems of education in rational and scientific way (Koşar et al. 2003).

Educational technology and instructional technology sometimes can be used one for another (Yalın, 2004). However; there are differences between educational technology and instructional technology. Educational technology is a process which makes systematic analysis of problems and develops suitable designs by the help of materials, technical, knowledge, manpower to find solutions for these problems. Instructional technology is related to technology, as teaching is sub branch of education and it consists of arranging the disciplines according to specific characteristic, for example; science teaching technology. In other words educational technology emphasizes the discipline of learning-teaching process, on the other hand; instructional technology expresses guidance activity for any subject during teaching (Alkan, 1998).

In present days, instructional manner mentality has changed from traditional teaching to modern teaching supported by the technological materials. In order to use technology in education it has become compulsory. The materials used in education can address most of the sense organs of students so that the subjects can be learned more meaningfully and efficiently. Furthermore; using technology during lessons excite students' attention and creates desire and exciting atmosphere. In order to use instructional technology in educational process effectively, some teaching aims should be known very well. These are defined by Sarıtaş (2007) as taking students' attention; arousing students' interest; developing students' attitude to the lesson on positive way; going away from teacher centered process and making the students active in the class; presenting the knowledge in various ways to students who have many different learning styles; learning easy by visualizing and concreting; individualizing education; spreading the education into larger groups. When these aims are taken into consideration, it can be achieved that each student can take advantages of educational process equally. As it is known, every individual has different interest and needs so each individual has typical learning styles. Using instructional technology during lesson, it can be managed to give close attention to individual differences and give opportunity to learn equally for each individual.

Instructional technologies not only make teachers' job easier but also impose a responsibility on them. That is because; new technology has always changed the instructional programme, learning-teaching process, the learning styles of the students so that teachers have to adapt to that change (Rose and Mayer, 2000). ISTE "International Society for Technology in Education" has developed standards for students, teachers and managers. ISTE (2004) states that according these standards; teachers' responsibility are to know the basic process and concepts; to plan designed environment supported by technology and apply; to use different assessment strategies supported by the technology; to follow the career development, technological changes and improve themselves; apply the social, ethnical, legal and humanistic principles related to the usage of instructional technology. As it is known; to educate the teachers about basic knowledge, skills, tendency about gaining abilities which gives them opportunity to benefit from technological devices more effectively. Therefore it is needed to have scale whose reliability and validity has been tested to observe or to measure the basic technological sufficiency of teachers (Flowers and Algozzine, 2000).

When the literature is examined, it was seen many researcher related to technology, educational technology and technological tolls.

Study of Akkoyunlu (1996) was dictated that there was a meaningful relationship between pre-service teachers' knowledge about technology and their attitude towards technology. The researcher also reveals that pre-service teachers equipped with more information about technologies have more positive attitude towards the use of technologies in teaching and learning environments. Akbaba (2001) aimed to determine the attitudes of the primary school children towards technology and computer experiences and their relationships. As a result of study, students expressed positive feelings toward technology and its applications, although the students were indecisive about the usage of technology. It was found no significant difference between the computer experiences and basic attitudes of the students towards technology. Another study was carried out by Akpınar et al. (2005). Aim of this study was to determined students' attitudes towards the use of technology in elementary education and to extent usage of technological materials in science courses. As a result, researchers have found significant differences between state and private schools and also between the school type and the students' attitudes towards the extent to the usage of technology in lessons. The aim of Yılmaz's (2005) study was to evaluate the effects of technology usage on students' achievement and attitudes in work. Researchers found that technological materials have positive impacts on students' achievement and attitudes. Besides, Demirel (2005) revealed that utilization of instructional technology in teaching-learning processes provides more effective presentation; moreover, it makes instruction more meaningful and enjoyable. Besides, teachers should acquire the quality of technology literacy to offer students rich learning environments integrated with new technologies. Then, teachers should learn how to integrate technology with learning environments. In addition to this, in Pala's study (2006) determined primary teachers' attitudes towards educational technologies. It has been found that the teachers' attitudes towards educational technology are positive. Furthermore there was no significant difference in teachers' attitudes towards educational technologies in respect to the different variables such as genders, ages, schools serviced and periods of service. Furthermore, Yavuz and Coskun (2008) investigated pre-services teachers' attitudes toward the utilization of technological tools. This study revealed that the technology-assisted project studies affected students' attitudes toward the utilization of technology in education positively. In addition to these researchers, Özgen and Obay (2008) investigated the attitudes of prospective teachers of secondary mathematics towards educational technology in respect to the some variables. According to the results, it was seen that the attitudes of prospective teachers towards educational technology didn't differ according to the gender variable, but it was found significant difference between class and their attitudes. In addition to this, it was determined that prospective secondary mathematics teachers had positive attitudes towards educational technology. Another study was carried out by Friedman et al, (2009). Friedman et al. (2009) investigated beliefs, practices, and the efficacy of social studies faculty members from the United States in terms of instructional technology usage. According to results, familiarity with the National Educational Technology Standards, as well as confidence with technology are related to the frequency and type of technology that social studies faculty members utilize in their courses. Besides, Can (2010) investigate that the attitudes of the pre-service teachers towards the effects of use of teaching materials; overhead projector and projector on learning. As a result of study, pre-service teachers believed that the use of overhead projector and projector brings some kind of change and variety to the teaching, saves teaching from being monotonous, and contribute to establishing lively, colourful and smooth setting for teaching and learning. Additionally, Beşoluk, Kurbanoglu and Onder (2010) were carried out a study related to usage of educational technology in the lesson. According to result of study, pre-service and in service teachers statistically differ with respect to current knowledge in the ways and in-service teachers with over 15 years experience have the lowest knowledge about using computers. In addition to many science teachers and pre-service science teachers realize the importance of technology usage and they desire to have more knowledge about educational technology.

In addition to these studies, many researchers were interested in developing reliable and comprehensive attitude scale towards the use of computers .Some of these scale are: The Attitudes Toward Computers (Raub, 1981), The Computer Use Questionnaire (Griswold, 1983), The Attitude Toward Computer Scale (Francis, 1993), The Computer Attitude Measure (Kay, 1993), The Computer Attitude Questionnaire (Knezek and Miyashita, 1993) and The Computer Attitudes Scale for Secondary Students (Jones and Clarke,1994). Furthermore, some attitude scale towards technology was developed by researchers: For example; Page et al (1979) developed a Likert-type scale of 40 items in order to evaluate the attitudes of students towards science and technology. This scale consisted of four subscales, namely, technology, technical education, its industrial position and attitude towards technology. Furthermore, Frantom et. al., (2002) developed a scale regarding children's attitudes towards technology. The scale was administered with 574 students. The attitude scale consisted two-factor scale including interests/aptitudes and alternative preferences. Besides, Öksüz et al (2009) have developed a measuring tool with 73 items in their study called "A perception scale for technology use in the teaching of elementary mathematics". After analyse of scale; it was determined that this scale can be used in education as it is valid and reliable.

When the literature is investigated, it is seen that there are studies to determine the attitude of technology, computer, but the studies related to the attitude of instructional technology are limited. However; the in-service and pre-service teachers' attitudes about instructional technology are directly related to usage of technology. Thanks to an effective scale prepared for investigating the instructional technology, pre-service teachers' attitudes can be identified and the teachers' negative attitudes and the reasons of their attitudes can be found and with different activities the negative attitudes can be resolved.

From this point of view; the aim of this study is to develop a scale regarding using instructional technology.

METHODOLOGY

In this study, an instrument was developed to define pre-service teachers' attitude towards using instructional technology. This instrumental development study was realized in the spring semester of 2009 academic years with the participation of 1235 pre-service teachers selected from different university in Turkey.

Sample

The sample of study consists of 1235 undergraduate that are chosen from seven universities' Faculty of Education in Turkey. Demographic information of the sample was given in Table 1.

Table 1: Demographic information of the sample

		Frequencies (f)	Percentage (%)
Gender	Male	517	41,9
	Female	718	58,1
Grade	Freshman	567	45,9
	Sophomore	401	32,5
	Junior	151	12,2
	Senior	116	9,4
Department	Primary Teacher Education	617	50,0
	Science Teacher Education	228	18,5
	Mathematics Teacher Education	188	15,2
	Social science Teacher Education	202	16,4

Sample of research consists of 517 (41.9%) male, 718 (58.1%) female pre-service teachers. It was determined that 567(45.9%) of them were freshman; 401 (32.5%) of them were sophomore; 151 (12.2%) of them were junior and 116 (9.4%) of them were senior students. Besides, it was seen that 617 of pre-service teachers were in Primary Teacher Education, 228 of them were in Science Teacher Education, 188 of them were in Mathematics Teacher Education and 202 of them were in Social science Teacher Education department.

Development Process of Attitude Scale towards Using Instructional Technology

Using instructional technology attitude scale is a five point likert scale used to collections of data from pre-service teachers. It was followed five stages in the development of the scales.

In the first stage: so many attitude scales towards using instructional technology were examined in order to determine the statements of instructional technology attitude scale and how to develop an attitude scale (Page et al 1979; Knezek and Miyashita, 1993; Francis, 1993; Frantom et al, 2002; Öksüz et al, 2009; Flowers and Algozzine, 2000; Rose and Mayer, 2000; Selwyn, 1997; Akkoyunlu et al, 2005; Çakıroğlu et al, 2008; Beşoluk et al, 2010; Can, 2010; Pala, 2006; Yavuz and Coskun, 2008; Yılmaz, 2005; Metin, 2010; Metin and Özmen, 2008). It was also carried out semi-structured with 15 pre-service teachers to determine their perceptions on the instructional technology. Interviews were held in a place where the pre-service teachers felt themselves comfortable and explained anything without hesitation. Each interview was recorded and finished within 20 minutes at a single session. In order to define perceptions of the pre-service teachers, they were asked, extra questions such as *"why", "how", "what do you mean exactly and explain"*: the four main questions were as a follow: *1) Do you think that instructional technologies have any positive effect? Please explain. 2) Do you think that instructional technologies have any negative effect? Please explain. 3) Do you think about using instructional technologies in the lessons? Please explain 4) Do you have enough knowledge about usage of instructional technologies in the lesson? Please explain.* After interview was analyzed, it was consisted items of attitude.

In the second stage: After interview and reviewing, item pool consisting of 55 statements about using instructional technology was developed. There are 28 positive and 27 negative statements in item pool of draft attitude scale. These statements were placed together which seemed to reflect an underlying theme, a process which resulted in three sets each comprising 55 items, preliminary indicators of possible scales. After deciding an initial item pool was generated 55 items on a five point rating scale such as "*strongly disagree*", "*disagree*", "*undecided*", "*agree*" and "*strongly agree*".

In the third stage: for the purpose of content validation, initial draft of the attitude scale with 55 items on a five point rating scale was given to a group of five experts in instructional technology, educational psychology, and educational measurement for taking their opinions about whether the selected items were valid items for assessing pre-service teacher' attitudes toward using instructional technology. The experts were asked to examine items with regard to their relevance purpose of the attitude, content coverage, understandability and consistency among one another. Having received feedback from experts, ten items were deleted because they are not suitable for unclear item and students' level. As a conclusion, attitude scale towards instructional technology consists of 26 positive and 19 negative items on five point rating scale.

In the fourth stage: Final draft of the attitude scale with 45 items was administered to 1235 pre-service teachers for calculating validity (particularly construct validity) and reliability of the attitude scale. Pre-service teachers' responses were entered an excel file created for further analyses.

In the last stage: The data collected from 1235 pre-service teachers were analyzed by means of factor analysis and reliability analysis through the use of SPSS 11.5. Firstly, for the validity of the USIT, it was calculated means and standard divisions of upper 27% (333 pre-service teachers) and lower 27% (333 pre-service teachers) points and t-tests between items' means of upper 27% and lower 27% points. In addition to the data were subjected to factor analysis with principle component method in order to examine the factor structure behind the attitude scale. The principal components factor analysis was followed by varimax rotation (rotated component matrix). I thought that the variance explained by one factor that would be independent of the variance in the other factors. Secondly, reliability analysis was performed for each of the emerged sub-scales and Croanbach alpha correlation coefficients were used. Then, Croanbach alpha correlation coefficients were calculated among these factors.

Findings

After attitude scale towards using instructional technology was administered to pre-service teachers, the suitability of the current data for factor analysis was checked through several criteria. First, 1235 participants were found to be sufficient for factor analysis according to several resources (Field, 2000**;** Pallant, 2001; Tabachnick and Fidell, 2007). Second, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Barlett's test was checked. The Kaiser–Meyer Olkin (KMO) measure of sampling adequacy (KMO) and Barlett's test were calculated to evaluate whether the sample was large enough to apply a satisfactory factor analysis and examine to determine appropriateness of factor analysis (Büyüköztürk 2003). The KMO value varies between 0 and 1. A value close to 1 indicates that patterns of correlations are compact, and factor analysis will yield reliable factors (Akbulut et al, 2010; Kline, 1994). KMO values of .60 or above are acceptable (Pallant, 2001; Kline, 1994; Tabachnick and Fidell 2007; Hair, et al., 1998, George and Mallery 2001). The KMO value of the initial analysis was .965, which is considered perfect by Hutcheson and Sofroniou (1999). The Bartlett's Test of Sphericity reached a significant value supporting the factorability of the correlation matrix obtained from the items [Approx. Chi-Square: 20260.196 ($p< 0.01$)]. According to results Barlett's test of Spherincity statistic was significant. Results of KMO and Barlett's test appear to support the validity of the factor analysis usage for this study. Third; it was carried out item analysis of the scale. It was calculated means and standard divisions of upper 27% and lower 27% points and P value and t-tests between items' means of upper 27% and lower 27% points in item analysis of the scale for validity of the USIT items. It was determinate unsuitable items in the scale.

After these applications, item analysis and exploratory factor analysis was conducted to data gathered from the attitude scale.

Item Analysis of the Scale

Before the exploratory factor analysis, means and standard divisions of upper 27% and lower 27% points and P value and t-tests between items' means of upper 27% and lower 27% points in item analysis of the scale were calculated in order to validity of the USIT items. Table 2 presents means, standard divisions, P value and t-tests between items' means of upper 27% and lower 27% points in item analysis of the scale

As seen in table 2, the t-test results showed significant differences between each item's means of upper 27% and lower 27% points except from items 4, 8, 19, 24 and 34. According to this result, 40 items of USIT is appropriate to measure undergraduates' attitude regarding instructional technologies.

Table 2. Means standard divisions, P value and t-tests means of upper and lower points

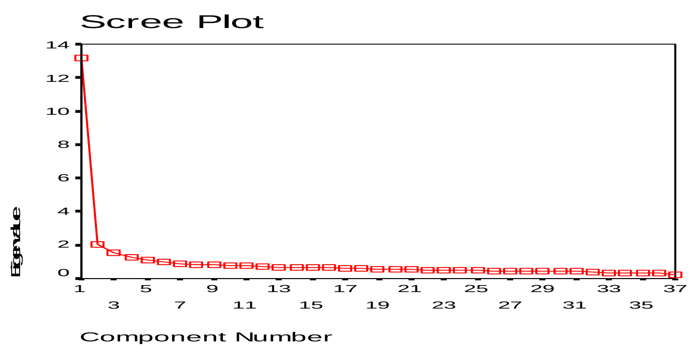
Item	Upper		Lower				Item	Upper		Lower			
No	$\bar{x}$	SD	$\bar{x}$	SD	t	p	No	$\bar{x}$	SD	$\bar{x}$	SD	t	p
1	4,67	,601	2,79	1,428	22,10	,000	**24**	3,17	1,35	2,90	1,295	2,55	**,281**
2	4,52	,624	2,77	1,290	22,27	,000	**25**	4,49	,722	2,73	1,267	22,01	,000
3	4,47	,687	2,85	1,201	21,38	,000	**26**	4,28	,735	2,63	1,210	21,33	,000
4	3,41	1,21	2,36	1,162	11,47	**,977**	**27**	4,78	,496	2,74	1,327	26,30	,000
5	4,43	,707	2,86	1,231	20,16	,000	**28**	4,23	1,16	2,79	1,300	15,03	,000
6	4,43	,723	2,70	1,198	22,60	,000	**29**	4,54	,632	2,89	1,294	20,93	,000
7	4,66	,647	2,74	1,296	24,10	,000	**30**	4,32	,725	2,69	1,251	20,62	,000
8	2,73	1,32	2,71	1,309	,236	**,939**	**31**	4,64	,674	2,84	1,305	22,39	,000
9	4,47	,887	2,83	1,263	19,46	,000	**32**	4,69	,660	2,84	1,336	22,69	,000
10	4,53	,647	2,80	1,229	22,77	,000	**33**	4,45	,682	2,84	1,287	20,09	,000
11	4,17	1,19	2,81	1,277	14,20	,000	**34**	3,82	1,27	2,82	1,328	9,93	**,104**
12	4,01	1,04	2,80	1,250	13,51	,000	**35**	4,67	,680	2,69	1,221	25,80	,000
13	4,41	,618	2,77	1,287	20,92	,000	**36**	4,59	,734	2,75	1,271	22,81	,000
14	4,39	,665	2,76	1,241	21,13	,000	**37**	4,55	,800	2,67	1,244	23,16	,000
15	4,59	,587	2,94	1,359	20,36	,000	**38**	3,54	1,44	3,00	1,340	4,99	,002
16	4,34	,861	2,72	1,224	19,73	,000	**39**	4,71	,608	2,77	1,322	24,28	,000
17	4,51	,739	2,68	1,228	23,37	,000	**40**	3,85	1,15	2,70	1,217	12,50	,003
18	4,25	,721	2,83	1,252	17,94	,000	**41**	3,84	,950	2,71	1,267	13,08	,000
19	3,56	1,23	2,67	1,246	9,233	**,802**	**42**	4,04	1,13	2,77	1,239	13,83	,000
20	4,69	,595	2,99	1,345	21,05	,000	**43**	4,44	,944	2,64	1,253	20,99	,000
21	4,52	,739	2,76	1,213	22,61	,000	**44**	4,72	,623	3,13	1,445	18,45	,000
22	4,17	,767	2,63	1,224	19,46	,000	**45**	4,75	,635	3,35	1,399	16,66	,000
23	4,26	,980	2,72	1,228	17,90	,000							

$\bar{x}$: Means, SD: Standard divisions, $P<0.01$

Exploratory Factor Analysis of the Scale

Exploratory factor analysis allows researchers to determine if many variables can be described by few factors; it reduces attribute space from a larger number of variables to a smaller number of factors (Fraenkel & Wallen, 1996). The aim of exploratory factor analysis is to find the number of separate components that may exist for a group of items (Kline, 1994; Büyük Öztürk 2003). In this study, the purpose of the exploratory factor analysis was to investigate the factors underlying the USIT. The data obtained from the analysis of this study was begun by examining the dimensions of data obtained from the analysis. So, the exploratory factor analysis was administered the 40 items. The Principle components factor analysis was used for all the data in order to extract the appropriate number of factors. The initial solution revealed that six factors had an eigenvalue greater than 1.These factors altogether explained 51.2% of variance of results. Overall, five of six factors were represented just by one item per each factor with loading higher than 0.4. Thus remaining one factor was considered not interpretable. Three items were deleted because their factor loadings were lower than 0.4 (Kline, 1994; Büyük Öztürk 2003). Three out of 40 attitude items were deleted and the factor analysis for rotation was run again over the data set with 37 items. Then, Varimax rotation was used. After using varimax rotation, the factor loadings for each item were examined. Loadings of less than 0.40, a commonly-used cut-off, were eliminated. Thus, the factor analysis resulted in five independent factors with factor loadings greater than 0.4.

However, Kline (1994) highlighted that this method of determining the number of factors can overestimate the number of factors. There are various criteria for determining how many factors to attain (Dunteman, 1989). They are: Eigenvalues statistics, Scree test, total variance percentage method, Joliffe criteria, explained variance criteria, and determining the number of factors by the researchers. It was used an alternative approach to determine the appropriate number of factors is to examine the scree plot produced by the analysis in study. It was seen scree plot to determine number of factors (Kline, 1994).



Scree plot shows that five factors were in sharp descent and then started to be level off. This was evidence that rotation was necessary for 5 factors. Each two methods of determining the number of factors was revealed that attitude scale towards using instructional technology consists of five factors. Table 3 present Eigenvalues, variances and total variances of the five factors

Table 3: Eigenvalues, variances and total variances of the five factors

Factors	Eigenvalues	Percentages of variances	Percentages of total variances
Factor 1	5,054	13,660	13,660
Factor 2	4,284	11,579	25,239
Factor 3	4,066	10,988	36,227
Factor 4	3,701	10,002	46,229
Factor 5	2,046	5,531	51,759

As seen in table 3, there are five factors in attitude scale. Eigenvalues of the factors are 5.054, 4.284, 4.066, 3.701 and 2.046. Factor 1 explained 13.660 % of total variance, factor 2 explained 11.579 % of total variance, factor 3 explained 10.998 % of total variance, factor 4 explained 10.002 % of total variance and factor 5 explained 5.531 % of total variance. These five factors explained 51.759% of total variance and were named according to the common characteristics of the items loaded on the same factor. This value is appropriate for considering other works focused on attitudes showed lower explained variance (Spinner and Fraser 2005**:** 42%, Kline 1994: 41%). According to results of item loading and Eigenvalues of the factors, it is said that this attitude scale is appropriated to assess attitude scale towards using instructional technology.

After it was determined the factor numbers of USIT, it was seen distribution of 37 items to five factors. Table 4 presents factor loadings and factor structures of the items.

Table 4: Factor Structures and Loadings of the 37 Items in USIT

Number of Items		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
2	I enjoy using the instructional technologies in lesson	,727				
1	Usage of the instructional technologies increases clarity of lessons	,700				
5	I learn better the lesson when instructional technologies use	,662				
6	I feel motivated the lesson used instructional technologies	,638				
10	I am pleased with the lesson used instructional technologies	,597				
3	I am bored when instructional technologies are used in lessons	,579				
14	I can listen carefully to the lesson used instructional technologies	,536				
13	I learn swiftly topics when instructional technologies are used	,528				
7	I am not interested to use instructional technologies in the lesson	,517				
9	I learn difficultly the lesson used instructional technologies	,469				
22	I enjoy being in the environments talking about instructional technologies		,649			
41	I delighted in reading the books explaining the instructional technologies		,626			
30	I feel myself more comfortable in the lessons used instructional technologies		,605			
18	I become active in the lessons used instructional technologies		,561			
26	I make effort to learn new instructional technologies		,542			
33	I remember the knowledge easily through lesson used instructional technologies		,542			
36	Usage of the instructional technologies in lessons increases learning		,528			
29	The knowledge learnt during the lessons by using instructional technologies are more permanent		,495			
25	My creativity increase in lessons used instructional technologies		,464			
42	Teachers are passive when instructional technologies were used in lessons			,680		
37	Students' achievement are not affected from usage of instructional technologies in lessons			,622		
39	Usage of the instructional technologies is unnecessary			,600		
27	It is a waste of time to use instructional technologies in lessons			,580		
31	I avoid using the instructional technologies in my classes			,546		
43	I dislike the topics that are told with the instructional technologies			,512		
16	I dislike talking about improving instructional technologies			,491		
21	I lose my concentration in the lesson used instructional technologies			,426		
23	I do not want to learn new improvements in instructional technologies			,409		
28	I do not know how to use computers in my lessons				,628	
32	I do not want to use computers and the internet in my classes.				,589	
35	I do not want to participate in lessons teaches by instructional technologies				,554	
20	I can make a search about anything in my lesson on the internet				,546	
15	I can benefit from the opportunities of computers in my lessons				,511	
11	I am stressed in the lesson used instructional technologies				,428	
17	I learn slowly in the lesson used instructional technologies				.402	
44	It is beneficial for me to learn the usage of the instructional technologies					,681
45	Usages of the instructional technologies are made more prevalent in education					,677

As seen in table 4, factor loading of items in the scale changes between 0.402 and 0.727. Kline (1994) said that the value of factors load between 0.30 and 0.60 is medium and between 0.6 and 1.0 is high quality. This situation indicated that 37 of item are enough qualified in the scale.

It is seen the distribution of 37 items to five factors, factor 1 includes ten items: 1, 2, 3, 5, 6, 7, 9, 10, 13 and 14. These items explicitly measures pre-service teachers' attitude towards belief regarding the usage of instructional technology in lesson. Therefore; this factor was named as ''belief regarding usage of instructional technology in lesson (BRUIT)". Factor 2 includes nine items: 18, 22, 25, 26, 29, 30, 33, 36 and 41. These items explicitly measure pre-service teachers' attitude towards appreciation to the usage of instructional technology in lesson. This factor was named as "Appreciation to usage of instructional technology in lesson (ASIT)". Factor 3 includes nine items: 16, 21, 23, 27, 31, 37, 39, 42 and 43. These items explicitly measure pre-service teachers' attitude towards unappreciated to instructional technology. This factor was therefore named as "Unappreciated using instructional technology (UPIT)". Factor 4 includes seven items: 11, 15, 17, 20, 28, 32 and 35. These items explicitly measure pre-service teachers' attitude towards disinclination to make use of instructional technology. This factor was therefore named as "Disinclination to make use of instructional technology (DMIT)". Factor 5 includes two items: 44 and 45. These items explicitly measure pre-service teachers' attitude towards belief in usefulness of instructional technology. This factor was therefore named as "Belief in usefulness of instructional technology (BUIT)".

Reliability of the attitude scale

Reliability analysis was performed for each factor and croanbach alpha correlation coefficients were used. Then, croanbach alpha correlation coefficients were calculated among these factors. Table 5 summarizes factor names, number of the items and reliability of each factor.

Table 5 Factor names, number of the items and croanbach alpha value of each factor

Factors name	Number of items	Coefficient items Cronbach Alpha
Believe regarding usage of instructional technology in lesson (BRUIT)	10	0.892
Appreciation to usage of instructional technology in lesson (ASIT)	9	0.849
Unappreciated using instructional technology (UPIT)	9	0.847
Disinclination to make use of instructional technology (DMIT)	7	0.791
Believe in usefulness of instructional technology (BUIT)	2	0.758
Total Scale	37	0.949

As seen in table 5, it was determined that croanbach alpha value of BRUIT is 0.892, ASIT is 0.849, UPIT is 0.847, DMIT is 0.791 and BUIT is 0.758. Also, it was found that croanbach alpha value of total scale (USIT) is 0.949. According to these results, it can be said that attitude scale regarding using instructional technology is a valuable and reliable scale.

DISCUSSIONS AND CONCLUSIONS

Rapid changes in technology have affected teaching-learning process. Also technology is the main support for the students learning developments nowadays. The aim of improving educational quality need to extent using technology aids this learning process. It is known that traditional approach not use to technology in the lessons is not always successful and efficient (Milliken and Barnes, 2002). With shifting from the teacher-centered instruction to child-centered instruction, the role, activities, attitudes, reflections of the students become more important concern to overlook the effectiveness of technology in instruction. Recent studies in the area indicate that effective use of education technology can help education system work better and more effectively (Jonassen and Reeves, 1996). Furthermore, Halderman (1992) expressed that majority of teachers demand using technology better in order to use of technology in the classes gives students the chance of learning faster and more permanent. Besides Tsou, Wang and Li (2002) dictated that instructional technology have positive effect of technology for realizing effective learning. So, teachers should know how to plan, design environment supported by technology and apply; how to use different strategies supported by the technology and how to follow the technological changes and improve them. Furthermore because of the fact that pre-service teachers will be in-service teachers in future, their' knowledge on using technology are very important. Therefore it is needed to have scale has been tested to pre-service teachers' attitude regarding using instructional technological. In the literature, there are so many attitude scales towards computer, technology, educational technology. But there are not enough attitude scales towards using instructional technology.

In this study, the using instructional technology scale was developed through the use of five stage model proposed. Subsequent to a review of literature and carried out interview with pre-service teachers, composed item pool, validated the item pool across the experts and then initial draft of the instrument was constructed. Later, this initial draft was reviewed by the experts, USIT was administered to 1235 pre-service teachers in different University to the factorial structure of the scale, provide validity and further reliability evidences. Lastly validity and reliability of the attitude scale were calculated. These factors such as believe regarding usage of instructional technology in lesson (10 items), appreciation to usage of instructional technology in lesson (9 items) unappreciated using instructional technology (9 items), disinclination to make use of instructional technology (7 items), and believe in usefulness of instructional technology (2 items),

Factor analysis with principle component methods and item analysis result revealed seven factors behind USIT which explain 51.759% of the total variance together and USIT are appropriate to measure pre-service teachers' attitudes towards using instructional technology. In addition to croanbach alpha correlation, coefficients of five factors were calculated using Cronbach's alpha reliability of the factors and ranged from 0.758 to 0.92, indicating acceptable reliability range (Kline 1994, Fraser 1989). The overall scale reliability was calculated as 0.949.

According to the results, it must be emphasized that the USIT, which allows researchers to study pre-service teachers' attitudes' towards using instructional technology, was developed. Many of the research conducted in the literature are limited to participants from a single university, but there are seven universities in Turkey. So, participation from different universities was provided to eliminate errors related to scale. So, the attitudes scale comprehensive for pre-service teachers. The attitude scale that was developed in this study will fill the gap in the literature related to determining attitudes towards using instructional technologies. Followed by the additional validation studies; the USIT will serve as a valuable tool for both instructors and researchers to assess students' attitudes towards using instructional technology.

REFERENCES

Akbaba Altun, S., (2001) *Elementary School Principals' Attitudes towards Technology and Their Computer Experiments,* The World Congress on Computational Intelligence (WCCI) Triennial World Conference,10th, Madrid, Spain, September 10-15, 2001, 16p.

Akkoyunlu, B. (1996) Öğrencilerin bilgisayara karşı tutumları. *Eğitim ve Bilim*. 20(1), 15-29

Akkoyunlu, B., Orhan, F. &Umay, A. (2005) A Study on Developing Teacher Self Efficacy Scale For Computer Teachers, *H.U. Journal of Education,*29: 1-8.

Akpınar, E., Aktamış, H. & Ergin, Ö. (2005) Fen Bilgisi Dersinde Eğitim Teknolojisi Kullanılmasına İlişkin Öğrenci Görüşleri, *The Turkish Online Journal of Educational Technology – TOJET, 4, 1, Article 12*

Alkan, C. (1998). *Eğitim Teknolojisi (Genişletilmiş Beşinci Baskı):* Anı Yayıncılık, Ankara.

Akbulut, Y., Sahin, Y.L., & Eristi, B. (2010) Development of a scale to investigate cybervictimization among online social utility members. *Contemporary Educational Technology,* 1 (1), 46-59.

Başaran, İ. E. (1994) *Eğitime Giriş.* Kadıoğlu Matbaası, Ankara.

Beşoluk, Ş., Kurbanoğlu, N. İ. & Önder, İ. (2010) Educational technology usage of pre-service and in-service science and technology teachers, *Elementary Education Online*, 9(1), 389–395

Büyüköztürk, Ş. (2003*) Sosyal bilimler için veri analizi el kitabı: İstatistik, araştırma deseni, SPSS uygulamları ve yorum* (Geliştirilmiş 3.Baskı)*.* Ankara: Pegema Yayınları.

Can, S. (2010). Attitudes of pre-service teachers from the department of elementary education towards the effects of materials use on learning, *The Turkish Online Journal of Educational Technology (TOJET)*, 9(2), 46-54.

Çakıroğlu, Ü., Güven, B. & Akkan, Y. (2008). Examining Mathematics Teachers' Beliefs About Using Computers in Mathematics Teaching, *Hacettepe University Journal of Education*, 35: 38-52.

Demirel, Ö. (2005). *Planlamadan Değerlendirmeye Öğretme Sanatı*. Pegem A Yayıncılık., Ankara.

Dunteman, G. H. (1989). *Principal component analysis, Quantitative applications in the social sciences series* (vol. 69). housand Oaks, CA: Sage.

Field, A. (2000). *Discovering statistics using SPSS for windows*, London: Sage Publications.

Flowers, C. P. & Algozzine, R. F. (2000) Development and Validation of Scores on the Basic Technology Competencies for Educators Inventory, *Educational and Psychological Measurement*, 60(3), 411-418.

Fraenkel J. R. & Wallen NE (1996) *How to Design and Evaluate Research in Education*, New York: McGraw-Hill.

Francis, J. (1993) Measuring attitude toward computers among undergraduate college students: The affective domain. *Computers and Education,* 20(3), 251-55

Frantom, C. G., Green, K. E. & Hoffman, E. R. (2002) Measure Development: The Children's Attitudes Toward Technology Scale (CATS). *Journal of Educational Computing Research*, *26*, 3, 249-263.

Fraser B. J. (1989). *Assessing and improving classroom environment*, Curtin University, Perth

Friedman, A., Bolick, C., Berson, M. & Porfeli, E. (2009) National educational technology standards and technology beliefs and practice of social studies faculty: Results from a seven year longitudinal study, *Contemporary Issues inTechnology and Teacher Education*, 9(4), 476-487.
George D. & Mallery, P (2001) *SPSS for Windows: Step by Step.* Allyn & Bacon, USA.
Griswold, P. A. (1983). Some determinants of computer awareness among education majors, *Association for Educational Data Systems Journal*, 16(2), 92-103
Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W.C., (1998) *Multivariate data analysis* (5th edition), New Jersey, Prentice Hall.
Halderman, C. F. (1992) *Design and evaluation of staff development program for technology in schools*. Dissertation Abstracts International, 53(12A), 4186
Hutcheson, G., & Sofroniou, N. (1999) *The multivariate social scientist*. London: Sage.
ISTE (2004) The National Educational Technology Standards. *http://cnets.iste.org/teachers/t_stands.html*
Jonassen, D., & Reeves, T. (1996) *Learning with technology: Using computers as cognitive tools*, In D. H. Jonassen (Ed.), Handbook of research on educational communications and technology (pp. 693-719), New York: Macmillan.
Jones, T., & Clarke, V. A. (1994) A computer attitude scale for secondary students. *Computers Education*, 22(4), 315–318
Kay, R. H. (1993). An exploration of theoretical and practical foundations for assessing attitudes toward computers: The computer attitude measure (CAM). *Computers in Human Behavior*, 9, 371-386.
Kline, P. (1994) *An Easy Guide to Factor Analysis*, London: Routledge
Knezek, G., & Miyashita, K. (1993) *Handbook for the Young Children's Computer Inventory,* Denton, TX: Texas Center for Educational Technology.
Koşar, E., Yüksel S., Özkılıç, R., Avcı, U., Alyaz, Y. & Çiğdem, H. (2003) *Öğretim teknolojileri ve materyal geliştirme*, (2. Baskı), Ankara: Pegem A Yayınları
Metin, M. (2010) A Study on Developing a General Attitude Scale about Environmental Issue for Students in Different Grade Level, *Asia-Pacific Forum on Science Learning and Teaching*, 11, (2), 3
Metin, M. & Özmen, H. (2008) *Performans Değerlendirmeye Yönelik Tutum Ölçeği Geliştirilmesi,* VIII. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, Abant İzzet Baysal Üniversitesinde, Bolu
Milleken, J., & Barnes, L. P. (2002) Teaching and technology in higher education: student perceptions and personal reflections, *Computers & Education,* 39 (3), 223-235
Öksüz, C., Ak, Ş. & Uça, S. (2009). A Perceptions Scale for Technology Use in the Teaching of Elementary Mathematics, *Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, VI,(1), 270-287.
Ozgen K. & Obay,M.(2008). *Ortaöğretim Matematik Öğretmen Adaylarının Eğitim Teknolojisine İlişkin Tutumlar,* IETC 2008, Anadolu University Faculty of Education Department of Computer Education & Instructional Technologies Eskişehir.
Page, R. L. and oth. (1979) Attitude Assessment in Science and Technology, *CORE,* vol. 3, no. 3, p9.
Pala, A. (2006). İlköğretim Birinci Kademe Öğretmenlerin Eğitim Teknolojilerine Yönelik Tutumları, *Sosyal Bilimler Dergisi,* Sayı: 16, 177-188.
Pallant, J. (2001). *SPSS survival manual*, Maidenhead, PA: Open University Press.
Raub, A. C. (1981). Correlates of computer anxiety in college students, unpublished doctoral dissertation, University of Pennsylvania, Philadelphia
Rose, D. & Meyer, A. (2000) The Future is in the Margins: The Role of Technology and Disability in Educational Reform
http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/16/ee/6d.pdf
Sarıtaş, M. (2007), Öğretim Teknolojileri ve Materyal Tasarımı, Pegem-A Yayıncılık, Ankara
Selwyn, N. (1997). Students' Attitudes toward Computers: Validation of a Computer Attitude Scale for 16-19 Education. *Computers Education,* 28, (1), 35-41
Spinner H, & Fraser B. J, (2005) Evaluation of an innovative mathematics program in terms of classroom environment, student attitudes, and conceptual development, *International Journal of Science and Mathematics Education, 3*, 267–293
Tabachnick, B., & Fidell, L. (2007) *Using multivariate statistics,* Boston: Allyn & Bacon.
Tsou, W., Wang, W., & Li, H. L. (2002) How computers facilitate English foreign language learners acquire English abstract words. *Computers & Education,* 39 (4), 415-428.
Varış, F. (1991).*Eğitim Bilimine Giriş*. Ankara: Ankara Üniversitesi
Yalın, H. İ. (2004). *Öğretim Teknolojileri ve Materyal Geliştirme*, Nobel Yayın Dağıtım, Ankara.
Yavuz, S. & Coskun A. E. (2008). Sınıf öğretmenliği öğrencilerinin eğitimde teknoloji kullanımına ilişkin tutum ve düşünceleri, *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 34, 276-286.
Yılmaz, M. (2005). *İlköğretim 7. sınıflarda simetri konusunun öğretiminde eğitim teknolojilerinin başarı ve tutuma etkisi*. Marmara Üniversitesi Eğitim Bilimleri Enstitüsü, Yayımlanmamış Yüksek Lisans Tezi,İstanbul.

DEVELOPMENT AND EVALUATION OF SENIOR HIGH SCHOOL COURSES ON EMERGING TECHNOLOGY: A CASE STUDY OF A COURSE ON VIRTUAL REALITY

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ABSTRACT
In Taiwan, the National Science Council has implemented the High Scope Program (HSP) since 2006. The purpose of this study was to analyze the development and effectiveness of senior high school HSP courses on emerging technology. This study used a course on virtual reality as an example, to investigate the influence of emerging technology courses on senior high school students' attitude toward technology. Research results showed that among students in the experimental group, the following constructs: cognition of the importance of technology, performance of technology-related action, and technology career planning, had been significantly enhanced. This study then developed the "Virtual Reality Course Performance Assessment Scale", and performed cross-evaluation of course teacher and non-course teachers to confirm this scale presenting great content validity, internal consistency validity, and scorer reliability. This scale can provide students and teachers with objective assessment indicators, which can be used to understand the learning effectiveness of students. Lastly, this study discussed the results of this research and external evaluation, as well as provided suggestions for future implementation and modification of the virtual reality course.
Keywords: emerging technology, virtual reality, attitude toward technology, cognition of the importance of technology, interest in learning about technology, performance of technology-related action, technology career planning

INTRODUCTION
Emerging technologies are radical innovations based on developing technologies. Because knowledge in related technological domains is still in continual development, emerging technologies still present high uncertainty in technological innovation, product development, customer demand, market scale, and innovative benefits. However, emerging technologies offer significant market opportunities, and may in the future become a completely new industry. Emerging technologies are also poised to greatly impact existing industries and markets, and therefore have received a great deal of emphasis from governments, research institutions, corporations, and investors (Liu, 2004). Technologies such as gene therapy, high-temperature superconducting materials, micro-robots, luminescent material, nano-material, and green technology are all emerging technologies that will significantly influence humanity and society in the future.

In Taiwan, in order to train up a skilled workforce for future development of emerging technology and scientific research, the Department of Science Education (National Science Council, Executive Yuan) referred to the Japanese "Super Science High School (SSH) Project" and implemented the "Experimental Program for the Development of Science and Technology Courses in Senior and Vocational High Schools" (High Scope Program, HSP) in 2006. The purpose of the plan was to assist senior and vocational high schools in developing science and technology courses in prospective domains and enhance the quality of science and technology education in senior and vocational high schools. Through this project, the government of Taiwan intended to implement the provisional course outlines in 2010 senior and vocational high schools, emphasize the establishment of partner relationships between universities and senior/vocational high schools, and allow senior/vocational high schools to develop innovative science and technology courses. The purpose of these courses was to enhance the quality of senior/vocational high schools nationwide, provide students with a real learning environment, and nurture students' scientific research capacity - such as ability to take initiative to explore the development process of dynamic emerging technology and the influence of technology on humanity (National Science Council High Scope Program, 2007).

The senior high school used in this research (known hereafter as High School A) was a comprehensive high school with considerable flexibility in its curriculum. The most prominent feature of the school was its provision of diversified courses for students to engage in adaptive learning. In 2001, High School A became the affiliated high school of a national university (known hereafter as University C) and received the full support of this university in hardware and software facilities. In 2007, the two schools cooperated to propose the "The Endless Sky: Research on Application of Wireless Hypermedia to Comprehensive High School Curriculum", which received funding from the High-Scope Program of the National Science Council. This allowed the development of emerging technology courses on topics such as wireless Internet technology, virtual reality, and digital astronomy. Through course design, these institutions hoped to boost students' passion in learning about and exploring emerging technologies, guide students in developing correct attitudes toward technology, and link such courses with university curriculum to enhance students' career exploration and reduce their adjustment period upon entry into university.

To assist in solving the problems encountered during the development of these new courses and evaluate the effectiveness of the courses upon implementation, curriculum experts from University C used the CIPP assessment model to conduct external evaluation. The purposes were to assist High School A in building development and instruction models for courses on emerging technology and provide reference for internal or external development of related technological courses. Apart from developing courses, researcher also combined self-evaluation mechanisms and external evaluation to fulfill the above-described predetermined objectives. The researcher in this study was the course developers and used the virtual reality course they developed as an example of course development, as well as utilized teaching experiments to analyze the course and its effectiveness. The purpose of this study was not only to develop a 3D virtual reality course suitable for helping high school students to develop basic technological implementation techniques. Researcher also aimed to use quasi-experimental design to rule out pre-test effects and examine the influence of the course on the various constructs (cognition of the importance of technology, interest in learning about technology, performance of technology-related action, and technology career planning) of high school students' attitude toward technology. In the next stage of planning, researcher intend to incorporate instruction in other academic subjects, to stimulate learners' ability for creative development and facilitate greater competitive capacity in meeting the challenges of the future.

Additionally, in the external evaluation results of course development for the second year, Huang, Lin, Wang, and Hou. (2009) pointed out that without an objective rating standard in assessment of learning effectiveness, the quality of an educational product or course is very difficult to determine. Instructors may say that "Intuition will indicate quality; whether the methodology is strong or not can be determined from a glance". However, if teachers wish to be able to clearly plan the core abilities and subject matter to be learned each week or in each unit, overall assessment at fixed intervals can help teachers to more closely approach the learning situations of students. To solve the problem of objectivity in evaluating students' work, Huang et al. (2009) suggested that the scoring indicators used in various domestic multimedia contests be used as a referential basis for assessing student work. Based on the above-described recommendation, another purpose of this study was to develop a performance assessment scale suitable for use in this course, to comprehend the learning effectiveness of individual students.

LITERATURE REVIEW

1.Virtual Reality

Virtual reality (VR) is a emerging technology that may affect human life. VR is a type of computer-based simulation. VR systems have the potential to allow learners to discover and experience objects and phenomena in ways that they cannot do in real life (Erenay & Hashemipour, 2003). The term was first proposed by VPL Research founder Jaron Lanier, and refers to a fabricated environment that resembles a real-life environment. In actuality, virtual reality is a type of illusion that is simulated by a computer and through our senses produces a type of feeling that is difficult to differentiate from reality. Hsu and Shin (1997) also indicated that virtual reality is a new domain developed from and based on computer graphics, computer simulation, user interface and interactive technology. The realistic interactive simulation results of virtual reality have brought computer users into a new epoch. Virtual reality has the following three essential elements: imagination, interaction, and immersion (Burdea & Coiffet, 2003).

Virtual reality is a computer-generated image simulation. Apart from providing lifelike scenes and images, the scene designer can bring feelings of vividness and fun to the user (student) through imagination. Students must also experience the sound and light effects generated by the virtual scene and imagine themselves present in this virtual space, as well as interact with the virtual scene, in order to achieve the desired results.

The scope of application of VR includes artwork, entertainment, and education (Yoon, 2010). A great number of artists use VR techniques to create an environment for interacting with viewers. In 1999, Camille Utterback and Romy Achituv created Text Rain, an interactive installation in which participants use the familiar instrument of their bodies to lift and play with falling letters on the screen. Other large immersive VR projects include Osmose and Ephemere (Yoon, 2010). The interaction and immersion characteristics of VR techniques are also suitable to be applied for entertainment purposes (Burdea & Coiffet, 2003). Various online games and movies have extensively adopted VR techniques; for example, the movie “Avatar” converted human motion into digital data, and combined the data with virtual characters via motion capture techniques. Regarding educational applications, VR systems allow learners to interact with learning materials, providing learners with real experiences and opportunities to practice continually. If VR techniques can support traditional teaching activities, the integrated education activities can provide learners with a more real, flexible, and effective learning environment (Lai, Huang, Liaw, & Huang, 2009).

2. Attitude toward technology

In the early 1980’s, Dutch scholar on science education Jan Raat and Marc de Vries et al. conducted an international study on attitude toward technology titled Pupils’ Attitude Toward Technology (PATT), which was successively extended to other studies related to attitude toward technology and concept of technology (Heywood, 1998). In 1993, Jeffrey developed a simpler measurement tool, the Technology Attitude scale (TAS-USA) based on the PATT-USA scale. The purpose was to use this scale to test and measure students’ attitude toward technology. Both PATT and PATT-USA consisted of six main constructs: “personal interest in technology”, “role of technology”, “ results of technology”, “difficulties with technology”, “courses on technology”, and “career in technology”.

In Taiwan, the constructs of scales related to attitude toward technology have been developed largely from the six constructs of the PATT scale. An example of this is the four constructs of the scale for attitude toward technology developed by Chang (1998): “content of technology”, “technological techniques”, “technology products”, and “influence of technology”. The scale for junior high students’ attitude toward technology developed by Cheng (2000) was divided into six constructs: “reaction to technological objects”, “basic awareness of the importance of technology”, “vigilance toward technology”, “behavioral inclinations with regard to technology”, “ assessment of the value of technology”, and “organizational analysis capacity regarding technology”. The scale for the attitude of junior high school students toward technology developed by Yu, Han, Hsu, and Lin (2005) was divided into five constructs: “learning about technology”, “interest in technology”, “difficulties of technology”, “contribution of technology”, and “technology in life”.

Combining the above-described references, Huang, Lin, Wang, and Hou. (2008) divided attitude toward technology into four constructs based on the areas of cognition, skill, and affective meaning.

- Cognition of the importance of technology: Refers to individual conception of the influence of technology on life and society
- Interest in learning about technology: Refers to individual reaction to, interest in, and willingness to learn about new information or developments related to technology; preferences and degree of satisfaction with regard to learning about technology, and desire to gain an in-depth understanding of technology.
- Performance of technology-related actions: Refers to the level to which individuals use actions or behavioral inclinations to express their attention to and preferences regarding technology-related objects and matters.
- Technology career planning: Refers to individuals planning for technological study and technological work in their future careers.

Concerning research related to attitudes toward technology, Dutch technology education scholars Raat and de Vries. (1985) surveyed 2500 eighth grade students on their attitudes toward technology. The research results indicate that most of the students conceived of technology as machines or facilities, stimulating the participation of global scholars in research on attitudes toward technology. Hurley and Vosburg (1997) explored the following issues: student attitudes toward emerging technology, whether these attitudes are positive, and whether a significant correlation exists between technology attitudes and attitudes toward emerging technology. The research results found that the student attitudes toward technology and learning attitudes toward emerging technology are positive and significantly correlated.. The research by Boser, Palmer, and Daugherty (1998) investigated the influence of different teaching methods used in technology education courses and their effect on student attitudes toward technology. The research discovered that three out of the four teaching methods have an impact on the student attitudes toward technology; however, in the dimension of “interest in technology”, none of the four teaching methods are effective. Moreover, after nine weeks of technology education courses, the students did not exhibit positive performance in the dimension of technological concepts. Scholars in other countries have also engaged in related research. Van Rensburg, Ankiewicz, and Myburgh (1999) adopted the PATT-USA scale to investigate attitudes toward technology among South African students aged between 12 and 16 years. The research results confirmed that technology is a vital issue of curriculum design in the near future. Voke and Yip (1999) translated and revised the PATT-USA scale to the PATT-HK scale. The PATT-HK scale was applied to investigate the attitudes of junior high school students in Hong Kong toward technology in 1999 and 2005. The research results indicate that altering Design and Technology courses with technology development can positively influence student attitudes toward technology (Voke & Yip, 2005).

Accordingly, the PATT scale has been widely applied to research on teaching and course design regarding technology education since the 1980s, facilitating course designers in planning technology education courses that support students' interests and needs. This study uses VR to develop emerging technology courses and the PATT scale to understand the impact of emerging technology courses on high school student attitudes toward technology.

3. Performance Assessment

With regard to the definition of performance assessment, Wu and Lin (1997) pointed out that performance assessment can also be called a non-written test. It is an assessment based on the students' performance in actual completion of a specific task or piece of work. These tasks or pieces of work may be actual practice, a verbal report, a scientific experiment, math problems, or composition. Lu (1998) indicated that the concept of performance assessment and portfolio assessment, also called alternative assessment, was a hot topic in the fields of education and educational testing and assessment in the U.S in the 1990's. Performance assessment can also be used as a strategic method for assessing the performance of the school and comprehending the general level of student achievement.

This study compiled the viewpoints of the above-described researchers (Wu and Lin, 1997; Lu, 1998; Stiggins, 1987) and defined performance assessment as a method of using observation and professional judgment to assess the learning achievements of students. The forms of performance assessment are diverse, and can include constructed response questions, written report, essays, speech, practice, experimentation, data collection, and display of works.

Evaluation items for the VR courses

The VR course developed by this study includes virtual roles and 2D and 3D designs in scenes and space, with the aim to develop students' art and design abilities. Therefore, this study used the evaluation standards of complete art and design work to develop items for evaluating actual performance in the VR courses.

Regarding works of art, the evaluation items include: (1) Completing the works on time; (2) the presentation of the works; and (3) learning attitudes (Liu, 2007; Hung, 2009). The items evaluating the on-time completion of work assess whether students are responsible. The presentation of artwork can reflect the process students in adjusting their physical and mental conditions; thus, an objective and multidimensional evaluation including five items, composition, color, technique, creativity, and completeness, was applied to cultivate the students' confidence. The main purpose of learning attitudes is to assess whether students work hard, focus on their work, and exhibit persistent learning attitudes. Indicators of learning attitudes can affect future student work attitudes and results. The evaluation items for design work suggested by the teachers are listed below in order of importance: (1) Creativity, (2) correspondence to topics, (3) the completeness of the work, (4) function, (5) aesthetics, and (6) presentation techniques (Yan & San, 2008).

Creativity is the most crucial indicator in the presentation of a work. Therefore, this study uses the evaluation items of artwork to evaluate design work. The researcher also increased the weight of the sub-items in creativity. To satisfy the requirements of this course, "composition" was replaced by "correspondence to topics" among the sub-items in the presentation of works.

RESEARCH METHODS

1. Development of Virtual Reality Course

Composition of research team

This group was mainly composed of teachers from the computer science course of the school being researched. The researcher also invited a professor from department of electrical engineering of university C (with many years of experience in teaching, research, and industry-academia cooperation in image processing, video processing, video compression, graphic theory and DSP/IC design) for guidance in professional technology and assessment of learning effectiveness, as well as invited three professors from a graduate insitute of curriculum and instructional technology at university C to assist in evaluating the course.

Stages of Course Development

In the first year, a course development committee was established to explore the core knowledge of virtual reality and teaching material with a structure suitable for high school level. These materials were then tested according to suitability of teaching methods. Each chapter was developed as one unit and comrpehensively discussed by the course development committee. Reflective logs and meeting minutes were also kept. After the course development committee had discussed and modified the material, the course was finalized, and the textual materials were prepared at the end of the year.

In the second year, researcher began to implement the instructional activities of the virtual reality course. With the counsel of the university professors, researcher used quantified experimenal design, qualitative classroom observation, and interviews to investigate whether the teaching materials were appropriate, the teaching methods suitable, and whether the course could enhance the attitude of students toward technology. The resulting data was used to modify the teaching materials and methods.

In the third and fourth years, researcher repeated the implementation of the modified teaching materials and methods, in the hope that the course would more accurately meet the needs of high school students. Lastly, researcher conducted promotional activities in the fourth year, working to extend implementation of the course to senior and vocational high schools nationwide.

Teaching Objectives

The objectives of this course are as follows:

- To enhance the learning motivation and literacy of students with regard to emerging technology through the instruction of an innovative course.
- To use investigation and practical application of virtual reality to increase the degree to which students use actions or behavioral tendencies to express their attention to or preferences regarding technology-related matters.
- To link this course with university curriculum to enhance students' career exploration and reduce their adjustment period upon entry into university.
- To train students to develop the basic abilities of industry professionals and join future technological industries.

Course development model

Organized the "virtual reality course development committee", invited the guidance of expert university scholars and teachers in related domains, and used a three-stage model for course development: A (analysis); I (design), D (development). The committee worked to ascertain core knowledge, establish the course framework, arrange the order of chapters and sections, integrate vertical and horizontal links, discuss learning goals, develop units, write teaching material content, and solicit the opinions of experts and teachers in related domains to modify the material. The committee designed different forms and charts for each stage, to ensure course development quality. This course was developed on the basis of students' mathematics and physics courses, such as coordinate systems, plane coordinate conversion, vectors, matrix, and curves in mathematics courses and kinematics, two-dimensional collision, and three-dimensional collision in physics courses. The virtual reality course framework was planned according to the principles and key elements of virtual reality.

Course Content

The course developed by this study includes a textbook and a teacher's manual, and can be used as a 4-credit point (one academic year) elective course in senior high school. The course units include: (1)What is virtual reality; (2)Input and feedback devices of virtual reality; (3)Design principles of virtual reality; (4)Virtual interior design; (5)Design of virtual scenery; (6)Design of virtual characters, and (7)Virtual reality and 3D technology.

Software and hardware facilities for teaching

In consideration of factors such as funding problems in high schools and the degree of acceptance of beginners, researcher integrated different types of software (such as Poser, Bryce, and Space Magician) in designing this course, with the intention of developing students' ability to operate and use different types of software for "virtual reality" digital creation.

Poser was chosen because Poser was the first tool that could produce complete 3D character animation. Although 3DS is used for most professional scenery design, it is time-consuming for even the most familiar user. Therefore, this study used the recently increasingly popular Bryce in scenery design programs. The user-friendly interface and powerful features of this program make it very suitable for beginners in virtual reality technology.

In the practical part of the virtual reality course, the researcher selected Space Magician as the first step in practice. The reason was that this software is easily learned and easy to understand, and offers a humanized operation interface, specific 3D presentation of space, fast drawing, instant imaging features, easy operation, and absence of complex commands. This program is therefore easy for beginners to learn to use. Additionally, with regard to teaching facilities, because this course involves learning to use related graphics software, higher-end computer facilities are needed, preferably with high capacity memory and separate display chips. With regard to the input/output devices required for the course, high schools that wish to teach this course can, funds permitting, purchase input devices such as lower-priced optical data glove, shutter glasses or head-mounted displays (HMDs) for teaching purposes. Moreover, through school strategic alliances, high schools may also be able to use mid-range and high-end equipment in virtual reality lab of university, allowing students to experience the actual process of 3D virtual reality animation filming such as “motion capture mirrors emotions” how to work, is shown in Figure 1.

Figure 1: students visited to 3D virtual reality lab of nearby university to allow them to experience the actual process of 3D virtual reality animation filming.

Instructional Implementation
Virtual reality courses are usually considered professional or advanced courses, or graduate courses, in university. Therefore, such courses must be adjusted according to the basic abilities of students when taught in high schools, to avoid learning difficulties. However, at the same time, virtual reality is a topic that can spark more interest among students and inspire them to take initiative to explore the development of this new technology, and thereby develop the technological and information-related abilities required. The instructional process of this course is shown in Figure 2.

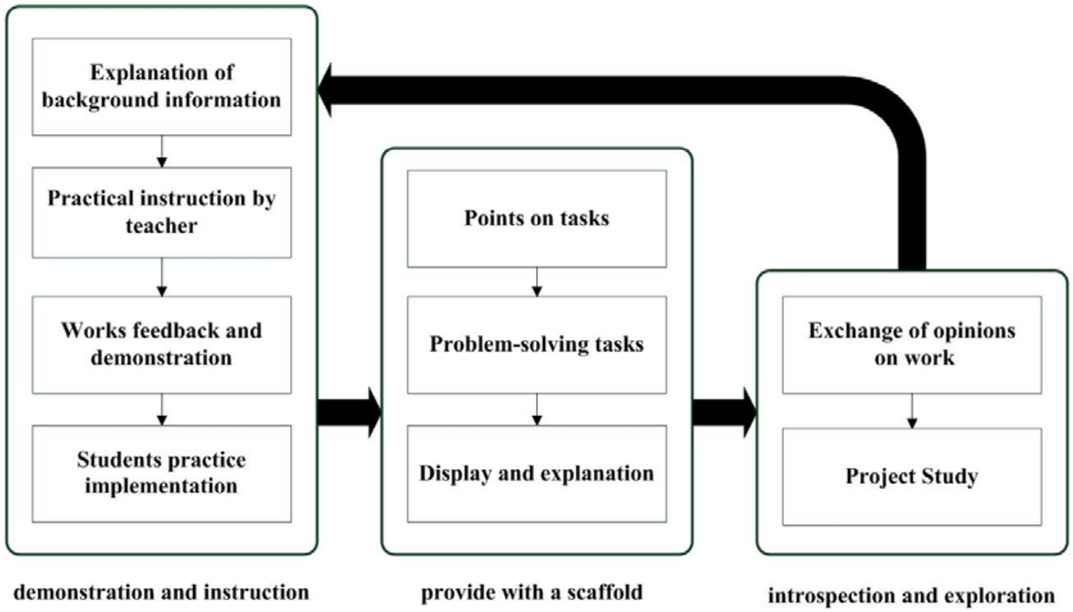

Figure2: Instructional process of the virtual reality course used a three-stage model for instructional Implementation: demonstration and instruction; provide with a scaffold, introspection and exploration.

Evaluation of teaching effectiveness

The PDCA cyclic model was used to construct the model of evaluation for the teaching cycle in this course. From the establishment of teaching goals and selection of teaching content, to implementation of teaching activities and evaluation of teaching results, teachers constantly reviewed the implementation of the teaching process and studied paths for improvement. Review meetings, classroom observation, questionnaire survey, teaching experiments, teacher reflection journals, and creation of teaching files were used to ensure the quality of course development.

2. Experimental Design

This study recruited 89 eleventh grade students majoring in science of High School A in 2010. To better understand the impact of the VR course developed by this study on the high school students' attitudes toward technology, the recruited students were divided into two groups according to their course selection results. The experimental group was composed of 31 students who selected the VR course, and the control group encompassed 21 students who did not select any emerging technology courses. To avoid disruptions to internal validity caused by the students selecting other emerging technology courses, the 37 students who selected other emerging technology courses were excluded from the control group.

Regarding the experiment design, this study used quasi-experimental research methods to investigate the difference in attitude toward technology between sophomore students (experimental group) who had attended the virtual reality course, and sophomore students (control group) who had not attended the course on emerging technology. Researcher conducted pre-testing in the first week of the 2010 school year, and conducted post-testing in the 11th week; the teaching experiment period was thus 10 weeks. The experiment design is explained in Table 1.

This study considered only the course structure of the High School A, and respected the free will of students to take elective courses; therefore, a true experimental design could not be conducted. The conclusions of this study can only be applied to students majoring in science, instead of general senior high school students.

Table 1: Experiment design.

Group	Pretest	Experimental Treatment	Posttest
Experimental Group	O_1	X	O_2
Control Group	O_3		O_4

1. The experimental group: those who took the VR course.
2. The control group: those without any experimental treatment.

3. Instruments

Scale of high school students' attitude toward technology

The test instrument in this experiment was the "Scale of High School Students' Attitude toward Technology". This scale was developed by the academic evaluators of this course (Huang et al., 2008). This scale was divided into four constructs: "cognition of the importance of technology", "interest in learning about technology", "performance of technology-related action", and "technology career planning". After being tested for construct validity by experts and modified, the scale was developed into a pre-test questionnaire. The targets of the pretest were 220 high school students. After the questionnaires had been returned, a valid sample of 202 students was obtained, making a 91.81% questionnaire recovery rate. Researcher then conducted item analysis and factor analysis, and removed seven items. With regard to reliability testing, the Cronbach's α of the overall questionnaire on attitude toward technology was .927, and the Cronbach's α values of the four constructs were .712, .846, 847, and .871. These results showed that this questionnaire had high reliability.

Performance assessment scale

To understand the effects of the students' actual practice and learning, this study developed a valid and objective performance assessment scale. Students' work was provided to the course teacher for assessment from his/her professional angle. Two professional teachers who had not taught the course were invited to provide assessment, after which students were allowed to self-evaluate their work using the assessment scale. Statistical analysis was used to test the validity of the assessment scale developed by this study. In developing and modifying the evaluation indicators in the assessment scale, this study referred to the assessment scale developed by Liu (2007) and the various evaluative indicators used in assessment of entries in the design category at the National Commercial Art Technology Competition in Taiwan, as well as solicited the opinions of experts.

RESEARCH RESULTS

1. Descriptive Statistics Analysis

Table 2 shows the mean, standard deviation, and adjusted mean corresponding to each variable as derived from data generated by the pre-testing and post-testing of students in the experimental group and the control group. Overall, students who had competed studying the virtual reality course performed better with regard to the four constructs of attitude toward technology, as compared to their pre-course performance. Their performance also exceeded that of the control group.

2. **Covariate Analysis**

Due to the limitations of class structure, this study was unable to use random allocation in research design, and therefore used the pre-test as a covariate to implement statistical control. This study then conducted analysis of covariance (ANCOVA) of the experimental group and control group. Prior to conducting ANCOVA, this study first conducted a test of homogeneity of group regression coefficients. The results of the interaction between the independent variables and the covariates were as follows:

"Cognition of the importance of technology": $F(1, 48) = 1.20$, $p > .05$,"Interest in learning about technology": $F(1, 48) = .47$, $p > .05$, "Performance of technology-related action": $F(1, 48) = .51$, $p > .05$, "Technology career planning": $F(1, 48) = .01$, $p > .05$.

These results did not reach a level of significance, indicating that the linear relationships between the covariates and dependent variables of each group were consistent.

Table 2: Mean and standard deviation of variables in attitude toward technology

Variables	Experimental group (N=31)		Control group (N=21)	
	M	SD	M	SD
Cognition of the importance of technology (pre-test)	38.35	3.00	35.90	3.66
Interest in learning about technology (pre-test)	44.45	5.09	44.57	5.09
Performance of technology-related actions (pre-test)	53.81	9.84	53.90	13.43
Technology career planning (pre-test)	15.23	2.85	15.57	4.15
Cognition of the importance of technology (post-test)	38.29	3.33	33.95	4.57
Interest in learning about technology	46.32	5.86	43.14	7.74

(post-test)				
Performance of technology-related action (post-test)	56.68	8.99	49.14	13.40
Technology career planning (post-test)	17.16	3.16	14.71	3.86
Cognition of the importance of technology (adjusted)	38.29		33.96	
Interest in learning about technology (adjusted)	46.33		43.14	
Performance of technology-related action (adjusted)	56.68		49.14	
Technology career planning (adjusted)	17.16		14.71	

3. Development of the performance assessment scale

Apart from using the above-described standardized measurements to assess the effectiveness of the course, this study also designed the "virtual reality course performance assessment scale" (see Appendix), based on suggestions provided by Huang et al. (2008) after her external assessment of the course. The analyses which follow are the validity and reliability analyses of the scale.

Table 3: Summary of one-way analysis of covariance regarding attitude toward technology

Source of variation	SS	df	MS	F	η^2
Cognition of the importance of technology					
Pretest(covariance)	.01	1	.01	.001	
Group	205.48	1	205.48	13.44 **	.22
Error	749.33	49	15.29		
Interest in learning about technology					
Pretest (covariance)	3.35	1	3.35	.08	
Group	127.05	1	127.05	2.80	.05
Error	2222.00	49	45.35		
Performance of technology-related actions					
Pretest(covariance)	19.29	1	19.29	.16	
Group	711.71	1	711.71	5.81 *	.11
Error	5998.06	49	122.41		
Technology career planning					
Pretest (covariance)	.09	1	.09	.01	
Group	75.04	1	75.04	6.14 *	.11
Error	598.39	49	12.21		

*$p<.05$ **$p<.01$ ***$p<.001$

Content Validity

In designing the assessment scale, this study referred to the assessment scale developed by Liu (2007) and the various evaluative indicators used for scoring purposes in the National Commercial Art Technology competition. To judge whether the constructs and items of the scale were appropriate, professors from the Graduate Institute of Curriculum Instruction and Technology of University C were invited to review the first version of the scale along with professors from art departments of other schools. This study modified each dimension and item according to the suggestions provided by the experts, indicating that the scale has a certain internal validity.

Correlation Analysis

Six dimensions for assessment of work were developed: communication of theme, creativity, color, technique, structure, and comprehensiveness. Prior to assessment, researcher discussed the evaluation indicators corresponding to these six dimensions, and Pearson's product moment correlation coefficient was used to investigate the relationships among the six dimensions and total score. Table 4 shows that no significant correlation existed between communication of theme and color (r =.284) or structure (r =.341). However, moderate and positive correlations were found to exist among the other dimensions. The research theme of this study was design-related courses, and the assessment indicators (creativity, technique, comprehensiveness, communication of theme, color, and structure) were found to be moderately and positively correlated, which indicates that except for color and structure, each dimension has a high correlation coefficient, meaning that these dimensions are highly correlated.

Moreover, as can been seen in Table 4, the six dimensions and the total score of the scale are significantly correlated, indicating a high internal consistency.

Scorer Reliability
Scorer reliability refers to whether different scorers demonstrated consistent assessments on the same indicator of performance. To assess whether the scale has scorer reliability, this study used the assessment of the course teacher (T_A) and the scale-based assessments of non-course teachers (T_B, T_C); of these, T_B is a computer teacher and T_C is an art teacher. Student work consisted of two parts: part one was a personalized suite, and part two was residential design. Course teacher used his professional viewpoint for assessment, and non-course teachers assessed the work according to the assessment scale. To understand whether differences existed between the assessment scores given, this study tested for differences among the scores.

Table 4: Correlation analysis of the six assessment dimensions

Measure	Communication	Creativity	Color	Technique	Structure	Comprehensiveness
Communication	-					
Creativity	.393*	-				
Color	.284	.618**	-			
Technique	.546**	.652**	.445*	-		
Structure	.341	.667**	.553**	.710**	-	
Comprehensiveness	.505**	.751**	.550**	.841**	.764**	-
Total	.657**	.881**	.713**	.839**	.809**	.899**

$^{*}p<.05$ $^{**}p<.01$ $^{***}p<.001$

The course teacher used 100 as the full score when performing assessment. When using the assessment scale for evaluation, the non-course teachers first subtracted the subjective dimensions of "work finished on time/attitude toward learning"; therefore, the full score used was 80. The score of the non-course teachers times 100/80, then all of them use 100 as full marks.

Based on the calculated scores, the researcher of this paper used Kendall's coefficient of concordance to analyze the level of consistency of the three scorers on the two works. The analysis shows consistent results regarding the design work of "personalized suites" (Kendall's coefficient of concordance = .680, chi-square value = 53.056, and p < .05) and "living house" (Kendall's coefficient of concordance = .611, chi-square value = 47.652, and p < .05); indicating that a significant correlation exist among the three scorers. Because the analytical result shows consistency among the three scorers, this study infers that this scale possesses scorer reliability.

DISCUSSION AND CONCLUSIONS

The above-described analysis results showed that after 10 weeks of attending the virtual reality course, students in the experimental group performed better in two constructs of attitude toward technology (performance of technology-related action, and technology career planning) as compared to their pre-course performance. Their performance also exceeded that of the control group. This showed the preliminary results of the course in enhancing the comprehension of students with regard to knowledge of emerging technology and the development of technological ability. The research results of this study prove that emerging technology courses do not positively influence the cognition of the importance of technology; this conclusion is similar to the research result of Boser, Palmer, and Daugherty (1998), which found no positive correlation between technology courses and student concepts of technology. The researcher infers that the cause might be an overemphasis on the teaching of technical abilities, leading to reduced importance on the cognition of technology. These results can serve as a reference for further course design.

The course also provided students with career exploration opportunities. Several graduates of High school A who attended the course have already entered good universities and technological universities with related departments (such as department of multimedia design, department of game creation, department of interior design…etc.) through college admission such as personal applications or recommendations by high schools, which corresponded to the originally established course objectives.

However, the course did not result in significant difference in the students' interest in learning about technology. The researcher infer that the reason for this may have been that this course was an interdisciplinary elective course (among 10-12 courses) in High School A, and students who opted for the course had selected it after attending a course description seminar and fully understanding its content. Students who selected this course from among a variety of courses may have already had a high level of interest in virtual reality technology, so that although students' interest in learning about technology was increased after the course, the increase was not significant. Therefore, the researcher suggests that future course teachers appropriately integrate teaching strategies that increase students' learning motivation during the implementation of the course, such as adding current examples of application of virtual reality or 3D technology, and explaining more about future learning approaches and career development in related domains. This should assist in enhancing students' interest in learning about technology.

In external evaluation of this course, Huang et al. (2009) pointed out that compared to mainstream virtual reality technology, the resources and facilities of high schools are limited and high school students must be seen as beginning learners in dynamic digital technology. Therefore, the arrangement of subject matter, learning process, and technological content must naturally correspond to practicality and feasibility. Therefore, based on the course development and evaluation in the first year, the course in the second year was modified to reduce focus on abstract theory in learning. The timetable of the course was modified to delay teaching such theory until after students had a certain amount of practical operational experience with virtual reality, which would naturally make subsequent learning more meaningful. Also, to enhance students' interest in learning about virtual reality and provide them with a preliminary understanding of related university departments, in addition to visit to nearby universities (or technological universities) with related departments, The researcher suggests that visits to multimedia companies can be added to the course in the future, in order to provide students with a more complete vision.

Performance assessment, whether it involves Q&A sessions with students or teacher assessment, is usually very time-consuming. With regard to student work in design-related fields, students must not only use the skills and principles learned but also incorporate their individual subjective consciousness, to order to comprehensively express the idea of their work. When teachers assess such work, apart from performing evaluation from the angles of academic principles and facts, they also use their individual and extremely subjective viewpoint and ideas in assessment. Therefore, performance assessment is often discriminated against.

Although performance assessment is costly, time-consuming, and difficult to conduct, when viewed from the angle of its principles and methods, it still offers many advantages; for example: emphasizing students' practical performance, shifting from previous methods of assessment that overly emphasized written examination, guiding students to take initiative in learning, and emphasizing teacher-student interaction in the instructional process. Therefore, education authorities should still encourage teachers to use performance assessment. At the same time, if an objective and valid assessment scale was provided, teachers could perform evaluation according to existing assessment indicators and scores. Before creating their work, students would also be able to understand which key points should be a focus. After assessment, students could use their score on the scale as a form of feedback to understand their strengths and weaknesses.

This study conducted correlation analysis of the six dimensions (communication of theme, creativity, color, technique, structure, and comprehensiveness) in the assessment scale. Results showed that the dimensions were moderately correlated, and the six dimensions with the total score of the scale are significantly correlated, indicating a high internal consistency. However, when designing the proportional scores for the six dimensions of the scale, this study was limited by research time and the number of research targets; therefore, the weights were determined according to the personal experience of each researchers. Thus, whether the proportional specific weight of each dimension is appropriate must be determined through scientific and objective analysis. In the future, if further research could be conducted on the proportional specific weight of the scale dimensions, this would make the indicators in the performance assessment scale more complete.

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REFERENCES

Bame, E., Dugger, W., Jr., de Vries, M., & McBee, J. (1993). Pupils' attitudes toward technology - PATT-USA. *Journal of Technology Studies, 19*(1), 40-48.

Becker, K. H., & Maunsaiyat, S. (2002). Thai students' attitudes and concepts of technology. *Journal of Technology Education*, *13*(2), 6-20.

Boser, R. A., Palmer, J. D. & Daugherty, M. K. (1998). Student's attitudes toward technology in selected technology education programs. *Journal of Technology. Education, 10*(1), 4-19.

Burdea, G. C. & Coiffet, P. (2003). *Virtual reality technology.* (2nd ed.). NJ: John Wiley & Sons, Inc.

Chang, Y. S. (1998). A study of college students' attitudes toward technology. *Journal of National Hualien Teachers College, 8*, 297-315.

Chen, Y. F & Martin, M. A.(2000). Using performance assessment and portfolio assessment together in the elementary classroom. *Reading Improvement, 37*, 32-38.

Cheng, C. M. (2000). *A study of junior high school students' attitude toward technology in Taipei*. Unpublished master's thesis, National Taiwan Normal University, Taipei, Taiwan.

Erenay, O. & Hashemipour, M. (2003). Virtual reality in engineering education: a CIM case study. *The Turkish Online Journal of Educational Technology, 2*(2), 51-56.

Heywood, J. (1998). *Pupils' attitudes to technology: A review of studies which have a bearing on the attitudes which freshmen bring with them to engineering*. Retrieved June 25, 2003, from http://fie.engrng.pitt.edu/fie98/papers/1406.pdf

Hsu, M . L. & Shin, J. C. (1997). The application of virtual reality in Education. *Distance Education, 3*, 19-23.

Huang, S. L., Lin, J. J., Wang, C. P., & Hou, S. C. (2008). *The evaluation of endless sky- research on application of wireless hypermedia to comprehensive high school curriculum (1/4).* Research report of National Science Council High-Scope Project (NSC-96-2514-S-260-001-GJ). Nantou: National Chi-Nan University.

Huang, S. L., Lin, J. J., Wang, C. P., & Hou, S. C. (2009). *The evaluation of endless sky- research on application of wireless hypermedia to comprehensive high school curriculum (2/4).* Research report of National Science Council High-Scope Project (NSC-97-2514-S-260-001-GJ). Nantou: National Chi-Nan University.

Huang, S. L., Lin, J. J., Wang, C. P., & Hou, S. C. (2010). *The evaluation of endless sky- research on application of wireless hypermedia to comprehensive high school curriculum (3/4).* Research report of National Science Council High-Scope Project (NSC-98-2514-S-260-001-GJ). Nantou: National Chi-Nan University.

Hung, T. H. (2009). The implementation and application of art work performance assessment in classes of the pupils with art talent. *Gifted Education, 117*, 8-17.

Kalawsky, R. S.(1993). *The Science of Virtual Reality and Virtual Environments*. Wokingham: Addison-Wesley.

Lai, C. M., Huang, H. M., Liaw, S. S., & Huang, W. W. (2009). A study of user's acceptance on three-dimensional virtual reality applied in medical education. *Bulletin of Educational Psychology, 40* (3), 341-362.

Liu, Y. C. (2007). *The assessment criteria of art teaching for Jian sing primary school in Pingtung county*. Retrieved June 25, 2010, from http://163.24.16.21/icheng_web/jack_web/table_file/jsps_art%20standard.doc

Lu, S. M. (1998). The promises, problems and challenges of performance evaluation. *Bimonthly Journal of Educational Resources and Research, 20*, 1-5.

National Science Council High Scope Program. (2007). *2007 Annual Plan Outline*. Retrieved July 10, 2010, from http://www.highscope.fy.edu.tw/(96)plan-brief-introduction.asp

Popham, W. J. (1995). *Classroom assessment: What teachers need to know*. Boston: Allyn and Bacon.

Raat, J. H., & de Vries, M. (1985). *What do 13-Year old pupils think about technology? The conception of and the attitude towards technology of 13-year old girls and boys.* Eindhoven University of Technology, Netherlands. (ERIC Document Reproduction Service No. ED 262 998)

Stiggins, R. (1987). Design and development of performance assessment. *Educational Measurement: Issues and Practice, 6*(3),33-42.

Tseng, D. C. (2010). *Virtual Reality* (8th Ed.). Unpublished manuscript, National Central University, Chungli, Taiwan.

Van Rensburg, S., Ankiewicz, P., & Myburgh, C. (1999). Assessing South Africa learners' attitudes towards technology by using the PATT (Pupils' Attitudes Toward Technology) questionnaire. *International Journal of Technology and Design Education,* 9, 137-151.

Voke, K. S., & Yip, W. M. (1999). Gender and technology in Hong Kong: A study of pupils' attitudes toward technology. *International Journal of Technology and Design Education,* 9, 57-71.

Voke, K. S., Yip, W. M., & Lo, T. K. (2003). Hong Kong pupils' attitudes toward technology: The impact of

design and technology programs. *Journal of Technology Education, 15*(1), 48-63.
Vince, J. (1995). *Virtual Reality Systems*. Wokingham: Addison-Wesley.
Wu, C. S. & Lin, T. Y. (1997). Performance assessment, portfolio assessment, & authentic assessment. *Bimonthly Journal of Educational Resources and Research*, *15*, 68-70.
Yen J. & Sun C. C. (2008). A study on the design teachers' and students' recognition of performance evaluation and evaluation Criteria. *Journal of Science and Technology,17*(1), 41-57.
Yoon, S. (2010). *Virtual reality in art education*. Unpublished master's thesis, School of the Arts Virginia Commonwealth University, Richmond, Virginia.
Yu, K. C., Han, F. N., Hsu, I. Y., & Lin, K. Y. (2005). The development of attitude toward technology scale for junior high school students. *Kaohsiung Normal University Journal, 19*, 69-83.

Appendix. Performance assessment scale for the virtual reality course

Name:		Final score:			
Item		Assessment indicators	Score		
			-	+	+ +
Completed work on time (10%)		a. Can hand in work assignments on time according to teacher instructions			10
		b. Can complete work before deadline after limited reminders from the teacher	5	7	9
		c. Work is not completed without constant urging and supervision from the teacher	0	1	3
Work assignment (80%)	Communication of theme (25%)	a. The work and the theme closely interlock	20	23	25
		b. Does not have a good grasp of the theme; work does not fully express the theme	10	13	17
		c. Considerable distance exists between the finished work and its theme; ability to communicate theme requires improvement	1	4	7
	Creativity (15%)	a. Work is creative and unique	11	13	15
		b. Work has some uniqueness but is not outstanding	7	8	9
		c. Additional guidance, examples, or demonstration is needed from the teacher before the student can develop his/her own ideas and creativity	1	3	5
	Color (10%)	a. Use of colors is appropriate; does not often use concept colors, giving the image a rich feeling	8	9	10
		b. Skill in color use could be improved; richer color functions could be used to enhance the work	5	6	7
		c. More guidance from the teacher in techniques of color use is needed to enrich this work	1	2	3
	Techniques (10%)	a. Student is proficient in use of software components and understands the strengths and limitations of software	8	9	10
		b. Can use basic components, but creative skills need improvement	5	6	7
		c. Needs more guidance form the teacher to understand the strengths and limitations of the software and become proficient in these skills	1	2	3
	Structure (10%)	a. Content is rich and comprehensive, corresponds to psychological development, presents aesthetic balance	8	9	10
		b. Has spatial feeling and expresses individual thought, but requires improvement in screen configuration relationships	5	6	7
		c. Lacks in structure, requires more guidance form teacher	1	2	3
	Comprehensiveness (10%)	a. Understands creative concepts, construction process, and related principles; can make full use of software components	8	9	10
		b. Can complete a project but needs improvement or remedial work in some areas	5	6	7
		c. Work has some incomplete and unsatisfactory parts; insufficient use of software components	1	2	3
Attitude toward learning (10%)	Creative process (10%)	a. Willing to make class presentations, attentive in creative work, helpful and willing to instruct others	8	9	10
		b. Can follow the teacher's instructions, works hard, does not interact much with other students	5	6	7
		c. Cannot work independently, requires constant supervision and goading from the teacher, rarely interacts with classmates	1	2	3
Comments from teacher					

DO ONLINE LEARNING PATTERNS EXHIBIT REGIONAL AND DEMOGRAPHIC DIFFERENCES?

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ABSTRACT
This paper used a multi-level latent class model to evaluate whether online learning patterns exhibit regional differences and demographics. This study discovered that the Internet learning pattern consists of five segments, and the region of Taiwan is divided into two segments and further found that both the user and the regional segments are highly interpretable. The individual segments are dictated by demographic variables, such as age and gender. For instance, younger people were good at employing Internet services; those 21-30 years old adopted e-learning, browsed blogs, and enjoyed the Internet more than others; and females preferred e-learning applications more than males did. On the other hand, the regional segments are dictated by the individual segments. For instance, the service area segment comprised a higher proportion of members who were good at online learning applications. The agricultural area segment made up a higher proportion of members who were traditional users. The findings provide both product or service providers/vendors and curriculum designers with an applicable guideline for developing service strategies for better matches and higher service satisfaction between the curriculum and the users' needs.
Keywords: regional difference, demographic differences, online learning pattern

INTRODUCTION

What kinds of online learning patterns do people have when they use the Internet? Understanding online learning behaviors might be helpful for increasing fitness and service satisfaction between a curriculum and students' needs. People's daily activities have gradually shifted from concrete circumstances into virtual ones. For example, bulletin boards have evolved into websites, diaries have transformed into blogs or micro-blogs, while the learning environment has migrated from actual classrooms into online ones. The rise of the Internet has extended/prolonged the service hours/time to 24 hours a day and has attracted user from all around the world. Such changes have made service-providers value users' needs and their usage behaviors on the Internet more than before. Teachers are now also more eager to perform web-reinforced teaching, and they are expected to use blogs, Wikipedia, and social network sites in their own teaching (Kiyici, 2010). It could be agreed that people are not doing anything particularly new – they are just doing old things in new ways and finding that some of those new ways suit their lifestyle better (Anderson & Tracey, 2001). More and more Internet users have contributed to the generation of online learning, like online movies, online games, online shopping, e-news, blogs, Wikipedia, and e-learning (Selwyn, Gorard & Furlong, 2005; Shah, Kwak & Holbert 2001). Forecasts are thus more likely to be reliable if they are based on consumers' on-line behaviors (Lohse et al., 2000). If a marketer on the Internet is able to identify potential early adopters and understand their personalities, then along with appropriate incentives it can facilitate the adoption process (Citrin, Sprott, Silverman & Stem, 2000; Song, Kim, J. K. & Kim, S. H., 2001).

Understanding online behaviors can help increase fitness and service satisfaction between products and users' needs. This study looked at online interactive learning behavior patterns in particular issues related to browsing blogs and information sharing. This paper investigated the usage behaviors through nine items of categorical variables about online learning patterns among 16,133 users in 25 regions of Taiwan. This study implemented a multilevel latent class model to investigate online learning patterns, which exhibited regional differences and demographic difference, with the goal of providing service providers an understanding and mastery of their target users.

Typical online activities

Internet applications and services have certainly enriched peoples' lives (Anderson & Tracey, 2001; Colley & Maltby, 2008). The research results of Weiser (2001) showed that Internet usage is motivated principally by goods and information acquisition. What are typical online activities? According to research on Internet usage patterns in the U.S. from some scholars, like Howard, the chief purpose can be sorted into communication, fun, information utility, major life activities, and transactions (Howard, Painie & Jones, 2001). Some studies have shown that other activities conducted through the Internet encompass online communication, e-mail, downloading of software and games, obtaining information, shopping, researching products and service information, entertainment, and education (Sahin, Balta & Ercan, 2010; Sam, Othman & Nordin, 2005). Colley and Maltby (2008) revealed that the most common applications are communicating with friends, browsing news, acquiring general information, entertainment, shopping, and job-search information. Gross and Leslie (2009) exhibited that the new approach applications are blogs, RSS, image hosting, podcasting, social networking, and Wikipedia. In the Internet world, blog application, information sharing, and connecting to the Internet through mobile device are new issues. This study herein categorized some on-line behaviors that frequently occur and chose nine of them to analyze. These nine behaviors encompassed: purposes of entertainment, such as traveling, food, and recreation; acquiring general information; searching for product information; online shopping; searching for job information; e-learning; browsing blogs; information sharing, such as videos and photos; and connection with the Internet through a mobile phone.

Regional and demographic effects

The diffusion of the Internet has occurred at the intersection of both international and within-country differences in socioeconomics (Chen & Wellman, 2004; Donnermeyer & Hollifield, 2003). Divergent regions have different infrastructures, economies, and populations, leading to environmental divergences of location (Delialioglu, Cakir, Bichelmeyer, Dennis & Duffy, 2010; Mills & Whitacre, 2003). Hence, this also has affected divergences of citizens' Internet usage patterns (Wilson, Wallin & Resier, 2003). Users in the same region have the same background environment, and therefore when discussing online learning behaviors across different areas, like rural versus urban, researchers should take account of their environments, so that they can accurately compare the on-line behaviors of users from different regions.

In addition to location, other factors that influence on-line behaviors, such as users' social status, age, and gender, are also noted as the major concerns in several research studies (Aypay, 2010; Wilson et al., 2003). For example, Livingstone and Helsper (2007) showed that demographic, use, and expertise variables all played a role in accounting for variations in the breadth and depth of Internet usage. Among them, demographic variables such as gender, age, and socioeconomic status had significant influences (Delialioglu et al., 2010; Korupp & Szydlik, 2005; Wasserman & Richmond-Abbott, 2005). The types of Internet content may attract users who seek to satisfy certain motivations more broadly, potentially because of their social situation (Shah et al. 2001). Students' characteristics (gender and weekly hours of Internet use) showed a significant relationship with their participation level in discussion forums of online courses (Yukelturk, 2010). Hargittai and Hinnant (2008) suggested that user attributes also revealed that online skill is an important mediating factor in the types of people's online activities. Teo and Lim (2000) proved that different genders and age levels had a significant impact on on-line use patterns, like time spent over one day for browsing or downloading. The findings of Yang, Hsu, and Tan (2010) presented that the perceived ease of use is an important determinant for sharing videos (e.g. YouTube), and that social factors (e.g. gender) affect intention. Males, regardless of race, were the most intense videogame players, while females were the most intense users of cell phones (Jackson et al., 2008). Colley and Maltby (2008) showed that more women's responses mentioned receiving information and advice, studying online, and shopping and booking travel online, while more men's responses noted the Internet had helped or brought them a career and had positive socio-political effects. Lo´pez-Bonilla, J. M., and Lo´pez-Bonilla, L. M. (2010) discovered that gender has significant impacts on online shopping. This study herein referred to the findings from the scholars mentioned above and brought some demographic variables such as age and gender into the research model to analyze how these demographic variables influence the pattern of online learning.

Investigating user behavior patterns

Some scholars also indicated that understanding customer behaviors on the Internet is helpful for products' research and development, together with their sales (Lohse, Bellman & Johnson, 2000). Scholars have discovered differences among time, frequency, and the range of Internet usage (Howard et al., 2001; Selwyn et al., 2005). Changchien, Lee and Hsu (2004) presented that due to the diversity in individual usage behaviors, cognitive needs, and personality, further research of methods on clustering users may be quite interesting and helpful. Some studies suggested sorting online use pattern by users' age (Shah et al. 2001), while others explored the length of experience, access time, and frequency of online use patterns (Donnermeyer & Hollifield, 2003; Howard et al., 2001)

Another way to examine which people conduct what type of online activities is to explore user typologies. For example, researchers used factor analysis to investigate the online motivated patterns among various users (Teo, 2001; Torkzadeh & Dhillon, 2002). In online behavior studies, the behaviors of users usually showed categorical outcomes and a latent usage pattern. Although the length of experience and frequency of online use helps predict which activities people conduct online, the patterns of online behavior also prove to be a significant predictor. This study aimed to test this particular relationship of types of online usages. This study took the methodology from previous scholars and applied multilevel latent class analysis to investigate user behavior patterns based on multilevel data structures (Bijmolt et al., 2004; Henry & Muthén, 2010; Horn et al., 2008).

This research used MLCA (Multi-level Latent Class Analysis) to discover patterns of online learning. It consisted of regional areas simultaneously and also considered demographic variables such as age and gender, discussing the potential influence behind users' on-line behaviors, with the goal of providing curriculum designers an understanding and mastery of their target customers. Curriculum designers and service-providers could refer to the patterns of online learning for their own research and development. Together with their promotion of them, this might be helpful to increase/elevate fitness/appropriateness and service satisfaction between service and users' needs.

METHOD

This study simultaneously applied multilevel latent class analysis to attain regional segmentation (T; level 2) and cross-region user segmentation (S; level 1). The multilevel latent class methodology is available in the computer program LatentGOLD v4.0 (Vermunt & Magidson, 2005). This study used SPSS v12.0 to collate data descriptive statistics and the contingent table.

Objectives of this study

Do online learning behaviors exhibit certain identifiable patterns (based on multilevel data structures)?
Do online learning patterns exhibit regional differences?
How do demographic variables affect online learning patterns?
What kind of special or interesting online learning pattern differences exist?

Multi-level latent class analysis (MLCA)

In the social sciences, many research questions have investigated the relationship when both categorical outcomes and predictor variables are latent. Categorical data analysis has been useful in looking at sociological data (Goodman, 2007). For an attitude or classify survey, researchers generally are more concerned about the potential group of samples, and the Latent Class Model can provide a better means to categorize data. With an attitude or classify survey it is more appropriate to use Latent Class Analysis (Bijmolt, Paas & Vermunt, 2004; Horn, Fagan & Jaki, 2008). A latent class model assumes that the population of subjects is divided into a few exclusive latent classes. LCA (latent class analysis) is a statistical method used to identify subtypes of related cases using a set of categorical and/or continuous observed variables. These subtypes are referred to as latent classes. The classes are inferred from the multiple observed indicators and are not directly observed (Bijmolt et al., 2004; Henry & Muthén, 2010).

Traditional LCA assumes that observations are independent of one another, but multilevel data structures are common and needed in social and behavioral research. For example, observations are not independent when the data structure includes citizens nested in a city, employees nested in companies, or students nested in schools. The consideration and assessment of contextual level predictors in the framework of a latent class analysis have implications for many salient research questions in the social and behavioral sciences. These nested data structures require multilevel techniques. In response to these needs, Vermunt (2003) presented a framework for assessing latent class models with nested data. Multi-Latent class analysis (MLCA) has been suggested as a model-based tool for both regular individual (level 1) segmentation and regional segmentation (level 2) (Bijmolt et al., 2004; Henry & Muthén, 2010; Horn et al., 2008; Vermunt, 2003). This study simultaneously applied MLCA to attain regional segmentation and cross-region user segmentation. The parameters of the MLCA model can be estimated by maximum likelihood. The maximization of the likelihood function can be achieved by an adapted version of the Expectation-Maximization (EM) algorithm (Bijmolt et al., 2004; Vermunt, 2003).

Social science research using user-level data is typically based on regional samples that are not proportional to actual population sizes. If one requires conclusions out of the entire cross-region population, then re-weighting would be necessary to ensure the pooled sample accurately represents the population (Vermunt, 2003; Bijmolt et al., 2004). To achieve valid inferences in the multi-level latent class analysis, this study herein weighted each observation by sample size according to the population of gender, age, and the population of each region. This investigation examined the extent to which there were cross-regional versus regional-specific user segments defined by behavior patterns and whether groups of regions existed that were homogenous in their user segment structure. In particular, the relative sizes of cross-regional user segments determined region segmentation. The simultaneous approach ensured that both regional-specific and cross-regional user segments were accommodated. Estimations are obtained for fixed numbers of regional segments (T) and user segments (S). Appropriate values for these numbers can be determined by estimating the multi-level latent class model for different values of T and S, and by examining the relative fit of alternative model specifications, e.g. by using the minimum Bayesian information criterion (BIC) rule (Henry & Muthén, 2010; Horn et al., 2008; Vermunt, 2003). A variety of studies and articles suggested the use of the BIC as a good indicator for class enumeration over the others (Henry & Muthén, 2010; Horn et al., 2008; Nylund, Asparouhov & Muthén, 2007; Vermunt, 2003).

Sample

Taiwan's Internet prevalence is rather high. In 2009 the average percentage of household Internet access was 78.1%, with average time spent on the Internet at 2.95 hours per day (Research, Development and Evaluation Commission, RDEC, Taiwan, 2009), proving that Taiwan can move side by side with developed countries in this regards, such as the United States of America (77.3%), Austria (74.8%), France (68.9%), Germany (79.1%), Turkey (45%), Japan (78.2%), South Korea (81.1%), and Singapore (77.8%) (Miniwatts Marketing Group, Internet World Stats, 2010). Therefore, the surveyed data of Internet e-learning on Taiwanese residents could be a reference to some extent and also be a good source for curriculum designers to work on e-learning products and marketing services. The collected data herein for all analyses adopted the digital divide survey conducted by the RDEC, which had intended to evaluate the status of information infrastructure implementation and the current situation in Taiwan. This annual survey of the digital divide included three parts: information and communications technology environment, skills to use the Internet, and usage behaviors of the Internet. The survey was conducted by computer and telephone interviews from July to August in 2009. Random sampling interviews were used to interview a segmented population of interviewees at age 12 or above in 25 counties and cities. The survey collected 16,133 valid random samples with a response rate of 66.4%, and the sampling errors never exceeded ±4%. This study took nine items of categorical variables about online use behavior as a research dataset. The data were used in exclusion of missing values for the 10,909 valid samples.

Nine categorical indicators were used to inform latent class membership: (1) using for entertainment purposes (1=yes, 0=no), (2) acquiring general information (1=yes, 0=no), (3) searching for product information (1=yes, 0=no), (4) using online shopping (1=yes, 0=no), (5) searching for job information (1=yes, 0=no), (6) e-learning (1=yes, 0=no), (7) browsing blogs (1=yes, 0=no), (8) sharing information (1=yes, 0=no), and (9) connection with Internet through a mobile phone (1=yes, 0=no). This paper considered latent classes of online learning among 10,909 Taiwan residents who live in one of 25 different regions. This data structure represents a nested or multi-level design in which individuals make up level 1 of the hierarchy and regions are level 2. This study took both individual and contextual level predictors of the Internet use behaviors' typologies. Table 1 shows descriptive statistics for the Internet use sample.

Table 1: Descriptive statistics for the online behavior sample

Region	Sample size	%
Taipei City	1856	11.51
Taipei County	2712	16.81
Keelung City	274	1.70
Ilan County	322	1.99
Taoyuan County	1337	8.29
Hsinchu County	338	2.10
Hsinchu City	274	1.70
Miaoli County	387	2.40
Taichung County	1082	6.70
Taichung City	742	4.60
Changhua County	918	5.69
Nantou County	371	2.30
Yunlin County	499	3.10
Chiayi County	387	2.40
Chiayi City	193	1.20
Tainan County	789	4.89
Tainan City	532	3.30
Kaohsiung City	1077	6.68
Kaohsiung County	868	5.38
Pingtung County	627	3.89

Penghu County	64	0.40
Hualien County	241	1.50
Taitung county	161	1.00
Kinmen County	65	0.40
Lienchiang County	16	0.10
Total	16133	100.00
Demographic	**%**	
Age		
20 and younger	20.80	
21-30	25.86	
31-40	23.94	
41-50	18.51	
51 and older	10.88	
Gender		
Female	48.31	
Male	51.69	
Learning behavior	**% (had experience)**	
Entertainment	75.14	
General information	87.99	
Product information	68.52	
Online shopping	59.28	
Job information	78.33	
e-Learning	30.41	
Browser blog	76.70	
Share information (video, photo)	38.55	
Connect Internet w/mobile phone	20.31	

Model Fit

In order to study the similarities and differences between the patterns of on-line behaviors from nine Internet applications among 10,909 users and 25 regions, this study applied the multi-level latent class analysis model described beforehand. This paper incorporated the effects of two demographic variables (age and gender) by means of concomitant variables. Model estimates were obtained for alternative numbers of user segments (S=1...5) and regional segments (T=1...2). Table 2 reports model fit (in particular, the BIC value) for each combination of S and T. The minimum BIC was applied on the optimal number of user segments (Henry & Muthén, 2010; Horn et al., 2008; Vermunt, 2003). The overall minimum BIC was attained at five user segments and two regional segments (BIC= 100226), which this study identified as the most appropriate solution. The research also checked the reports' model fit through the result of the Wald test (Wald, 1943). The Wald value of the Model for Clusters (T1=52.27, p-value<0.00; T2=24.73, p-value<0.00) means the contextual level is divided into two segments with significant differences (Agresti, 2007; Wald, 1943). In addition, Models for Indicators (nine categorical indicators in level 1) are also significantly different (p-value<0.00). The covariates' variables (two demographics variables) are also significantly different (p-value<0.00). Therefore, this study divided the user level into five segments and regional level into two segments, which altogether induced the most appropriate solution thereof.

Table 2. Model fit (BIC) for alternative numbers of region and user segments

BIC	**Number of regional segments**		
Number of user segments	1	2	3
1	*110876*	110886	110895
2	*101939*	101943	101959
3	101100	*101095*	101119
4	100305	*100281*	100308
5	**100233**	***<u>100226</u>***	**100261**
6	100255	*100244*	100298
7	100289	*100280*	100325

Note: The lowest BIC within each row is in italic and within each column in boldface. The lowest BIC overall is underlined.

RESULTS

User and regional segmentation

Do online learning behaviors exhibit certain identifiable patterns (based on multilevel data structures)? Table 3 presents Internet use and online learning behaviors within each user segment. The table shows the conditional probabilities of nine users' online behaviors. At the individual level, this paper discovered that the Internet use pattern consists of five segments (S1-S5) that showed distinctive online learning patterns. Taiwan was divided into two regional segments (referred to as T1 to T2), where Figure 1 presents each regional segment, and the population size of each group is 53.33% and 46.67%. In order to deduce interpretation, this paper offered regional segment membership probability through the category of each user segment, averaged across all categories (user segment) of the other regional segments. Based on individual level (five segments) and contextual level (two segments), this paper summarized the multi-contingency by a table of regional segments and administrative region of Taiwan (see Appendix A). Regional Segment 1 (T1) includes relatively more metropolitan areas, and most of the local governments focus on service development. This class was categorized as the service area segment. Regional Segment 2 (T2) locations are in central or southern Taiwan which encompasses mainly agricultural areas. This class was categorized as the agricultural area segment. These two regional segments of the composition are different.

Users' on-line behaviors and thereby membership of user segments are often related to demographic variables such as age and gender. This paper assessed the effects of two demographic variables: age and gender. Ages included under 20, 21-30, 31-40, 41-50, and above 51 for 5 species. The probability that a user belonged to a particular segment is modeled to depend on his/her demographics and on regional segmented membership. To assess the significance of the demographic effects, this paper employed the Wald test (Agresti, 2007; Wald, 1943) for nested models. Both two demographic variables significantly affected user segment factors: age (Wald value=1934.57, p<0.001) and gender (Wald value=63.83, p<0.001). The lower part of Table 3 presents the findings for the effects of demographic variables. In order to deduce further interpretation, this paper referred to the practice by Bijmolt et al. (2004) and did not present logic parameters, but rather segmented membership probability per category of each demographic variable, averaged across all categories of the other variables. For example, the rate of males in every user segment (S1 to S5) was 32%, 30%, 14%, 16%, and 9%, respectively.

Table 3. Model Results: User Segments

	Individual (user) segment							Regional segment	
	S1	S2	S3	S4	S5	likelihood ratio chi-square test		likelihood ratio chi-square test	
Cluster size	**0.33**	**0.31**	**0.15**	**0.14**	**0.06**	χ^2	p-value	χ^2	p-value
On-line behaviors	**Behaviors probabilities**								
Entertainment	0.64	0.95	0.33	0.96	0.88	3404.17	0.00	1.01	0.31
General information	0.95	0.98	0.67	0.88	0.49	1982.52	0.00	46.95	0.00
Product information	0.83	0.96	0.23	0.46	0.10	5523.59	0.00	76.64	0.00
Online shopping	0.67	0.95	0.19	0.26	0.09	5861.55	0.00	41.69	0.00
Job information	0.80	0.96	0.36	0.89	0.55	2733.33	0.00	1.56	0.21
e-Learning	0.24	0.48	0.06	0.37	0.16	1366.99	0.00	0.51	0.47
Browsing blogs	0.74	0.99	0.27	0.97	0.48	4678.31	0.00	7.89	0.00
Information sharing (videos, photos)	0.14	0.76	0.04	0.62	0.08	5519.50	0.00	1.69	0.19
Connection to the Internet through mobile phone	0.15	0.36	0.06	0.17	0.10	941.35	0.00	14.26	0.00
Demographics variables	**Relative sizes of individual segment**								
Age						9890.28	0.00	49.75	0.00
20 and younger	0.00	0.25	0.00	0.55	0.20				
21-30	0.22	0.60	0.06	0.08	0.04				
31-40	0.53	0.33	0.11	0.01	0.03				
41-50	0.57	0.13	0.29	0.01	0.01				
51 and older	0.39	0.04	0.52	0.05	0.00				
Gender						162.37	0.00	1.46	0.23
Female	0.34	0.33	0.16	0.13	0.03				
Male	0.32	0.30	0.14	0.16	0.09				

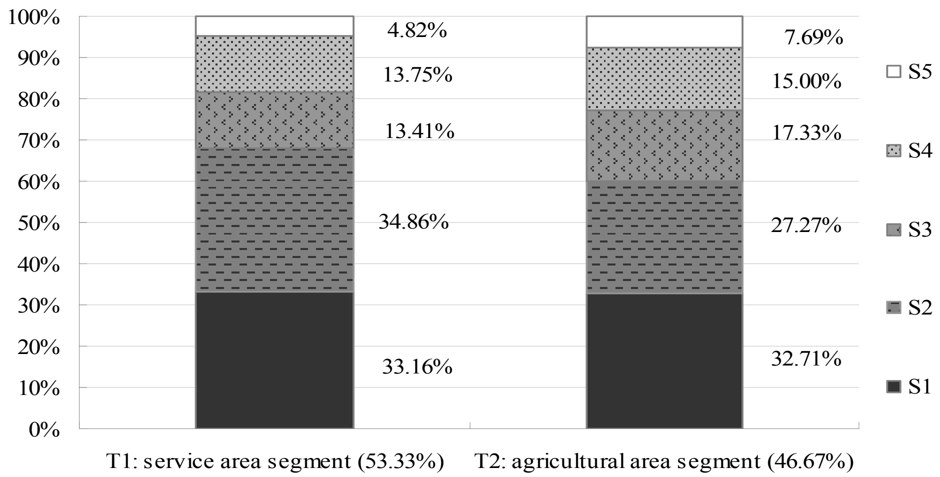

Figure 1. Multilevel latent class solution

Full model estimated

Do online learning patterns exhibit regional differences? This paper further assessed the significance of the individual segment effects. Moreover, the individual segment (user segment) variables significantly affected regional segment membership (χ^2=93.27; df=4; p-value<0.00). These results show that online learning patterns did exhibit regional and demographic differences and that the online behavior patterns exhibited urban and rural differences. For instance, the service area segment comprised a higher proportion of members who were good at using the Internet. The agricultural area segment made up a higher proportion of members who occasionally used the Internet. These two regional segments of the composition were different.

How do demographic variables affect online learning patterns? The full model is next estimated, including both two concomitant variables. To assess the significance of the demographic effects, this research employed the likelihood ratio test for nested models. All two demographic variables significantly affected user segment membership: age (χ^2=9890.27; df=16; p-value<0.00) and gender (χ^2=162.37; df=4; p-value <0.000). Users' personal characteristics dictated the individual segments. Age and gender had a large influence on the user segment probabilities. For instance, younger people were good at various online services, as they conducted more interactive applications than others. Older people were less likely to use online learning applications. Of the users' personal characteristics included in this study, gender had the smallest impact, as shown by the chi-square test values and the differences between the segment membership's probabilities (right part of Table 3). Generally speaking, males were relatively energetic at connecting to the Internet through a mobile phone, while females had a comparative concern for online shopping.

Online users' behavior patterns

This study took the contextual effect influenced by areas and their demographic variation into account for analysis. Table 3 shows the conditional probabilities of each of the nine types of use behavior within each individual segment (S1-S5, level 1). By considering some demographic variables such as age and gender, this paper divided user segmentation at the individual level into five groups and regional segmentation at the contextual level into two clusters, gaining striking and significant results. In short, the clusters identified in this research (S1-S5 and T1-T2) effectively partitioned the online learning pattern among 10,909 users. User segmentation in each model of users' on-line behaviors was not the same. Figure 1 and Table 3 summarize a more detailed classification of users' on-line behaviors. Considering contextual level (regional) and demographic variables, the five patterns of users' on-line behaviors (user segments S1 to S5) are stated as follows.

S1: This segment consisted of 33% of the total samples, chiefly composed of ages 31-50. They were good at using the Internet for information research related to work and business communication, such as researching general information (95%), searching for product information (83%), and searching for job information (80%). They had relatively lower frequencies to use it for entertainment (64%) and information sharing (14%). Their contextual level resided evenly in each regional segment. This group was categorized as the business segment.

S2: This segment consisted of 31% of the total samples. This group was knowledgeable on various Internet applications, such as entertainment (95%), researching general information (98%), searching for product information (96%), online shopping (95%), searching for job information (96%), and browsing blogs (99%).

Within this group, 76% have experienced sharing information (video, photo), 48% of them have used e-learning, and their connection to the Internet through a mobile phone was even up to 36%: these are the highest conditional probabilities of all segments. Their contextual level (regional segment) had a maximum number in the service area segment. This group was categorized as the knowledge segment.

S3: This segment consisted of 15% of the total samples. They were not young. They used traditional Internet applications such as researching general information (67%) and searching for product information (23%). Only 19% of them used online shopping and less than 10% of them used e-learning, sharing information, and connecting to the Internet through a mobile phone. Their contextual level (regional segment) had more numbers in the agricultural area segment. This group was categorized as the traditional segment.

S4: This segment consisted of 14% of the total samples. They basically were composed of people under the age of 20. More than 85% of them used the Internet for entertainment, general information, job information, and browsing blogs. Their use of e-learning, frequencies, and participation of information sharing was relatively high (37% and 62%), whereas their connection to the Internet through a mobile phone was also significantly prominent (17%). Their contextual level resided evenly in each regional segment. This group was categorized as the active segment.

S5: This segment consisted of 6% of the total samples. Most of them were young and skilled in using amusement services such as for entertainment (88%) and browsing blogs (48%). They did not to care about product information (10%), information sharing (8%), or e-learning (16%). They rarely used online shopping (9%), but they did use the Internet for researching general information (49%). This group had a higher proportion of males. Their contextual level (regional segment) had more numbers in the agricultural area segment. This group was categorized as the entertainment segment.

What kind of special or interesting online learning pattern differences exist? These five user segments showed distinctive online behavior patterns. The knowledge segment's members were good at various Internet applications. Most of the knowledgeable users were relatively energetic for online learning versus the others, and websites could offer these users discounts of customization to attract their use. The active segment's members were relatively young and skilled at various online interactive applications, such as browsing blogs, online sharing information, and e-learning. If a service designer is trying to target this group, then it could use pre-introduction or a trial together with a promotion of an online interactive service. The business segment's members had relatively lower frequencies to use the Internet for entertainment and information sharing. If a service designer is trying to target the business segment, then it should enhance work and business communication services. The entertainment segment's members preferred to use the Internet for entertainment and were inexperienced at online shopping service. The traditional segment's members were not young and had a lower use rate of online services, whereas they also used general information searching service. If a service designer is trying to target the traditional segment or the entertainment segment, then it should offer these users a relative friendly and easy-to-use service to attract their purchases.

CONCLUSIONS

This study has applied nine types of online applications as the classification scheme from the survey of the digital divide conducted by RDEC in Taiwan in 2009. This study used a multi-level latent class model to evaluate whether the online learning patterns exhibited regional differences in Taiwan at both the individual level and the regional level. This paper categorized the online leaning patterns into five user segments: business, knowledge, traditional, trendy, and entertainment. At level 2, this paper categorized the population into two regional segments: service area and agricultural area. This paper found that both user segments and regional segments were highly interpretable. Do online learning patterns exhibit regional and demographic differences? Yes, they do.

MANAGERIAL IMPLICATIONS

The regional segments are dictated by the user segments (level 1). For instance, the service area comprised a higher proportion of knowledge segments and business segments (level 1). This service area group was made up of a higher proportion of members who were good at using online learning applications, such as acquiring general information, searching for product information, and browsing blogs. The agricultural area comprised a higher proportion of the traditional segment and entertainment segment (level 1). This agricultural area group made up a higher proportion of members who used the Internet for entertainment applications and a lower proportion of people who were good at using the Internet.

The results of the analysis indicated that age and gender influenced online learning behaviors. For instance, younger people were good at using Internet services, as those aged under 30 adopted entertainment, online shopping, and connecting to the Internet through a mobile phone more/faster than others. Younger people preferred interactive applications such as e-learning, browsing blogs, and sharing information, while older people used traditional Internet services, such as general information research. The gender difference affected online usage patterns. This research showed that males preferred enjoyment applications, such as entertainment service, while females preferred education or purchasing Internet services, such as e-learning or online shopping.

This paper has suggested that Internet product or service providers could find more appropriate user clusters based on the characteristics of products. Partnerships between users' demographic and regional institutions should prove valuable for service area population and agricultural area population segments by enabling online learning applications. For instance, if a service designer is trying to target younger users, then it could implement a pre-introduction or a trial together with a promotion on a trendy online application, such as an entertainment, online shopping, e-learning, blog, or mobile phone service. People aged 21-30 were the major users of online learning applications, and websites could offer these users appropriate interactive functions and discounts of customization to attract their purchases. E-learning or online shopping websites could offer females an appropriate discount of customization to attract their purchases.

Among individual segment members using the Internet to look for general information, searching for product information, online shopping, browsing blogs, and using a mobile phone connection to the Internet had the most obvious differences between service area and agricultural area. Service providers can offer an appropriate collocation of local product information, customized interaction blogs, and a trial together with promotions on online learning applications in order to attract such usage. On the other hand, websites could offer knowledge segment members a mobile learning service and discounts of customization to attract their use. Service designers could use pre-introduction or a trial together with a promotion on an online interactive service to invite active segment members' use. Websites could make themselves more applicable to business segment members by enhancing work and business communication services. With these findings, a service provider might identify its potential users in order to design the proper marketing strategies. Service providers can refer to the online learning patterns for their own online curriculum design, which might be helpful to increase the fit and service satisfaction between products and users' needs.

LIMITATIONS AND FUTURE RESEARCH

The multi-level latent class results herein described the current usage segmentation structure based on online learning patterns, without making inferences on what may have caused these patterns. In general, the online learning behavior by a user will not only depend on the user's skills and needs, but will also partly be driven by what education department is offered. It remains unclear to what extent demand or supply factors have generated the online learning patterns observed in this paper. For a conclusion on this topic, further research could investigate the influence of the curriculum offerings and other service efforts by education department on user behavior-portfolios in different regions. On the other hand, one limitation of the database concerns the lack of information on cross-regional equivalence, such as local economic capacity. The performance of the multi-level latent class model will depend on the number of countries or the number of users per region. Future research using a larger and broader set of regions could highlight the value of simultaneously grouping regions and users.

REFERENCES

Agresti, A. (2007). *An introduction of Categorical Data Analysis*. Hoboken, New Jersey: JohnWiley & Sons, Inc.

Anderson, B., & Tracey, K. (2001). Digital living: The impact (or otherwise) of the Internet on everyday life. *The American Behavioral Scientist*, 45(3), 456-475

Aypay, A. (2010). Information and communication technology(ICT) usage and achivement of turkish students in PISA 2006. *The Turkish Online Journal of Educational Technology*, 9(2), 116-124

Bijmolt, T.H.A., Paas, L.J., & Vermunt, J.K. (2004). Country and consumer segmentation: Multi-level latent class analysis of financial product ownership. *International Journal of Research in Marketing*, 21(4), 323–340. DOI:10.1016/j.ijresmar.2004.06.002

Changchien, S. W., Lee, C.F., & Hsu, Y. J.(2004). On-line personalized sales promotion in electronic commerce. *Expert Systems with Applications*, 27(1), 35-52. DOI:10.1016/j.eswa.2003.12.017

Chen, W., & Wellman, B. (2004). The global digital divide-within and between countries. *IT&Society*, 1(7), 39-45

Citrin, A.V., Sprott, D.E., Silverman, S.N. and Stem, D.E. (2000). Adoption of Internet shopping: the role of consumer innovativeness. *Industrial Management & Data Systems*, 100(7), 294-300. DOI:10.1108/02635570010304806

Colley, A., & Maltby, J. (2008). Impact of the Internet on our lives: Male and female personal perspectives. *Computers in Human Behavior*, 24(5), 2005–2013. DOI:10.1016/j.chb.2007.09.002

Delialioglu, O., Cakir, H., Bichelmeyer, B. A., Dennis, A. R., & Duffy, T. M. (2010). Factors Impacting adult learner achievement in a tehcnology certificate program on computer networks. *The Turkish Online Journal of Educational Technology*, 9(2), 97-107.
Donnermeyer, J. F., & Hollifield, C. A.(2003). Digital divide evidence in four rural towns. *IT&Society*, 1(4), 107-117
Goodman, L. A. (2007). Statistical Magic and/or Statistical Serendipity: An Age of Progress in the Analysis of Categorical Data. *Annual Review of Sociology*, 33, 1-19. DOI:10.1146/annurev.soc.33.040406.131720
Gross, J. and Leslie, L. (2009). Learning 2.0: a catalyst for library organizational change. *The Electronic Library*, 28(5), 657-668.
Hargittai, E., & Hinnant, A. (2008). Digital Inequality Differences in Young Adults' Use of the Internet. *Communication Research*, 35(5),602-621. DOI:10.1177/0093650208321782
Henry, K. L., & Muthén, B. (2010). Multilevel latent class analysis: An application of adolescent smoking typologies with individual and contextual predicators. *Structural Equation Modeling: A Multidisciplinary Journal*, 17(2), 193-215.
Horn, M.L.V., Fagan, A.A., & Jaki, T. (2008). Using Multilevel Mixtures to Evaluate Intervention Effects in Group Randomized Trials. *Multivariate Behavioral Research*, 43(2), 289-326.
Howard, P. E. N., Painie, L., & Jones, S. (2001). Days and Nights on the Internet The Impact of a Diffusing Technology. *American Behavioral Scientist*, 45(3), 382-404. DOI:10.1177/0002764201045003003
Jackson, L. A., Zhao, Y., Kolenic, A., Fitzgerald, H. E., Harold, R., & Eye A. V. (2008). Race, Gender, and Information Technology Use: The New Digital Divide. *CyberPsychology & Behavior*, 11(4), 437-442. DOI:10.1089/cpb.2007.0157
Kiyici, F. B.,(2010). The definitions and preferences of science teacher candidates concerning Web 2.0 tools: a phenomenological research study. *The Turkish Online Journal of Educational Technology*, 9(2), 185-195
Korupp, S. & Szydlik, M. (2005). Causes and trends of the digital divide. *European Sociological Review*, 21(4), 409-422. DOI:10.1093/esr/jci030
Livingstone, S., & Helsper, E. (2007). Gradations in digital inclusion: Children, young people and digital divide. *New Media & Society*, 9(4), 671-696. DOI:10.1177/1461444807080335
Lohse, G. L., Bellman, S., & Johnson, E. J. (2000). Consumer buying behavior on the internet: findings from Panel Data. *Journal of Interactive Marketing*, 14(1), 15-29.
Lo´pez-Bonilla, J. M., & Lo´pez-Bonilla, L. M. (2010). Sensation Seeking and the Use of the Internet : A Confirmatory Analysis of the Brief Sensation Seeking Scale (BSSS) by Gender. *Social Science Computer Review*, 28(2), 177-193. DOI:10.1177/0894439309341229
Mills, B. F., & Whitacre, B. E. (2003). Understanding the non-metropolitan-metropolitan Digital Divide. *Growth and Change*, 34(2), 219-43. DOI:10.1111/1468-2257.00215
Miniwatts Marketing Group. (2010). Re: Internet World Stats. Retrieved February 1, 2011 From http://www.internetworldstats.com/stats.htm
Nylund, K. L., Asparouhov, T., & Muthén, B. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling: A Multidisciplinary Journal*, 14, 535–569.
Research, Development and Evaluation Commission (RDEC), Executive Yuan, Taiwan. (2009). Re: Digital Divide in Taiwan Survey. Retrieved January 25, 2011 From http://www.rdec.gov.tw/mp110.htm
Sahin, Y. G., Balta, S., & Ercan, T. (2010). The use of Internet resources by university students during their course projects elicitiation: a case study. *The Turkish Online Journal of Educational Technology,* 9(2), 234-244.
Sam, H. K., Othman, A. E. A., & Nordin, Z. S. (2005). Computer Self-Efficacy, Computer Anxiety, and Attitudes toward the Internet: A Study among Undergraduates in Unimas. *Educational Technology & Society*. 8(4), 205-219.
Selwyn, N., Gorard, S., & Furlong, J. (2005). Whose Internet is it Anyway? Exploring Adults' (Non)Use of the Internet in Everyday Life. *European Journal of Communication March*, 20(1), 5-26. DOI:10.1177/0267323105049631
Shah, D.V., Kwak, N., & Holbert, R. L. (2001). "Connecting" and "Disconnecting" With Civic Life: Patterns of Internet Use and the Production of Social Capital. *Political Communication*, 18(2), 141–162
Song, H. S., Kim, J. K., & Kim, S. H. (2001). Mining the change of customer behavior in an internet shopping mall. *Expert System with Applications*, 21(3), 157–168. DOI:10.1016/S0957-4174(01)00037-9
Teo, T. S. H. (2001). Demographic and motivation variables associated with internet usage activities. *Internet Research: Electronic Network Applications and Policy*, 11(2), 125-137.
Teo, T. S. H., & Lim, V. K. G. (2000). Gender differences in internet usage and task preferences. *Behavior & Information Technology*, 19(4), 283-295.
Torkzadeh, G., and Dhillon, G. (2002). Measuring factors that influence the success of Internet commerce. *Information Systems Research,* 13(2), 187-204.

Vermunt, J. K., (2003). Multilevel latent class models. *Sociological Methodology*, 33(1), 213-239. DOI:10.1111/j.0081-1750.2003.t01-1-00131.x
Vermunt, J. K., & Magidson, J. (2005). *Latent GOLD 4.0 User's Guide.* Belmont, Massachusetts: Statistical Innovations Inc.
Wald, A., (1943). Tests of statistical hypotheses concerning several parameters when the number of observations is large. *Transactions of the American Mathematical Society*, 54(3), 426-482.
Wasserman, I.M., & Richmond-Abbott, M., (2005) Gender and the Internet : causes of variation in access, level, and scope of use. *Social Science*, 86(1), 252–270. DOI:10.1111/j.0038-4941.2005.00301.x
Weiser, E.B. (2001). The Functions of Internet Use and Their Social and Psychological Consequences. *CyberPsychology&Behavior*, 4(6), 723-743. DOI:10.1089/109493101753376678
Wilson, K.R., Wallin J.S., Resier C. (2003) Social stratification and the digital divide. *Social Science Computer*, 21(2),133-143. DOI:10.1177/0894439303021002001
Yang, C., Hsu, Y. C. & Tan, S. (2010). Predicting the Determinants of Users' Intentions for Using YouTube to Share Video: Moderating Gender Effects. *Cyberpsychology, Behavior, and Social Networking*, 13(2), 141-152. DOI:10.1089/cyber.2009.0105
Yukelturk, E. (2010). An investigation of factors affecting student participation level in an online discussion forum. *The Turkish Online Journal of Educational Technology*, 9(2), 24-32

Appendix

Appendix A. The region composition of the Regional Segment

City/County	Regional Segment T1	T2	Subtotal
Taipei City	1355	0	1355
Taipei County	1942	0	1942
Keelung City	189	0	189
Ilan County	198	0	198
Taoyuan County	967	0	967
Hsinchu County	233	0	233
Hsinchu City	208	0	208
Miaoli County	0	256	256
Taichung County	0	726	726
Taichung City	572	0	572
Changhua County	0	579	579
Nantou County	220	0	220
Yunlin County	0	265	265
Chiayi County	0	211	211
Chiayi City	131	0	131
Tainan County	0	499	499
Tainan City	0	353	353
Kaohsiung City	0	760	760
Kaohsiung County	0	532	532
Pingtung County	0	364	364
Penghu County	36	0	36
Hualien County	158	0	158
Taitung county	104	0	104
Kinmen County	40	0	40
Lienchiang County	11	0	11
Total	6364	4545	10909

EFFECTIVENESS OF INSTRUCTIONAL DESIGN MODEL (ISMAN - 2011) IN DEVELOPING THE PLANNING TEACHING SKILLS OF TEACHERS COLLEGE STUDENTS' AT KING SAUD UNIVERSITY

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ABSTRACT
The new instructional design model (Isman - 2011) aims at planing, developing, implementing, evaluating, and organizing full learning activities effectively to ensure competent performance by students. The theoretical foundation of this model comes from behaviorism, cognitivism and constructivism views. And it's based on active learning. During teaching and learning activities, learner is active and uses cognitive learning to construct new knowledge. To construct new knowledge, educational technology materials are used. These materials are connected with goals and objectives. This study examines the effectiveness of the instructional design model (Isman - 2011) in developing the students teaching skills (Planning Teaching Domain) by redesign "General teaching methods course – curr 233-", which taught to the sixth level students at teachers' college, King Saud University. The sample of the study consisted of 80 students that enrolled in the second semester 2010/2011, they were divided into two groups of 40 students each, (an experimental group and a control group). The result comes by administered pre- post teaching skills test to find out the model has strong effectiveness in achieving the research aims especially in developing the student teaching skills.
Keywords: instructional design, teaching skills, Isman 2011 instructional design model.

INTRODUCTION
Instructional System looks large and consecutive development to keep up with changes resulting from the progress of science, technology and the subsequent rapid growth and constant in the era of knowledge. It was natural to strive instructional systems to adapt to these developments and understand concepts commensurate with the needs of the individual society. Focusing on continuity of learning motivation and work on activating the role of the teachers to be more positive roles, therefore the ability to participate in the production the ability to provide information by modern methods that are compatible with the characteristic of students and twenty-first century instead of the traditional methods.

Given global economic conditions that are increasingly forcing organizations' to downsize while simultaneously requiring an increase in productivity from their remaining, reduced workforce, instructional designers are increasingly called upon to produce higher quality instructional programs using ever more efficient methodologies. This new economy can be summarized in two words: change and speed (Gordon & Zemke, 2000, p44).

Instructional design research has historically focused on increasing learner efficiencies through the examination of areas such as cognitive load theory, the study of what instructional designers actually do to increase efficiency during the design of instruction. Therefore, Instructional events refer to actions of both teacher and learners during the teaching session. Selecting appropriate events and planning them in the right format and the right sequence is crucial in a successful lesson design. A lesson design is a plan showing the type of instructional events, their order and the kind of activity taking place in each event. In designing a lesson plan, there are two important factors: the objectives and the learners.

Dick & Carey (2001) ; Ross &Kemp (2004) ; Smith & Ragan (1993) and Posner& Rudnitsky (2001) stated that the term instruction design can be defined as the systematic method for analyzing , designing , developing , evaluating and managing the instructional process efficiently on the knowledge and experience of learning and instructional theories .

Developing teaching skills is the umbrella of any activities doing in any teachers college around the world. Many educators use several approaches, method, frameworks and models to achieve this target. The Model is a schematic description of a system, theory, or phenomenon that accounts for its known or inferred properties and may be used for further study of its characteristics. The model can present complex information in a simpler way. And the model may be procedural (describing hoe something works) or conceptual (describing components and the relationship between these components). In this paper we take (Isman - 2011) instructional design model as Example for these efforts to enhancing and developing teaching and learning.

Arthur Markman (1999) stated that. Mental models are one way that humans represent knowledge (Markman, 1999, p44 Instructional Design is defined as "a conceptual model for developing instruction and typically includes analysis, design, development, implementation, and evaluation. (i.e., ADDIE model). The others say it is a central intellectual process that guides the design and development of successful learning environments (Nelson, Magliaro & Sherman, 1987, p87).

So we should know answer the following questions: ***What are ID models? What is the difference between ID & ICD Model?*** The terms Instructional Design (ID) and instructional Systems Design (ISD) could be used interchangeably. The same holds for Instructional Development and Instructional Systems Development; therefore, both can be used interchangeably. Kent Gustafson points out this mixed use of terminology in many places within each version of his Survey of Instructional Development Models (Dick & Carey,2001); for example, while Dick and Carey refer to their model as Instructional Design, (Gustafson & Branch,1997) Gustafson believes it should be categorized as an Instructional Development model.

Instructional System Design indicates the overall plan and it is concerned with the processes for any instruction regardless of the field. It works as a guide indicating how to implement as instruction. Basically and simply the routine of the instructional design includes and follows the stage of analysis, design, development, implementation and evaluation and shortly this model is called ADDIE. These are the common characteristics found in almost all instructional design models. (Baturay, 2008, 472)

Conceptual models have been created for teachers, professional developers, and others partners of Learning and Training Field, some models are advertised as applicable to a range of contexts, students, and content (e.g., Dick & Carey Model, Kemp Model, 3PD, 4C/ID-Model, Merrill's 5-Star Model and others Instructional Design Models).

Most of instructional design models agree in this points with different arrangements (basic description of the ADDIE component): **Analysis:** the initial information gathering activities which assess the what, who, how and why of the instructional activity. **Design:** designing the objectives and desired outcomes of the instructional activity and the overall plan such as timelines, strategies, lesson plans, etc. **Development**: the actual making of the instructional materials including instructor guides. **Implementation:** putting the plan and the instructional materials into action such as completing offering a computer –based instructional module. **Evaluation:** checking for the effectiveness of the instructional program both immediately and in the long run.

Isman (2011) presented new instructional design model in his paper entitled "instructional design in education: new model". The major goal of this model is to point up how to plan, develop, implement, evaluate, and organize full learning activities effectively so that it will ensure competent performance by students.

In addition, the main goal of this model is to organize long term and full learning activities. The new instructional design model is based on the theoretical foundation of behaviorism, cognitivism and constructivism. During teaching and learning activities, learner is active and uses cognitive, constructivist or behaviorist learning to conduct new knowledge. To construct new knowledge, educational technology materials are used. These materials are related with goals and objectives. Isman model is based on instructional system theory. It is occurred within the five stages. These are input, process, output, feedback and learning (Isman, 2011. p 142).

Isman (2011) in his paper descries the five steps which contains twelve stages: Input (five stages), Process (three stages), Output (two stages), Feedback (one stage), and Learning (one stage). The model steps divided into twelve stages which distributed in the five steps as follows in table (1).

Table (1) shows the steps and stages of (Isman- 2011) instructional design model

The step	The stages	The descriptions
1- The input step	1.1 Identify needs	Derived from a needs assessment with regard to particular curriculum by using survey, observation and interview methods to determine what the students need to learn. The definition of needs may be derived from a needs assessment with regard to particular curriculum
	1.2 Identify contents	The contents are derived from students' needs. The main goal of this step is to clarify what to teach
	1.3 Identify Goals-Objectives,	The goals and objectives are derived from need assessment and contents, and define what students will be able to do after instructional process. Goals and objectives usually contain skills, knowledge and attitudes. Skills could be psychomotor skills and intellectual skills. When students learn psychomotor skills, they develop muscular actions. When students learn intellectual skills, they develop cognitive activity such as discrimination, implementation and solving problem. The goals and objectives are derived from need assessment and contents
	1.4 Identify teaching methods,	Teaching methods should be related with content and goals because goals and objectives will be taught with the appropriate method
	1.5 Identify instructional media.	It tells us how to deliver the instruction to students. And apply communication and learning. Identify instructional media is based upon a review of needs, contents, goals and teaching methods. These instructional media should motivate students to learn and keep the new knowledge in the long term memory. It includes books, journals, graph, model, picture, poster, cartoon, newspaper, dioramas, trip, blackboard, multimedia, films, radio, telephone, television, computer, data projection, internet and others. The instructional media is usually used to enhance learning by instructional designer.
2- The process step	2.1 Test prototypes,	The main goal is to find out which stages are working and which stages are not working. Testing prototypes tells us what students really want to learn and how to get there
	2.2 Redesigning of instruction	After problems are identified, we reorganize instructional activities. To reorganize instructional activities, pre-testing plays a key role to design an effective instruction. If an effective instruction is designed well, instructional goals will be achieved successfully.
	2.3 Teaching activities.	Teacher begins teaching activities in terms of content, teaching methods, goals and objectives with instructional media.
3- The Output step	3.1 Assessment	Teacher uses formative and summative evaluation methods to check goals and objectives. This process requires teacher to implement assessment tools to determine whether the students did demonstrate the skills, knowledge, and attitudes that teacher described in instruction goals and objectives or not. When the students participate in the instructional activities, teachers want to know whether they learned what the instructional plan expected them to learn. Teachers should analyze the results and make decision on where to go in the instruction
	3.2 Revise instruction	We shall evaluate all instructional activities. If we find problems during the instructional design process. Then, we solve the problems after that redesign the instruction.
4- Feedback	4.1 Go back to related steps	The feedback process involves revise instruction based upon the data collected during the implementation phase. If, during the phase, teacher finds that students are not learning what the plan wanted them to learn, and/or they are not enjoying the learning process, teacher will want to go back to related step and try to revise some aspect of their instruction so as to better enable their students to accomplish their goals. During this cycle, instructional designer may go back to any steps to where a problem is occurred
5- Learning	5.1 Long term learning	The learning process involves full learning. In this process, teacher wants to make sure that their students have learned what the instructional plan wanted

The step	The stages	The descriptions
		them to learn. If, during the phase, teacher finds that their students accomplished their goals in the instructional activities, teacher will want to go new instructional activities. At the end of this step, long term learning is accomplished by instructional designer.

THE STUDY

In this paper, we have chosen a routine practical procedure that student teachers need to learn the designing lessons, instructional situations in the classroom lessons and the planning Teaching Skills. Therefore, we think that our duty is to improve the student teachers' understanding of instructional design models, its implementation in teaching, learning, and help student teachers design successful learning environments.

This study attempts to examine the effectiveness of the instructional design model (Isman - 2011) in developing the students' teaching skills (Planning Teaching Domain) by redesign “General teaching methods course – curr 233- which is taught , for the first time, to the sixth level students in teachers college at King Saud University, in the light of (Isman - 2011) instructional design model. Also the research tries to answer the following question: What is the effectiveness of using (Isman - 2011) instructional design model in developing the planning teaching skills for student teachers?

The researcher used the Quasi-Experimental approach design for equivalent groups. The population of the study consisted all male students at the curriculum department at Al-Riyadh Teachers' College- King Saud University during the second semester of the academic year 2010/2011. The sample of the study consisted of 80 students who were divided randomly in two groups of 40 students each, (an experimental group and a control group). In this research, the experimental group studied “General teaching methods course – curr 233- which redesign in (Isman - 2011) instructional design model, and the control group studied the original course as it is.

FINDINGS

To answer the first question: What is the effectiveness of using (Isman - 2011) instructional design model in developing planning teaching skills for student teachers? The researcher used an observation scale card to observe the planning teaching skills of the experimental and control groups as pretest and posttest. This scale card is the planning domain from “Teaching Skills Scale card” of (Isman, A. et al, 2012). The differences between two groups in planning teaching standards, at the pretest, are revealed in table (2).

Table (2) the differences between experimental and control groups in planning teaching standards at the pretest

Standards	groups	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
determining the students educational needs	Experimental	8.8250	2.09869	.33183	.499	78	.621
	control	9.0750	2.23478	.35335			
planning for greater targets not for detailed information	Experimental	4.6750	1.30850	.20689	-.172	78	.864
	control	4.6250	1.25448	.19835			
Designing suitable educational activities	Experimental	6.3500	1.09895	.17376	.557	78	.581
	control	6.5000	1.21950	.19282			

The previous tables revealed that there are no significant differences between experimental and control groups at the pretest in planning teaching standards, that mean the two groups are equivalents before the experimental treatment. After 3 weeks of teaching "the planning Teaching Unite" in “General teaching methods course – curr 233“ the researcher made the posttest. The differences between two groups in planning teaching standards, at the posttest, are revealed in table (3).

Table (3) shows that the differences between experimental and control groups in planning teaching standards at the posttest

Standards	groups	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
determining the students educational needs	Experimental	24.7250	1.78293	.28191	8.856	78	.000
	control	20.2750	2.55190	.40349			
planning for greater	Experimental	11.3000	1.35495	.21424	1.410	78	.167

Standards	groups	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
targets not for detailed information	control	10.9000	1.15913	.18328			
Designing suitable educational activities	Experimental	17.0750	1.71550	.27124	7.977	78	.000
	control	13.8500	2.28204	.36082			

The previous tables revealed that there are significant differences between experimental and control groups at the pretest in the first and the third planning teaching standards, but there are no significant differences in the second planning teaching standards. Which indicates the model contributes in developing many of planning teaching skills especially in determining the students' educational needs and Designing suitable educational activities.

About the Experimental group that studied the redesign course, the differences between pre and post test as revealed in table (4).

Table (4) shows that the differences in planning teaching standards between pre and post test of Experimental group

Standards	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
determining the students educational needs	15.90000	2.80841	.44405	35.807	39	.000
planning for greater targets not for detailed information	6.22500	1.94129	.30694	20.281	39	.000
Designing suitable educational activities	10.72500	2.01262	.31822	33.703	39	.000

The result in table (4) shows that there are significant differences between the pre and posttest in favor of the posttest. This finding indicates that the model contributes in developing the planning teaching skills especially over the third standards.

To check the development in teaching skills over indicators, table (5) shows the differences between indicators over standards.

Table (5) shows the differences in planning teaching indicators over standards between pre and posttest of Experimental group

Standards	Indicators	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
determining the educational needs of the student	The teacher designs activities to explore the students' need and talents.	2.57500	1.05945	.16751	15.372	39	.000
	Uses different methods to determine the students' level of understanding.	2.80000	.96609	.15275	18.330	39	.000
	Encourages students to reflect about their life and personal experience.	2.50000	.96077	.15191	16.457	39	.000
	Uses dialogue as a means of knowing the needs and experience of students.	2.72500	.96044	.15186	17.944	39	.000
	Involves students in setting targets for the educational plan and its components.	2.55000	1.21845	.19265	13.236	39	.000
	Determines the stages of lesson planning according	2.75000	.89872	.14210	19.353	39	.000

Standards	Indicators	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
	to student needs and implements them during the time available.						
planning for greater targets not for detailed information	Teacher makes an integrated and comprehensive study of his subject to set his plan.	2.35000	1.02657	.16231	14.478	39	.000
	Adds to his plan motivating activities to encourage research.	1.80000	.93918	.14850	12.121	39	.000
	Sets educational objectives to develop critical thinking and methods of problem solving.	2.07500	1.20655	.19077	10.877	39	.000
Designing suitable educational activities	Teacher designs activities that increase effective learning time.	2.75000	.89872	.14210	19.353	39	.000
	Designs educational units and lessons in the light of long-term objectives.	2.47500	.81610	.12904	19.180	39	.000
	Plans lessons on the bases of his knowledge of the subject and the students.	2.65000	.86380	.13658	19.403	39	.000
	Designs educational activities that allow the use of diverse strategies such as peer and cooperative education.	2.85000	.80224	.12685	22.468	39	.000

The result in table (4) assess the result in table (3), Its shows that, there are significant differences between the pretest and the posttest in favor of the posttest, Also this finding indicates that the model contributes to developing the planning teaching skills in indicators over standards. Then the Results of statistical treatment indicated that, there are significant differences between means of pre-post treatment in Experimental group in favor of posttest. As Students thought, these results indicated that using (Isman - 2011) model helped them to improve their planning Teaching skills. In general, the result indicated that (Isman - 2011) instructional design model which had significantly increased the students competencies in planning lessons and their learning.

CONCLUSION AND DISCUSSIONS

The researcher thinks that until now, Isman (2011) model for instructional design hasn't measured its validity in teaching class, but the findings of this study are logic result. Because this model based on the theoretical foundation of behaviorism, cognitivism and constructivism, and using materials which related with goals and objectives and flows scientific consequence process from Identify needs, contents, Goals-Objectives, teaching methods, instructional media Through Assessment and Feedback to exist the long term learning. And this is compatible with the literature in the result of examining the instructional design model as:

Min Kyu Kim (2010) discusses an effort to improve training performance in a large corporate conglomerate in South Korea. In particular, focus is placed on a new instructional design (ID) model named the Cogwheel ID model. The cogwheel metaphor is used to illustrate the integrated processes within complex training organizations, including organizational, functional, and managerial elements. The model is likely to be directly applicable to other contexts where there are large organizations with a diverse set of sub-groups having different training requirements. In addition, the Cog-wheel ID model can inspire training practitioners to create their own ID solutions to manage and control the quality of training service in their complex organizations.

Le Roux, L & Oosthuizen, H (2010) presented an instructional design (ID) model positioned in the intersection between the positioning-based and resource-based theories and used a multi-disciplinary approach to extend the literature on ID models and offer measurable improvements in job-specific knowledge and productive behavior as proxies for sustainable competitive advantage. The research confirmed the contribution of the ID model in this regard and described and substantiated the pivotal link between training and ID models and the application thereof in practice to aid organisations in the achievement and sustainability of competitive advantage. In this, the second article, the ID model will be subjected to empirical investigation and evaluated through the application thereof in a case organization and a grounded conclusion provided. Hence, this article presents a brief overview of the first article, and focuses on the research methodology, research results, analysis and interpretation; conclusions and assessment of the research.

Fazelian, Porandokht ; Ebrahim, Abdolrarim Naveh and Soraghi, Saeed (2010) investigated the effect of 5E instructional design model on learning and retention in sciences of middle school students. In this regard two hypotheses were tested: 1) 5E instructional design model that increases the learning of students. 2) The instructional design model that increases the retention of science lessons. Population was all middle school students in the city of Nahavand. The sample was selected by cluster sampling method and it was put into two experimental and control groups. Instrument consisted of a researcher made test, which was used as pre and post test during a six weeks period. Collected data was analyzed by ANCOVA and MANOVA. The result indicated that 5E instructional design model which had significantly increased learning and retention of science lessons.

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REFERENCES

Dick W., Carey L.& Carey J. O. (2001). The Systematic Design of Instruction, Addison-Wesley Educational Publishers Inc.

Fazelian, Porandokht ; Ebrahim, Abdolrarim Naveh and Soraghi, Saeed (2010). The effect of 5E instructional design model on learning and retention of sciences for middle class students. World Conference on Psychology, Counselling and Guidance (WCPCG 2010). Antalya, TURKEY. APR 2225, Vol 5 pp 140143. DOI:10.1016/j.sbspro.2010.07.062.

Gordon, J. & Zemke, R. (2000). The attack on ISD. Training,37, 4.

Gustafson, K. L. and Branch, R. M. (1997). Survey of instructional development models, third edition. Syracuse, NY:
ERIC Clearinghouse on Information and Technology.

Isman, A. (2011). Instructional Design in Education: New Model. Turkish Online Journal of Educational Technology - TOJET, 10(1), 136 - 142.

Khadjooi, K., Rostami, K., & Ishaq, S. (2011). How to use Gagne's model of instructional design in teaching psychomotor skills. Gastroenterology & Hepatology from Bed To Bench, 4(3), 116119.

Le Roux, L & Oosthuizen, H (2010). The development of an instructional design model as a strategic enabler for sustainable competitive advantage. South African Journal Of Business, 41(2), 29-38

Markman, A. B. (1999). Knowledge representation. Mahwah, NJ: Erlbaum. Mayer, R. E. (1989). Models for understanding. Review of Educational Research, 59(1), 43–64.

Baturay, Meltem Huri. (Kış, 2008). Characteristics of Basic Instructional Design Models, EKEV AKADEMİ DERGİSİ Yıl: 12 Sayı: 34.

Kim, Min Kyu (2010). Dynamics of the Cogwheel Instructional Design Model: Integrating a Central Training Center with Subordinate Training Branches. Educational Technology, 50(6), 27-32

Morrison, G.R., Ross, S.M. & Kemp, J. E. (1987). Designing Effective Instruction, John Wiley and Sons, Inc., 2004

Nelson, W. A., Magliaro, S., & Sherman, T. A. The intellectual content of instructional design. Journal of Instructional Development, 37(3), 81–94.

Posner, G. J. & Rudnitsky, A. N. (2001). Course Design. New York: Longman.

Smith, P.L., & Ragan, T.J. (1993). Instructional Design, New York: Macmillan Publishing Company.

Appendix (1): The Planning Teaching Skills Scale card

Standards	Indicators	score				
		1	2	3	4	5
determining the educational needs of the student	The teacher designs activities to explore the students' need and talents.					
	Uses different methods to determine the students' level of understanding.					
	Encourages students to reflect about their life and personal experience.					
	Uses dialogue as a means of knowing the needs and experience of students.					
	Involves students in setting targets for the educational plan and its components.					
	Determines the stages of lesson planning according to student needs and implements them during the time available.					
planning for greater targets not for detailed information	Teacher makes an integrated and comprehensive study of his subject to set his plan.					
	Adds to his plan motivating activities to encourage research.					
	Sets educational objectives to develop critical thinking and methods of problem solving.					
Designing suitable educational activities	Teacher designs activities that increase effective learning time.					
	Designs educational units and lessons in the light of long-term objectives.					
	Plans lessons on the bases of his knowledge of the subject and the students.					
	Designs educational activities that allow the use of diverse strategies such as peer and cooperative education.					
	Total Domain score					

EXAMINING STUDENT OPINIONS ON COMPUTER USE BASED ON THE LEARNING STYLES IN MATHEMATICS EDUCATION

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ABSTRACT
The purpose of this study is to identify the opinions of high school students, who have different learning styles, related to computer use in mathematics education. High school students' opinions on computer use in mathematics education were collected with both qualitative and quantitative approaches in the study conducted with a survey model. For this purpose, 388 high school students were included in the study. A learning style inventory, questionnaire form and interview questions were used as the data collection instruments. Frequency, percentages and chi-square analysis were used in the analysis of quantitative data and content analysis was used in analyzing the qualitative data. The results of the study showed that students with a diverger and accommodator learning styles have more positive opinions regarding computer use in the mathematics education compared to the students with assimilator and converger learning style.
Keywords: Learning Style, Mathematics Education, Computer Use

INTRODUCTION

Changes and innovations in technology are known to deeply affect our real world and many disciplines. Technology has a significant place in the field of education. Particularly in mathematics education, the use of technology as well as its application in learning-teaching processes has been widespread. In mathematics learning processes where principles of the constructivist learning approach were adopted, technology seems to be an important component. More efficient and functional learning environments can be established by means of using information technology in this approach (Baki, 2002: 23). It is seen that both national and international entities have positive views on technology and computer use in mathematics learning processes. One of the principles that NCTM [National Council of Teachers of Mathematics] (2000: 24-27) determines for school mathematics is technology. It is pointed out that technology is essential in mathematics learning and instruction and that it affects the mathematics learned while improving students' learning. It is stated by MEB [Turkish Ministry of National Education] (2005) that technology should be used effectively in mathematics education. The most important tool that can be used in learning and teaching processes is the computer. Computers are not an option in mathematics education but rather have a complementary role in the system. Moreover, it is emphasized that prepared materials should have content designed according to the constructivist principles of computer-assisted instruction.

Today, it is a fact that student centered approaches and principles should be considered in using computers, the most widely used of the technological tools, in mathematics education. This is because we should regard computers as the components of a learning environment and employ them in the task of facilitating learning. In line with this, the principles of the constructivist learning approach are adopted and students' learning processes are supported while learning environments and materials are designed and developed (Solvie & Kloek, 2007). The learning environment and materials developed do not have the same impact on each student due to the differences in learners' knowledge perceiving and processing and reaction processes (Kolb, 1984). These individual differences are known collectively as a learning style, which is an important issue in mathematics education. Learning style has a deep impact on education planners. It is seen that the quality of educational material increases when designed giving consideration to the individual learning styles of learners (McLoughlin, 1999).

Whether technology and computers used in mathematics education, and the learning environment designed accordingly, match the learning styles of students is an important issue. This is because whether technology used and materials developed affect the learning process of students with different learning styles is an essential question. The basic purpose here is to ensure that computers, and materials used, support and facilitate student's learning. However, since students have different learning styles, there is a probability that the material developed can facilitate one individual's learning process while, in turn, making the learning process of another harder. In line with this, the teacher should feel the necessity to understand the individual learning styles of the students while designing activities by making use of technology (Grasha & Yangarber-Hicks, 2000). Geisert &

Dunn (1990) point out that teachers should be more informed about the benefits of combining learning styles and computer use in classroom teaching. When the strength of students' learning styles and computers are considered together, they become powerful instructional tools. Geisert & Dunn (1991) state that there are two problems at this point: one of these is that most of the computer software programs address a certain learning style and the second is that other learning styles are much ignored (for instance, most programs are visual while auditory and tactual ones are less). The necessary thing to do at this point is to ensure that learning is realized by means of learning styles that individuals are strong and dominant and then reinforced with the other learning styles which are not as dominant (Geisert & Dunn, 1991; Solvie & Kloek, 1997). It is seen that learning style has effects on technology and computer use, just as it has in many other areas. Several different models and inventories have been developed for measuring learning style. Although most of them have different aspects, they mostly focus on learning process and individual differences (Silver, Strong & Perini, 1997: 22). In this study, the learning style model developed by Kolb is discussed.

One of the leading figures of the field, Kolb developed a learning style model which is based on his "Experiential Learning Theory". The theory particularly underlines the effect of experiences in the learning process, and maintains that learning occurs by transforming knowledge and experience. It further argues that the learning process includes two dimensions called perceiving/comprehending and processing/transforming (Kolb, 1984: 41). These two dimensions are independent but support each other. Kolb's learning style model consists of four main categories, which are "concrete experience (CE)", "reflective observation (RO)", "abstract conceptualization (AC)" and "active experimentation (AE)". What is highlighted in these dimensions are learning *"by feeling"* for concrete experience, *"by watching"* for reflective observation, *"by thinking"* for abstract conceptualization and *"by doing"* for active experimentation. In the theory, learning is perceived as a cycle. At times, one of these four categories gains priority over others for the individual, who inevitably repeats this cycle countlessly throughout his/her learning experience. Students are classified according to which category they prefer in this model: Concrete experience or abstract conceptualization (how they perceive and comprehend knowledge) and active experimentation or reflective observation (how they transform and internalize knowledge) (Kolb & Kolb 2005; Felder, 1996).

In identifying students' learning styles, one element does not alone reveal the individual dominant learning style. Learning style of every individual is determined by a combination of the above four elements. Integrated scores show different individual preferences from abstract to concrete and from active to reflection. These two groups of learning styles form the basis of Kolb's two-dimensional learning styles. A combination of the four elements under two dimensions helps determining which of the four dominant learning styles an individual prefers. These include *diverger, assimilator, converger* and *accommodator* learning styles. The categorization defining these four basic learning styles is briefly summarized as follows (Kolb, 1984; Felder,1996; Guild & Garger,1998): divergers (AE + RO) rely on active experience and process these experiences in a reflective manner; assimilators (AC + RO) rely on theory and conceptualize reflectively-processed knowledge in an abstract way; convergers (AC + AE) rely on an abstract conceptualization of the world, performing active processing; and accommodators (CE + AE) rely on their own concrete experience, which they actively process.

The concepts of computer and learning style have been the subjects of research in several different age groups and fields of study. It is seen that studies have been made on subjects such as learning style and attitude towards computers (Miller, 2000; Shaw & Marlow, 1999) and computer assisted learning (Brudenell & Carpenter, 1990; Federico, 2000), blended learning (Akkoyunlu & Soylu, 2008), computer anxiety (Ayersman & Reed, 1995; Cummings & Ballance, 2009), e-learning (Brown, et.al., 2009), computer performance (Buch & Bartley, 2002; Davidson, Savenge & Orr, 1992; Miller, 20005), attitude towards computer assisted learning and computer achievements (Erdoğan, 2006), achievement in different learning environments (Soylu & Akkoyunlu, 2002), multimedia course design (Zin, 2009) and computer assisted cooperative learning (Wang, Hinn & Kanfer, 2001). Erdoğan (2006) examined pre-service teachers' attitudes towards computer assisted teaching and their computer achievements based on their learning styles. He found that computer assisted education attitudes of visual learners are high level and there are significant relationship between attitude scores and computer achievements. Zin (2009) concluded in his experimental study, in which he examined the effectiveness of a multimedia course design he developed for mathematics education based on learning style, that students are effective in developing learning materials in the experimental group created, based on learning styles. Cummings & Ballance (2009) found that computer related anxieties of primary school teachers have significant differences based on learning styles. Miller (2005) put forth in his study, in which the effects of learning styles on performance in computer assisted teaching were assessed according to the Gregorc and Kolb learning style model, that the Gregorc learning style model had a significant effect, while the Kolb learning style model did not. In their study, Buch & Bartley (2002) concluded that converger students in the Kolb learning style model had a stronger preference for computer based presentations, while assimilator students had stronger preferences for written presentations. Federico (2000) designated in his study, in which attitudes towards computer assisted teaching were examined according to the Kolb learning style model that accommodators and assimilators are the most acceptable and convergers and divergers are the least acceptable. Moreover, Miller (2000) assigned that there is no significant difference between students' learning styles and their general attitudes towards computers and students with all learning styles have positive attitudes towards computers.

The necessity of knowing students learning styles and carrying them over to the learning and teaching process is demonstrated by the findings of the research and the principles of the learning style model. Similarly, Erdoğan (2006) mentions about the fact that the education programs that do not consider students' learning styles would not reach the desired level of success. In line with this, it is inevitable that computers, which are integrated with the mathematics education process and students' learning styles in computer assisted education, are noticed. It is a misconception that computer assisted learning activities can only be prepared in the form of visual learning. Aside from this, learning activities can be enhanced by considering the strengths of learners preferring other learning styles (Erdoğan, 2006). Designing such learning environments and processes will support and facilitate learners (Geisert &Dunn, 1991). Regardless of learning style model or learning aspects of the model (visual, auditory, tactual, concrete, abstract, active, reflective…), the basic aim should be to develop computer assisted learning activities compliant to the dominant learning styles of learners. While students find the opportunity to learn more easily through the learning activities which are appropriate to their own learning styles, they will find the chance to deal with difficulties and see the alternatives by means of other learning styles. In line with this, within the scope of the constructivist approach, it is thought of as helpful to apply an approach of multiple learning styles (Solvie & Kloek, 2007).

In the field of mathematics education various studies on computer use and attitudes towards computers have been conducted at different levels and age groups (Birgin et.al., 2010; Birgin, Kutluca & Çatlıoğlu, 2008; Çelik & Bindak, 2005; Güven, Çakıroğlu & Yaşar, 2009; Keşan & Kaya, 2007; Kutluca & Ekici, 2010; Özgen, Obay & Bindak, 2009; Wittwer & Senkbeil, 2008; Zin, 2009). In these studies conducted in mathematics education, the subjects of the research are teachers' and students' attitudes toward computers and computer-assisted education, their self-efficacy perceptions, beliefs, opinions and their profiles on computer use (the frequency of use, ownership status, taking computer related courses…etc.). Moreover, it is important to note that the majority of the research was conducted with the participation of teachers and teacher candidates.

It is seen that research related to learning style and computer use, particularly in high school mathematics education, is limited. In the literature, no studies can be found regarding students' opinions on computer use in mathematics education based on learning styles. With this study, the opinions of high school students with different learning styles on computers in mathematics education processes will be determined. Thus, the study is thought to provide essential information in designing and developing learning processes of students with different learning styles.

THE PURPOSE OF THE STUDY

The purpose of the study is to determine the opinions of high school students with different learning styles regarding computer use in mathematics education. For this purpose, it is considered that the following sub-problems will be answered:

1. Is there a significant difference among the computer use frequency of high school students with different learning styles?
2. Is there a significant difference between the tools that facilitate mathematics learning processes of high school students with different learning styles?
3. Is there a significant difference between the purposes of high school students with different learning styles to use computers in mathematics learning processes?
4. What are the opinions of high school students with different learning styles related to computer use in mathematics learning processes?

METHOD

This is a descriptive study in survey model conducted for the purpose of determining the opinions of high school students with different learning styles related to computer use in mathematics education. It is composed of two stages, one of which includes data about personal information of high school students, their learning styles, status on possessing a computer and preferences about using computers in mathematics education, as well as their purpose of use. In the second stage, data were obtained through interview technique from a certain number of students participating in the first stage of the study for the purpose of determining the opinions of high school students with different learning styles related to computer use in mathematics education in detail. In the present study, qualitative and quantitative research methods were used together during the data collection process. Hence, method triangulation was made; making use of different methods, such as qualitative and quantitative, to obtain data is known as method triangulation (Banister, et al., 2002). By implementing these two stages together, an attempt is made to understand students' opinions and control consistency. In parallel with this, Yıldırım & Şimşek (2005) state that using different methods together is significant in detecting the accuracy and validity of the data collected and the explanations made based on these data.

Participants
In the first stage of the research, a total number of 388 students from three different high schools located at the center of one of the metropolitan cities of Turkey participated in the study in the spring term of the 2009 – 2010 academic year with purposeful sampling (Çepni, 2007). The target population on which purposeful sampling was used is students; therefore, all types of high-schools were considered in three categories, and one school was selected to represent each category. In Turkey, the different types of schools in high school education following mandatory primary education, which lasts eight years, are classified as vocational schools, Anatolian-Science high schools, which have an entrance exam, and general high schools, where everyone can study. The socio-economic level and computer and internet access at the three schools where the research took place is said to be similar. One hundred and twenty-one of the students (31.2%) are studying at government high schools, 174 of them (44.8%) at Anatolian high schools and 93 (24 %) are at vocational high schools. Two hundred and six (53.1%) of these students are male while 182 (46.9%) are female. There are 129 students (33.2%) who do not have a personal computer and 259 students (66.8%) who have a personal computer. Furthermore, in the second stage of the research, semi-structured interviews were carried out, with a total of 48 students from three different schools included in the first stage of the research. It was explained that the interviewees were volunteers and had different learning styles.

Data Collection Instruments
In the study, a questionnaire form was used in order to determine students' personal information, their status of possessing a personal computer, their frequency of using a computer, and the purpose of their preference for using computers in mathematics education. In this questionnaire form, students' purposes for using the tools facilitating the process of learning mathematics and computers were examined with open-ended questions.

In order to identify the learning styles of students, the study employed the *"Learning Style Inventory –Version 3.1"* developed by Kolb (2005). The inventory contains twelve fill-in items, each of which consists of four choices. For each given situation, an individual is asked to rate the most suitable statement with "4", the second most suitable with "3", the third most suitable with "2", and the least suitable with "1" point. Each choice contains statements representing the four learning preferences (concrete experience, reflective observation, abstract conceptualization and active experimentation). As for the organization of "Learning Style Inventory – LSI Version 3.1", the items and rating are the same with LSI 3 (Kolb, 1999), the new version introduced new norms and different interpretation (Kolb & Kolb, 2005). Gencel (2007) performed validity and reliability studies of the Turkish version of the inventory. The studies set the reliability coefficients of the inventory dimensions as 0.61 for concrete experience (CE), 0.76 for reflective observation (RO), 0.66 for abstract conceptualization (AC) and 0.69 for active experimentation (AE). As it has been used in several studies, the inventory is considered as valid and reliable.

Moreover, questions were prepared to be used in the semi-structured interview with students. Students were asked questions such as, "*How and why computers should be used in the process of learning mathematics?", "What are the benefits and limitations of learning mathematics with the assistance of computers?"* Specialists from the field were asked for their opinions on the validity and reliability of the interview questions and the final form of the questions were decided in line with their suggestions. Also, in order to check question coherency and comprehensibility, a preliminary trial was conducted with five students.

Data Analysis
Students answered open-ended questions related to the purpose of using computers in the process of learning mathematics, and about the tools facilitating the process of learning mathematics. After their responses were examined, they were scored within the framework of determinated categories. Should a student have an opinion in any category in the scoring process, "1" point was recorded and if not, a score of "0" was recorded. In the analysis of personal information of students and their opinions on the variables regarding computer use, frequency, percentage and chi-square analyses were used.

By rating the twelve items in the learning style inventory, the participants obtained a minimum score of 12 and a maximum score of 48 for each learning preference. After the rating, composite scores were computed for use in identifying an individual's learning style. Composite scores were calculated in two categories, which are abstract conceptualization (AC) – concrete experience (CE) (perceiving knowledge) and active experimentation (AE) – reflective observation (RO) (processing knowledge). AC – CE and AE – RO composite scores ranged between -36 and +36. The obtained composite scores were placed in the coordinate system given in the Learning Style Type Grid (Version 3.1). The score obtained with AC – CE was placed on the "y" axis, while the score obtained with AE – RO was placed on the "x" axis, and the resulting area of intersection for these two scores was identified to indicate an individual's learning style (*diverger, converger, assimilator, accommodator*) (Kolb & Kolb, 2005).

The content analysis technique was used in analyzing the open-ended questions asked to the students in the first stage and the qualitative data obtained as a result of the interview made in the second stage. The main purpose in content analysis is to reach concepts and relationships that can explain the data obtained (Yıldırım & Şimşek, 2005: 227). Content analysis was used in line with the problems of this study in order to obtain systematic data regarding students' computer use in the process of learning mathematics, and make deductions based on these data. The steps of coding the data, finding themes, organizing data based on the given themes and codes, and defining them were followed. Aside from the main theme determined from the data, sub-themes were formed by means of content analysis. In the method of content analysis, data that resemble each other are gathered together around certain concepts and themes and arranged, interpreted in a way that the reader understands (Yıldırım & Şimşek, 2005). Data obtained within the scope of sub-themes formed were handled without making changes to the individual's statements. Each student was given codes e.g. "*S1-D, S2-A, …*" during the collection and analysis of data. Here, *"S1"* indicates which student s/he is and the symbols of "D, A, C, AC" indicate the learning styles of students as "diverger (D), assimilator (A), converger, (C) and accommodator (AC)". The main themes formed under two headings, and the sub-themes formed under these main themes in the study, are presented in tables in the results section. Tables in the results section were formed based on the repetition frequency, depending on the status of being repeated by the students, according to the learning style. The total percentage column in the tables was calculated in the following way: the number of students stating a theme were added (considering how many people with a learning style that causes a theme to generate) stated the related theme, and divided by the number of all participants with the learning style of the students stating that theme. Hence, participants who did not express an opinion for each theme were prevented from affecting the total percentage and, regarding the total of the general status of participants. While commenting on the total percentages in the results section, it was noted for which learning style the mentioned total was valid and next, the relevant percentage value was given.

In order to test the reliability in the content analysis, it is possible to compare the analysis of data made either by different people or by the same person at different times and calculate the similarity relationship between them. Also, validity can be obtained by answering the question whether there is compliance between the problems/purposes and tools of the research (Gökçe, 2006: 83). For the purpose of ensuring the reliability of the research, data were examined by two researchers using P (Percentage of Agreement) = [Na (Agreement) / Na (Agreement) + Nd (Disagreement)] X 100 (Miles & Huberman, 1994) formula. As a result of this calculation, the value P = 86.8% was found and the research was found to be reliable.

Findings

The results obtained from data analysis according to the order of presentation of the sub-problems are given as follows: In order to find an answer to the first sub-problem of the study, which was mentioned above as *"Is there a significant difference between the computer use frequency of high school students with different learning styles?"*, the information related to students' frequency of computer use and chi-square analysis were given in Table 1.

Table 1. Chi-Square Results regarding students' frequency of computer use according to learning styles.

		Learning Styles				
		Diverger	**Assimilator**	**Converger**	**Accommodator**	**Total**
		f (%)	**f (%)**	**f (%)**	**f (%)**	**f (%)**
Frequency of Computer Use	1-Never	30 (22,1)	9 (18,0)	21 (21,6)	20 (19,0)	80 (20,6)
	2- A few hours a month	19 (14,0)	13 (26,0)	27 (27,8)	14 (13,3)	73 (18,8)
	3-A few hours a week	50 (36,8)	14 (28,0)	31 (32,0)	36 (34,3)	131 (33,8)
	4- A few days a week	10 (7,4)	6 (12,0)	5 (5,2)	18 (17,1)	39 (10,1)
	5- A few hours a day	17 (12,5)	3 (6,0)	11 (11,3)	12 (11,4)	43 (11,1)
	6- Regularly everyday	10 (7,4)	5 (10,0)	2 (2,1)	5 (4,8)	22 (5,7)
Total		136 (100)	50 (100)	97 (100)	105 (100)	388 (100)

$\chi^2_{(15)}$=25.259; *p*=,047

It was found that students in all learning styles use computers at least “a few hours a week”. Moreover, it is seen that the accommodator and diverger students use computers more often than the students with other learning styles. It was also found that this difference observed in students’ opinions regarding their computer use was significant. In other words, there is a significant relationship between students’ learning styles and opinions about their computer use frequency.

Regarding the second sub-problem of the study, Table 2 shows students opinions regarding the tools facilitating the process of learning mathematics.

Table 2. The descriptive statistical information about students’ opinions on the tools facilitating the process of learning mathematics

Tools *	f	%
Blackboard	220	56,7
Projector	54	13,9
Overhead projector	27	7,0
Television	16	4,1
Computer	67	17,3
Books	256	66,0
Internet	54	13,9
Poster-Graph	24	6,2
Geometric objects	72	18,6
Calculator	53	13,7
Other	11	2,8

*More than one answer was given

Frequencies in high school students’ opinions about the tools facilitating the process of learning mathematics were listed, respectively, as follows: blackboard, books, geometric objects, computers… 17.2 % of the students stated that computers facilitated the process of learning.

The results of the chi-square analysis made in order to find out whether there are significant differences among students’ opinions on the tools facilitating the process of learning mathematics based on different learning styles are given in Table 3.

Table 3. Chi-square results of students’ opinions on the tools facilitating the process of learning mathematics based on different learning styles

	Learning Style						
	Diverger	Assimilator	Converger	Accommodator	Total	Result	
Tools	f (%)	f (%)	f (%)	f (%)	f (%)	$\chi^2_{(3)}$	*p*
Blackboard	75 (55,1)	27 (54,0)	57 (58,8)	61 (58,1)	220 (56,7)	0.533	*0.911*
Projector	12 (8,8)	10 (20,0)	17 (17,5)	15 (14,3)	54 (13,9)	5.556	*0.135*
Overhead projector	7 (5,1)	5 (10,0)	9 (9,3)	6 (5,7)	27 (7,0)	2,461	*0.482*
Television	7 (5,1)	1 (2,0)	4 (4,1)	4 (3,8)	16 (4,1)	0.922	*0.820*
Computer	25 (18,4)	11 (22,0)	14 (14,4)	17 (16,2)	67 (17,3)	1.533	*0.675*
Books	83 (61,0)	27 (54,0)	76 (78,4)	70 (66,7)	256 (66,0)	11.317*	*0.010*
Internet	13 (24,1)	9 (18,0)	12 (12,4)	20 (19,0)	54 (13,9)	5.352	*0.148*
Poster-graph	9 (6,6)	3 (6,0)	8 (8,2)	4 (3,8)	24 (6,2)	1.779	*0.620*
Geometric objects	25 (18,4)	7 (14,0)	27 (27,8)	13 (12,4)	72 (18,6)	8.865*	*0.031*
Calculator	19 (14,0)	2 (4,0)	17 (17,5)	15 (14,3)	53 (13,7)	5.231	*0.156*
Other	4 (2,9)	2 (4,0)	2 (2,1)	3 (2,9)	11 (2,8)	0.463	*0.927*

Diverger, converger and accommodator students stated mostly “the books” as the tool facilitating the process of learning mathematics while assimilator students stated mostly “the books” and “the blackboard”. In their opinions, divergers (18.4%) consider computers the fourth tool facilitating the process of learning mathematics while assimilator students (22%) consider computers the third, convergers (14.4%) the sixth and accommodators (16.2%) the fourth. According to Table 3, it was found that there are significant differences between those stating their opinion as “the books” and “the geometric object” and others who did not express an opinion among students’ opinions on the tools facilitating the process of learning mathematics based on different learning styles. It is also seen that there is no significant difference between the opinions about the other tools according to learning styles. In other words, there is a significant relationship between students’ learning styles and their opinions about books and geometric objects as the tools facilitating learning.

Regarding the answer to the third sub-problem of the research, Table 4 shows the students' opinions related to their purposes for using computers in the process of learning mathematics.

Table 4. The descriptive statistical information of the students' opinions regarding their purposes for using computers in the process of learning mathematics

Purpose of computer use	f	%
Writing	43	11.1
Research-investigation	236	60.8
Downloadig homework	181	46.6
Calculation	59	15.2
Drawing	70	18.0
Making presentation	53	13.7
Math software programs	73	18.8
Other	22	5.7

In students' opinions with regards to their purposes for using computers in the process of learning mathematics, it was stated that the purpose of using computers is mostly research-investigation. The purposes of computer use are, respectively, research-investigation, downloading homework, math software programs, drawing, calculation, making presentations, writing and others.

Table 5 shows the results of chi-square analysis made in order to determine whether there are significant differences among the opinions of students related to their purpose of computer use in the process of learning mathematics according to different learning styles.

Students in all learning styles stated mostly research-investigation and downloading homework as the purpose of using computers, respectively. It was found that there are significant differences between the students who expressed an opinion about using computers for the purposes of writing and downloading homework and those who did not. In other words, there is a significant relationship between the students' learning styles and their opinions about writing and downloading homework as their purposes for computer use. It is seen that there is no significant difference among the opinions regarding the other purposes for using computer according to learning styles.

Table 5. The results of the chi-square of students' opinions related to their purpose of computer use in the process of learning mathematics according to different learning styles

			Learning Style				
	Diverger	Assimilator	Converger	Accommodator	Total	Result	
Purpose of computer use	f (%)	f (%)	f (%)	f (%)	f (%)	$\chi^2_{(3)}$	*p*
Writing	19 (14,0)	2 (4,0)	5 (5,2)	17 (16,2)	43 (11,1)	9.935*	*0.019*
Research-investigation	79 (58,1)	31 (62,0)	58 (59,8)	68 (64,8)	236 (60,8)	1.183	*0.757*
Downloadig homework	72 (52,9)	13 (26,0)	49 (50,5)	47 (44,8)	181(46,6)	11.462*	*0.009*
Calculation	20 (14,7)	7 (14,0)	15 (15,5)	17 (16,2)	59 (15,2)	0.167	*0.983*
Drawing	24 (17,6	11 (22,0)	17 (17,5)	18 (17,1)	70 (18,0)	0.619	*0.892*
Making presentation	18 (13,2)	7 (14,0)	15 (15,5)	13 (12,4)	53 (13,7)	0.439	*0.932*
Math software programs	21 (15,4)	7 (14,0)	23 (23,7)	22 (21,0)	73 (18,8)	3.609	*0.307*
Other	5 (3,7)	6 (12,0)	6 (6,2)	5 (4,8)	22 (5,7)	4.966	*0.174*

Regarding the fourth sub-problem of the research, Table 6 shows the findings obtained with the content analysis of the students' opinions on computer use in the process of learning mathematics.

Table 6. Students' opinions on computer use in the process of learning mathematics

Theme/Sub-theme	Percentages are expressed according to learning styles									
	Diverger		Assimilator		Converger		Accommodator		Total	
	f	%	f	%	f	%	f	%	f	%
Theme I. Computer should be used										
Theme I-a. whole process of learning mathematics	16	89	3	50	7	50	6	60	32	67
Theme I-b. the reasons for computer use										
b.1. It is easier to learn visually.	7	39	1	17	1	7	3	30	12	25
b.2. I am learning by doing	1	6	1	17	-	-	-	-	2	4
b.3. I am learning by observing	1	6	-	-	-	-	-	-	1	2
b.4. I am learning by listening	1	6	1	17	4	29	2	20	8	17
b.5. I am associating real life with mathematics	1	6	1	-	1	7	2	20	5	10
Theme I-c. benefits of computer use										
c.1. it facilitates learning	13	72	3	50	7	50	3	20	26	54
c.2. it helps reinforce the things that have been learnt	5	28	1	17	-	-	2	20	8	17
c.3. repeating the things that have been learnt	1	6	-	-	2	14	2	20	5	10
c.4. attracting attention to the issue	-	-	-	-	2	14	-	-	2	4
c.5. filling in teacher's gaps	5	28	-	-	3	21	1	10	9	19
Theme I-d. usage conditions										
d.1. research-investigation	3	17	3	50	5	36	2	20	13	27
d.2. drawing figure-graph and tables	4	22	-	-	-	-	2	20	6	13
d.3. learning the history of mathematics	1	6	1	17	3	21	-	-	5	10
d.4. visual and auditory course presentations	2	11	-	-	3	21	3	30	8	17

According to Table 6, 32 (67 %) of the 48 students interviewed expressed positive opinions on using computers for the whole mathematics education process. When data are examined in terms of the learning styles of the students interviewed, it is seen that 89 % of the diverger students, 50 % of the assimilator students, 60 % of the accommodator students and 50 % of the converger students presented positive opinions about computer use in mathematics education. Some of the positive opinions of students about computer use in mathematics education are given below:

> **S1-D:** *I think computers should be used in all areas of mathematics*.
> **S29-A:** *Learning mathematics with computers affects students considerably. The students can learn the issues not known by means of a computer and implement them. Therefore, they can learn in a shorter time.*
> **S44- AC:** *When an issue is not understood, it is possible to turn on a computer and solve the problem. We can listen to any problem on a computer, whenever we want, and we can make it explain the problem to us.*
> **S35-C:** *It should be completely and appropriately be used to its purpose. The issues should be handled individually and examined in detail.*

Students presented their opinions on the reasons for computer use in the process of learning mathematics as, "It is easier to learn visually (25 %)", "I am learning by doing (4 %)", "I am learning by observing (2 %)", "I am learning by listening (17 %)" and "I am associating real life with mathematics (10%)". A great majority of the diverger (39 %) and accommodator (30 %) students stated the opinion, "learning visually is easier", as the reason for computer use. A great majority of the converger (29 %) students stated the opinion, "I am learning by listening". On the other hand, assimilator students are of different opinions regarding the reason for computer use. Some of the student opinions regarding the reasons for computer use in the process of learning mathematics are presented below:

S1-D: *It would be better if it were used more as I am a visual learner.*
S4-C: *I think it is very useful to learn mathematics by means of computer because the best way to learn is visually and by investigating.*
S8-A: *Generally, I can learn better by listening. It would be useful by means of a computer.*
S38-AC: *It would be effective visually in understanding mathematics.*
S5-D: *I think computers should be used mostly visually in the process of learning mathematics, and the reason why I think like this is that mathematics can be learnt more easily when it is visual.*
S21-C: *It should be used in research and investigation. It helps us investigate what kind of benefits the issue we learn provides and how we can use it in real life.*

It is seen that students' opinions about the benefits of computer use in the process of learning mathematics are "it facilitates learning (54 %)", "it helps reinforce the things that have been learnt (17 %)", "repeating the things that have been learnt (10%)", "attracting attention to the issue (4%)" and "filling in teacher's gaps (9 %)". When students' opinions about the benefits of using computers are examined in terms of learning styles, it is seen that students in all learning styles presented the opinion "it facilitates learning". Moreover, some of the diverger, converger and accommodator students put forth an opinion that computer use would be helpful in filling in teachers' gaps. Some of the opinions of students regarding the benefits of computer use in the process of learning mathematics are as follows:

S7-D: *Computer should be used in the process of learning mathematics because it facilitates learning. It ensures that we regard events from a more detailed perspective.*
S14-C: *It is helpful when the teacher is not very good or having trouble explaining the subject…*
S19-A: *…in order for the student to reinforce an issue better.*
S27-AC: *Teachers mostly write down the questions on the board and students copy them into their notebooks, which is mostly a waste of time. Studies with computers may eliminate this problem.*
S28-C: *It attracts students' attention more when it is done on computer.*
S33-D: *It is very effective because there are programs to audit the lessons, which helps understand and reinforce the things they have listened to.*
S43-C: *Computers are better than my teacher. I would rather listen to the computer than listen to my teacher. I recommend it to everyone.*
S44-A: *When we use computers, we can repeatedly listen to the subject in the lesson.*

It is seen that student opinions regarding computer use in the process of learning mathematics are "research-investigation (27 %)", "drawing figure-graph and tables (13 %)", "learning the history of mathematics (10 %)" and "visual and auditory course presentations (17 %)". When student opinions regarding computer use in the process of learning mathematics are examined in terms of learning styles, it is seen that a majority of the diverger students presented their opinions as "drawing figure-graph and tables (13 %)"; a majority of the assimilator and converger students presented their opinions as "research-investigation (50 %)"; and a majority of the accommodator students presented their opinions as "visual and auditory course presentations (30 %)". Some of the opinions of students regarding computer use in the process of learning mathematics are as follows:

S3-D: *Computers should be used for researching the origins of mathematics and learning the purpose of mathematics up to the present day.*
S9-AC: *Computers can be used in drawing figures and graphs or in terms of how to apply mathematics to real life.*
S11-AC: *Using computers is significant for mathematics courses. Videos we listen to on the computer are helpful in reinforcing the subject.*
S16-C: *Computers should be used in order to do research.*
S17-D: *It can be used for research, drawing graphs, making presentations, downloading homework and making calculations.*
S20-C: *It is necessary for computers to be used in auditing the lessons and repeating the subjects in interactive education.*
S41-A: *It is important for gaining knowledge about the history of mathematics. For instance, it is important for learning which scientists were successful in mathematics and applying their behavior in your own life.*
S47-C: *Giving lectures visually and vocally…*

Table 7 shows the findings obtained with content analysis of the students' opinions regarding not using computers in the process of learning mathematics.

Table 7. Students' opinions regarding not using computers in the process of learning mathematics

Theme/Sub-theme	Percentages are expressed according to learning styles									
	Diverger		Assimilator		Converger		Accommodator		Total	
	f	%	f	%	f	%	f	%	f	%
Theme II. Computer shold not be used										
Theme II-a. whole process of learning mathematics	-	-	-		1	7	2	20	3	6
Theme II-b. should be partially used	2	11	3	50	6	43	2	20	13	27
Theme II-c. the reasons for not using computers										
c.1. it does not take the place of teachers	1	6	1	17	4	29	1	10	7	15
c.2. it is useless and ineffective			2	33	8	57	3	30	13	27
c.3. mathematics is based on understanding, seeing, feeling and thinking	-	-	2	33	3	21	1	10	6	13
c.4. I cannot learn visually	-	-	-	-	-	-	1	10	1	2

When students' negative opinions regarding computer use in the process of learning mathematics are examined, it was seen that 6 % of the students expressed their opinions as "computers should not be used in the whole process of learning mathematics" and 13 % of them expressed their opinions as "should be partially used". It was also observed that students with assimilator and converger learning styles presented more negative opinions than the others. Below are some of the negative opinions of students:

> **S6-C:** *It is ridiculous to learn mathematics by means of computers. It is a lesson based on explaining, ideas and opinions.*
> **S32-C:** *Mathematics cannot be learned on a computer because understanding is essential in mathematics, not reading.*
> **S4-AC:** *I think computers are not that effective in the process of learning mathematics yet it is good to learn it by means of computers. This is because being visual is more attractive.*
> **S15-A:** *Mathematics cannot be learnt from computers alone. We need to study on our own. We need to make use of books.*

The reasons for not using computers based on students' opinions were found to be as follows: "it does not take the place of teachers (15 %)", "it is useless and ineffective (27 %)", "mathematics is based on understanding, seeing, feeling and thinking (13 %)" and "I cannot learn visually (2%)". It is seen that assimilator and converger students presented more opinions regarding not using computers. Some of the student opinions regarding not using computers in the process of learning mathematics are given below:

> **S2-AC:** *I would not recommend and use it as I learn by writing not visually.*
> **S3-D:** *I think the best way to learn mathematics is through teachers. Under no circumstances can computers take the place of teachers because teachers have plenty of instruction styles. However, a computer has a single way of explaining, which cannot be perceived by all people.*
> **S9-AC:** *I think we need to practice, study and think about mathematics more than computers. I do not think it is right to use computers in this way. Mathematics is learnt by practicing.*
> **S13-A:** *It doesn't have much use because mathematics is the task of seeing and feeling. However, a mathematician making use of computers cannot contribute much because computers affect the brain waves, which may prevent concentration.*
> **S21-C:** *I do not think computers are helpful in learning this subject. Books are more helpful for me. I use computers for homework and fun.*
> **S24-C:** T*here is no point in using it much as, in my opinion, mathematics should be learnt in the lesson.*
> **S41-A:** *I think it is limited. Computers alone cannot help in understanding mathematics.*

DISCUSSION AND CONCLUSION

In this study, opinions of high school students, who have different learning styles, about computers in the process of learning mathematics were examined. This section includes the comments and suggestions about data obtained from students' opinions on their computer use frequency in terms of their learning styles, tools facilitating the processes of learning mathematics and purposes of computer use and computer use in the process of learning mathematics.

The finding of the first sub-problem of the research shows that there is a significant relationship between students' learning styles and their computer use frequency. It is seen that students in all learning styles gave opinions mostly in the category of computer use "a few hours a week", and in this category, students seem to be the diverger, accommodator, converger and assimilator, respectively. In the model they developed, Levine & Donitsa-Schmidt (1998) state that computer use has a positive effect on computer self-confidence and attitudes associated with computers. In the studies conducted with students, teachers and pre-service teachers in various age groups, it is seen that computer use frequency and attitudes toward computers are connected. It is indicated that the ones using computers more often have more positive attitudes (Birgin et.al., 2010; Birgin, Kutluca & Çatlıoğlu, 2008; Çelik & Bindak, 2005; Ekici, Uzun & Sağlam, 2010; Günhan, Yavuz & Başer, 2007; Kutluca & Ekici, 2010; Loyd, Loyd & Gressard, 1987; Özgen, Obay & Bindak, 2009; Taghavi, 2006). Furthermore, Yılmaz & Çelik (2009) state in their study examining attitudes of university graduates, middle-school and high-school students and university students regarding computer use that university graduates have the lowest and university students have the highest attitudes. In the study conducted by Kutluca (2010), it was determined that there are significant differences in attitudes toward computers according to possessing a computer and the frequency and level of computer use. Today, since computers are indispensible tools used in homes, schools and at work, individuals' levels and frequency of computer use have been increasing. Particularly, it is seen that teachers' and students' levels and frequency of computer use outside school affect their attitudes toward computers (Birgin, Kutluca & Çatlıoğlu, 2008; Levine & Gordon, 1989; Wittwer & Senkbeil, 2008). The study by Ferdig (2006) conducted by using PISA data addresses the issue that high mathematics literacy scores and computer use at schools and outside schools is related and computer use at home is a significant predictor of mathematics literacy. It is possible to come across similar and contradictory findings in studies where students' or teachers' attitudes toward computers and their learning styles are examined. Bozionelos (1997) and Sein & Robey (1991) state in their research that converger students are better with computer applications and have more positive attitudes than the students in other learning styles (Cited in Shiue, 2002-2003). Miller (2000) couldn't find significant relationships between learning style and attitudes toward computers and stated that students in all learning styles had positive attitudes towards computers. With these results, if it is considered that learning styles of students and their computer use frequency are connected to each other, it can be thought that learning style can be connected to with attitudes toward computer use and sensual behavior such as self-sufficiency.

In this study, when the student opinions regarding the tools facilitating the process of learning mathematics according to their learning styles are considered, it is thought-provoking that opinions about "the board" and "the book" are mentioned the most in all learning styles. It is determined that there are no significant differences based on learning styles in the analysis of opinions of students who stated the computer category and those who did not. The opinions of students who stated the computer category were examined in terms of the learning styles and it was seen that the percentage of the assimilator students was the highest while the percentage of converger students was the lowest. It can be said that students' opinions on computers are still at an insufficient level although computers have rapidly been integrated into our educational system and, particularly, in the process of learning and teaching mathematics. Findings similar to this situation can be seen in previously conducted studies. In the research conducted by Kaya, Pekel & Sezer (2003), it is pointed out that students mostly use board, reference books, pictures and shapes in biology lessons. The fact that students don't regard computers as tools facilitating learning processes can arise from different reasons. Our learning-teaching approaches in our education system, the physical conditions and attitudes, beliefs and approaches of our teachers can be listed among these reasons. In a study conducted by Ersoy (2005) with mathematics teachers in a science high school, almost all teachers agreed with the statement, "*mathematics courses should be given in information assisted settings*" and "*the tools used in mathematics education are insufficient*". Moreover, it was found that mathematics teachers and pre-service teachers had negative opinions about computer use in mathematics education (Baki, 2002). Aside from this, it is seen in various studies that mathematics teachers and pre-service teachers have positive attitudes related to computer assisted education (Birgin et.al., 2010; Deniz, 2005; Erkan, 2004; Keşan & Kaya, 2007; Özgen, Obay & Bindak, 2009). Güven, Çakıroğlu & Akkan (2009) indicate that there is a gap between program expectations and teachers' beliefs in integrating computers in mathematics courses. In line with this, Baki (2000) emphasizes that the negative beliefs of Turkish mathematics teachers related to computer use in mathematics courses may be a result of their negative experiences and states that these experiences can be changed. When the positive attitudes of teachers and students towards computers and their status of computer use is considered, not considering computer as a facilitating tool for the process of learning mathematics creates a conflicting situation. This does not show a significant difference in terms of learning style. That is to say, the effect of learning styles on these opinions is out of the question because in this study, students in all learning styles don't consider computers as a tool facilitating the process of learning mathematics in the first place. Although there aren't significant differences among opinions in terms of learning styles, the fact that the percentage of assimilator students is the highest can be the result of these students' preference for learning mostly by observing, watching-listening. On the other hand, the converger students' percentage is the lowest, which may result from their preference for learning by practicing and implementing.

In results obtained about the third sub-problem of the research, it is determined that students' purposes for using computers in the process of learning mathematics differed and that they mostly expressed their opinion in those categories of research – investigation and downloading homework. It was found that in the writing and downloading homework categories, there is a significant relationship between the opinions of students who expressed their opinion and those who did not and their learning styles. It is an interesting finding that accommodator and diverger students expressed their opinions with a higher percentage than the students in other learning styles because concrete experiences are more at the forefront for the accommodator and diverger students. This can lead us to the fact that these students' computer use in mathematics education is not based on concrete experiences. Aside from this, opinions in the downloading homework category were examined in terms of learning styles and it was found that assimilators had the least percentage while students in other learning styles had similar opinions. It is thought provoking that students mostly express their opinion as downloading homework as the purpose of using computers in the process of learning mathematics because here students may benefit from the computer in the wrong way or think that it could contribute in the learning process. Buch & Bartley (2002) stated that converger students in the Kolb learning style model have a stronger preference for computer based presentations and assimilator students have a stronger preference for written presentation. It is also determined that students' opinions on computer use in the process of learning mathematics do not differ in other categories in terms of learning styles. However, the fact that students' opinions on the other categories have lower percentages brings some questions to mind. It is clearly understood that these students do not use computers with the right purposes in their processes of learning mathematics and they are not encouraged for different computer assisted activities by their teachers.

It is seen from the interview data obtained related to the last sub-problem of the research that the positive opinions about computer use in the process of learning mathematics are stated by diverger, accommodator, assimilator and converger students, respectively. The majority of diverger and accommodator students, half of the assimilator and converger students stated that computers should be used in whole process of learning mathematics. Considering the research conducted in Turkey in order to determine learning styles of students and studies regarding learning styles in mathematics education, it is seen that students mostly prefer assimilator and converger learning styles (Orhun, 2007; Peker, 2009; Peker, Mirasyedioğlu & Aydın, 2004). This shows that a majority of students still have adverse opinions regarding computer use in mathematics education. In the interviews, it is seen that a part of the students still present opinions about not use of computer in the whole process of learning mathematics or partially. When students' opinions about the reasons for computer use in the process of learning mathematics are examined, it is understood that there are opinions appropriate to the characteristics of learning styles. For instance, the fact that diverger and accommodator students presented more opinions in sub-themes as "it is easier to learn visually", "associating real life with mathematics" may be a result of their preferring concrete experience. In the sub-theme "I learn by listening", assimilators and convergers presented more opinions, which may imply they prefer abstract conceptualization. Moreover, it is a pleasing situation that students in all learning styles mostly presented their opinion in the sub-theme "it facilitates learning" as the reasons for computer use in in the process of learning mathematics. The diverger learners presented opinions with the highest percentage again in this sub-theme. Regarding their opinions about computer use status, it is seen that the status for visual purposes comes to the forefront and divergent and accommodators presented more opinions in this status. Aside from this, when the negative opinions about computer use in the process of learning mathematics are examined, it is seen that mostly assimilator and convergent learners gave their opinions. *"It will not take the place of the teacher, the belief that it will not be helpful, it is not suitable for mathematics and not being able to learn visually*" among the reasons for not using computers in learning mathematics. It can be said that these opinions partially match the divergent and assimilator learners' opinions because these students prefer learning by watching, listening, consulting an expert and practicing. In line with this, it should not be concluded that divergent and assimilator students have a disadvantage in computer use because correct encouragements and designing an effective computer based learning environment related to the learning styles and activities can, it is assumed, facilitate all students' process of learning mathematics. Likewise, Shiue (2009) state that learners who learn with a converger learning style have advantages in learning by using computers. In a study by Federico (2000) conducted for the purpose of examining the attitudes toward computer assisted learning according to the Kolb model of learning styles, it was determined that the most acceptable styles are accommodators and assimilators while divergers and convergers are the least acceptable. Enochs et al. (1985; cited in Ross & Schnulz, 1999) suggested that the concrete learners in the Kolb model of learning styles learn better than abstract learners in computer assisted teaching. It may seem natural that various findings are present in several studies regarding this issue since many factors affecting this situation can be listed. The basis of the model of learning styles can be stated as the cultural structures of students, their learning approaches, mathematics instruction and teachers, all the physical conditions for computer use and sensual behavior.

This study aimed to determine the opinions of high school students who have different learning styles related to computer use in mathematics education. It is partially seen here that the idea that computers should only be used in processes toward visual learning is wrong. As perceiving and comprehending information are involved in the process of learning mathematics, computers should be integrated in information processing and transforming. For this purpose, it would be appropriate to design activities and settings for skills like feeling, dreaming, activating, discussing, interpreting, adopting, discovering and forming with computers. Through realizing these, learning opportunities appropriate to the dominant learning style will be provided for the individuals in different learning styles and aside from this, it will support them in dealing with difficulties and their development in the processes in learning styles that are not dominant.

It should be ensured that, particularly the process of learning mathematics moves away from a teacher-centered approach, full of abstract concepts, where there are mostly activities like listening and writing, and it should be a process where students' learning styles are considered with a constructivist approach, and where computers are integrated with the mathematics courses with a multi-directional approach. While doing this, it is necessary to accept that all learning preferences, learning by feeling, watching, thinking and doing, are equally important as in the Kolb model of learning styles and apply it to the process of learning. In line with this, mathematics teachers should know their students, identify their learning styles and detect the aspects of their students' learning styles. By knowing the learning styles, teachers will ignore none of the styles in line with the learning styles of their students and investigate ways to benefit from computers in mathematics courses with a multi-directional approach. It should also be ensured that students' learning styles are considered in training pre-service mathematics teachers and accordingly, students should be provided with theoretical and practical trainings for designing computer assisted courses and learning settings. Also, students' learning styles and processes towards these styles should be taken into great consideration in the computer assisted learning activities in preparing mathematics textbooks, reference books and teacher guide books.

Since in this study, the opinions of a limited number of high school students, who have different learning styles, related to computer use in mathematics education were examined, it can be suggested that sample sizes in wider and across more varied age groups should be chosen for further research. Furthermore, the attitudes of students with different learning styles towards computer use in mathematics education should be examined together with various variables, such as self-efficacy perceptions. The most important of all is that although the number and status of computer use have increased in the process of learning, just as in real life, and the field of education, the reasons for students' adverse and wrong ideas about computer use for learning purposes in mathematics courses should be examined more in detail and, upon determining these reasons, solutions should be discussed.

REFERENCES

Akkoyunlu, B., & Soylu, M.Y. (2008). A study of students' perceptions in a blended learning environment based on different learning styles. *Educational Technology & Society*, *11(1),* 183-193.

Ayersman, D.J. & Reed, W.M. (1995). Effects of learning styles, programming and gender on computer anxiety. *Journal of Research on Computing in Education*, *28(2),* 148-161.

Baki, A. (2002). *Öğrenen ve öğretenler için bilgisayar destekli matematik*. İstanbul: Ceren Yayın Dağıtım.

Baki, A. (2000). Preparing student teachers to use computers in mathematics classroom through a long-term pre-service course in Turkey. *Journal of Information Technology for Teacher Education*, *9(3)*, 343-362.

Banister, P. et al. (2002). *Qualitative methods in psychology. A research guide*. Philadelphia: Open University Press.

Birgin, O., Çatlıoğlu, H., Gürbüz, R., & Aydın, S. (2010). Investigation of the computer experiences and attitudes of preservice mathematics teachers: new evidence from Turkey. *Cyberpsychology, Behavior and Social Networking*, *13(5),* 571-576, DOI: 10.1089/cyber.2009.0345.

Birgin, O., Kutluca, T., & Çatlıoğlu, H. (2008). Sayısal ve sözel ağırlıklı bölümlerde öğrenim gören öğretmen adaylarının bilgisayara yönelik tutumlarının karşılaştırılması: KTÜ örneği. *8th International Educational Technology Conference*, 6-9 Mayıs, Anadolu Üniversitesi, Eskişehir, 874-878.

Brown, T., et al., (2009). Are learning style preference of health science students predictive of their attitudes towards e-learning? *Australian Journal of Educational Technology*, *25(4)*, 524-543.

Brudenell, I. & Carpenter, C.S. (1990). Adult learning styles and attitudes toward computer assisted instruction. *Journal of Nursing Educ*ation, *29(2),* 79-83.

Buch, K. & Bartley, S. (2002). Learning style and training delivery mode preference. *Journal of Workplace Learning*, *14(1),* 5-10.

Cummings, S.M.M. & Ballance, C.T. (2009). Computer-related stress and learning styles among elementary school teachers. *Institute for Learning Styles Journal*, *1*, 20-26.

Çelik, H.C. & Bindak, R. (2005). İlköğretim okullarında görev yapan öğretmenlerin bilgisayara yönelik tutumlarının çeşitli değişkenlere göre incelenmesi. *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, *6(10)*, 27-38.

Çepni, S. (2007). *Araştırma ve proje çalışmalarına giriş* (3.Baskı). Trabzon: Celepler Matbaacılık.

Davidson, G.V., Savenye, W.C., & Orr, K.B. (1992). How do learning styles relate to performance in a computer applications course. *Journal of Research on Computing in Education*, *24(3)*, 348-358.

Deniz, L. (2005). İlköğretim okullarında görev yapan sınıf ve alan öğretmenlerinin bilgisayar tutumları. *The Turkish Online Journal of Educational Technology*, *4(4)*, 18-31.

Ekici, G., Uzun, N., & Sağlam, N. (2010). İlköğretim öğrencilerinin bilgisayar kullanma sıklığına bağlı olarak bilgisayara yönelik tutumlarındaki değişimin değerlendirilmesi. *İlköğretim Online*, *9(2)*, 658-667. Retrieved September 27, 2010 from http://www.ilkogretim-online.org.tr.

Erdoğan, Y. (2006). Öğretmen adaylarının öğrenme biçemlerine göre bilgisayar destekli eğitim tutumlarının ve bilgisayar başarılarının karşılaştırılması. *Uluslar arası İnsan Bilimleri Dergisi*, *3(2)*, 1-9.

Erkan, S. (2004). Öğretmenlerin bilgisayara yönelik tutumları üzerine bir inceleme. *Manas Üniversitesi Sosyal Bilimler Dergisi*, *12*, 141-145.

Ersoy, Y. (2005). Fen lisesi matematik öğretmenlerinin görüşleri II: matematik öğretim ortamı ve bazı kısıtlar. *The Turkish Online Journal of Educational Technology*, *4(4)*, 135-145.

Federico, P.A. (2000). Learning styles and student attitudes toward various aspect of network-based instruction. *Computers in Human Behavior*, *16*, 359-379.

Felder, R.M. (1996). Matters of style. *ASEE Prism*, *6(4)*, 18-23.

Geisert, G. & Dunn, R. (1990). Learning styles and computers. *ERIC*. ED 332 268.

Geisert, G. & Dunn, R. (1991). Effective use of computers: assignments based on individual learning style. *The Clearing House*, *64(4),* 219-224.

Gencel, İ.E. (2007). Kolb'ün deneyimsel öğrenme kuramına dayalı öğrenme stilleri envanteri – III'ü Türkçeye uyarlama çalışması. *Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *9(2),* 120-139.

Gökçe, O. (2006). *İçerik analizi. Kuramsal ve pratik bilgiler*. Ankara: Siyasal Kitabevi.

Guild, P.B. & Garger, S. (1998). *Marching to different drummers*. 2nd Edition. Association for Supervision and Curriculum Development (ASCD).

Günhan, B.C., Yavuz, G., & Başer, N. (2007). Sınıf öğretmenliği öğretmen adaylarının bilgisayara yönelik tutumlarının belirlenmesi ve demografik özelliklerine göre karşılaştırılması. *I. Uluslar arası Bilgisayar ve Öğretim Teknolojileri Sempozyumu,* Çanakkale, 16-18 Mayıs, 1370-1383.

Güven, B., Çakıroğlu, Ü., & Yaşar, A. (2009). The gap between expactations and reality: integrating computers into mathematics classrooms. *Asia Pasific Education Review*, *10(4)*, 505-515.

Kaya, E.; Pekel, F.O. & Sezer, F. (2003). Biyoloji öğretiminde kullanılan öğretim araçlarının kullanılma sıklıklarına ilişkin lise ve meslek lisesi öğrencilerinin görüşleri. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, *14*, 99-105.

Keşan, C. & Kaya, D. (2007). Bilgisayar destekli matematik dersi öğretimine sınıf öğretmenliği öğrencilerinin bakış açıları. *Üniversite ve Toplum*, *7(1)*. Retrieved September 14, 2010 from http://www.universite-toplum.org/pdf/pdf_UT_305.pdf.

Kolb, D.A. (1984). *Experiential learning: experience as the source of learning and development*. New Jersey: Prentice Hall.

Kolb, D.A. (2005). *Learning style inventory – version 3.1*. Hay Group.

Kolb, A.Y. & Kolb, D.A. (2005). *The Kolb learning style inventory – version 3.1. 2005 technical specifications*. Boston, MA: Hay Group, Hay Reseources Direct.

Kutluca, T. (2010). Investigation of teachers' computer usage profiles and attitudes toward computers. *International Online Journal of Educational Sciences, 2(1)*, 81-97.

Kutluca, T. & Ekici, G. (2010). Öğretmen adaylarının bilgisayar destekli eğitime ilişkin tutum ve öz-yeterlik algılarının incelenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *38*, 177-188.

Levine, T. & Donitsa-Schmidt, S. (1998). Computers use, confidence, attitudes and knowledge: a casual analysis. *Computers in Human Behavior*, *14(1)*, 125-146.

Levine, T. & Gordon, C. (1989). Effects of gender and computer experience on attitudes towards computers. *Journal of Educational Computing Research*, *5*, 69-88.

Loyd, B.H., Loyd, D.E., & Gressard, C.P. (1987). Gender and computer experience as factors in computers attitudes of middle school students. *The Journal of Early Adolescence*, *7(1)*, 13-19.

McLoughlin, C. (1999). The implications of the research literature on learning styles for the design of instructional material. *Australian Journal of Educational Technology*, *15(3)*, 222-241.

MEB. (2005). *Matematik dersi öğretim programı ve kılavuzu (9 – 12. sınıflar).* Ankara.

Miles, M.B. & Huberman, A.M. (1994). *An expanded source book: Qualitative data analysis*. London: Sage Publications.
Miller, L.M. (2005). Using learning styles to evaluate computer-based instruction. *Computers in Human Behavior*, *21*, 287-306.
Miller, P. (2000). Learning styles and general attitudes toward computers: an analysis of student enrolled in computer science modules Calvin College. *ERIC,* ED 456 813.
NCTM. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.
Orhun, N. (2007). An investigation into the mathematics achievement and attitude towards mathematics with respect to learning style according to gender. *International Journal of Mathematical Education in Science and Technology*, *38(3)*, 321-333.
Özgen, K., Obay, M., & Bindak, R. (2009). Ortaöğretim matematik öğretmen adaylarının bilgisayar ve bilgisayar destekli eğitime yönelik tutumlarının incelenmesi. *Dicle Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 1(2)*, 12-24.
Peker, M. (2009). Pre-service teachers' teaching anxiety about mathematics and their learning styles. *Eurasia Journal of Mathematics, Science and Technology Education*, *5(4)*, 335-345.
Peker, M., Mirasyedioğlu, Ş., & Aydın, B. (2004). Matematik öğretmenlerinin dikkate alabilecekleri öğrenme stilleri: McCarthy modeli. *Milli Eğitim Dergisi*, *163*. Retrieved May 3, 2010 from http://yayim.meb.gov.tr/dergiler/163/peker.htm.
Ross, J. & Schnulz, R. (1999). Can computer-aided instruction accommodate all learners equally? *British Journal of Educational Technology*, *30(1)*, 5-24.
Shaw, G. & Marlow, N. (1999). The role of student learning styles, gender, attitudes and perceptions on information and communication technology assisted learning. *Computers & Education*, *33*, 223-234.
Shiue, Y.M. (2002-2003). The effects of cognitive learning style and prior computer experience on taiwanese college students' computer self-efficacy in computer literacy courses. *Journal of Educational Technology Systems, 31(4),* 393-409.
Silver, H., Strong, R., & Perini, M. (1997). Integrating learning styles and multiple intelligences. *Educational Leadership*, *55(1),* 22-27.
Solvie, P. & Kloek, M. (2007). Using technology tools to engage with multiple learning styles in a constructivist learning environment. *Contemporary Issues in Technology and Teacher Education*, *7(2),* 7-27.
Soylu, M.Y. & Akkoyunlu, B. (2009). The effect of learning styles on achievement in different learning environments. *The Turkish Online Journal of Educational Technology*, *8(4)*, 43-50.
Taghavi, S.E. (2006). The effects of age, access to a computer and college status on computer attitudes. *Journal of Information Technology Impact*, *6(1)*, 1-8.
Wang, X.C., Hinn, D.M., & Kanfer, a.G. (2001). Potential of computer-supported colloborative learning for learners with different learning styles. *Journal of Research on Technology in Education*, *34(1)*, 75-85.
Wittwer, J. & Senkbeil, M. (2008). Is students' computer use at home related to their mathematical performance at school? *Computers & Education*, *50*, 1558-1571.
Yıldırım, A. & Şimşek, H. (2005). *Sosyal bilimlerde nitel araştırma yöntemleri* (5.Baskı). Ankara: Seçkin.
Yılmaz, V. & Çelik, H.E. (2009). Attitudes towards computer usage according to different educational levels: a comparative study in Turkey. *The New Educational Review*, *19(3-4)*, 133-146.
Zin, N.A.M. (2009). A-math multimedia courseware for effective mathematics learning: matching instructions to students' learning style. *Journal of Applied Sciences*, *9(8)*, 1510-1516.

EXEMPLARY SCIENCE TEACHERS' USE OF TECHNOLOGY

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ABSTRACT
The purpose of this study is to examine exemplary science teachers' level of computer use, their knowledge/skills in using specific computer applications for science instruction, their use of computer-related applications/tools during their instruction, how often they required their students to use those applications in or for their science class and factors influencing their decisions in using technology in the classroom. The sample of this study includes middle and high school science teachers who received the Presidential Award for Excellence in Science Teaching Award. Analysis of the survey responses indicated that exemplary science teachers have a variety of knowledge/skills in using computer related applications/tools. The most commonly used computer applications/tools are information retrieval via the Internet, presentation tools, online communication, digital cameras, and data collection probes. Results of the study revealed that students' use of technology in their science classroom is highly correlated with the frequency of their science teachers' use of computer applications/tools.

1. INTRODUCTION

Although Benchmarks for Scientific Literacy (AAAS, 1993), the National Science Education Standards (NCR, 1996), Project 2061: Science for All Americans (Rutherford & Ahlgren, 1989), the National Educational Technology Standards (NETS) (ISTE, 2000), the International Society of technology in Education (ISTE, 2008) and British Educational Communications and Technology Agency (BECTA) (2010) recommended the use of technology as part of a science curriculum, the literature indicates that science teachers are not using technology for learning and teaching science. *The Teaching, Learning and Computing Survey* (1998), the *1999 National Survey of Teachers' Use of Digital Content*, and the *2000 National Survey of Science and Mathematics Education* examined the computer use and access in the secondary science classrooms. Research suggests that inadequate access to computers is not a limiting factor for integration of computers in teaching. Although a majority of science teachers have an access to technology in their classroom, they are not using technology as recommended by state and national standards (Becker, 1999; Chen, 2008; Cuban, 2001; Dickson & Irvin, 2002; German & Barrow, 1996; Lehman, 1994; Niederhauser & Lindstrom, 2006; OTA, 1995).

Research supports the idea that teachers play a critical role in the classroom (Bybee, 1993; Evertson, 1986; Rosenshine, 1979; Schrage, 1995; Shapiro, 1995), and their beliefs affect practice in the classroom (Bybee, 1993; Clark & Peterson, 1985; Ertmer, 1999; Pajares, 1992). Teacher beliefs specifically affect their use of technology in their teaching (Ertmer, 1999; Marcinkiewicz & Grabowski, 1992). While some of the teachers use technology in an exemplary way, some other teachers does not using them. The characteristics of exemplary technology-using teachers have already examined to understand how those teachers differ from other teachers by many researchers (Becker, 1994; Berg, Benz, Lasley, & Raisch, 1997; Ertmer, Gopalakrishnan & Ross, 2001; Hadley & Sheingold, 1993; Zhao et al., 2001). According to Hadley and Sheingold, teachers who have a reputation of being expert computer users employ a wide variety of computer software, including simulations, programming languages, spreadsheet and database programs, electronic bulletin board communications software, and word processors to directly address curricular goals (Hadley & Sheingold, 1993). They are enthusiastic and confident about using computers themselves, as well as seeing their students using computers for learning. Exemplary science teachers share the same characteristics of exemplary technology using teachers (Bonnstetter, Penick, & Yager, 1983; Fraser & Tobin, 1989; Penick & Yager, 1993; Tobin & Fraser, 1987; Treagust, 1991; Waldrip & Fisher; 1999; Weiss & Raphael, 1996). However there is no research study that examined the how exemplary science teachers use technology in the classroom and how their students use technology in the classroom. This study focuses mainly on exemplary science teachers not exemplary technology-using teachers. This study examined exemplary science teachers' level of computer use, their knowledge/skills in using specific computer applications for science instruction, their use of computer-related applications/tools during their instruction, how often they required their students to use those applications in or for their science class and factors influencing their decisions in using technology in the classroom. Thus, the following guiding questions were created:

1. What are the exemplary science teachers' knowledge/skills in using specific computer applications for science instruction?
2. How exemplary science teachers use the computer-related applications/tools during their instruction?
3. How often are exemplary science teachers require their students to use computer-related applications/tools in or for their science class
4. What kinds of factors influence their decisions in using technology in the classroom?

2. THEORETICAL FRAMEWORK

2.1. Computer self-efficacy

Self-efficacy refers to "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). As a psychological construct, self-efficacy is rooted in a social learning theory developed by Bandura (1977, 1982, and 1986) (Anderson & Maninger, 2007; Delcourt & Kinzie,1993; Wang, Ertmer & Newby, 2004). One's judgment of his capability to perform a specific task is a strong predictor of his capabilities to accomplish that task (Marakas, Yi, & Johnson, 1998). What a person perceives as his capabilities to perform a particular behavior influences his choice of activities, degree of effort, and persistence of effort (Bandura, 1986).

Bandura (1977) describes two dimensions of self-efficacy beliefs (self-efficacy and outcome efficacy) upon which behavior is based. He defines self-efficacy beliefs as judgments of how well one can execute courses of action required to deal with prospective situations. Outcome expectancy refers to the judgments about likely consequences of a behavior in a particular situation (Bandura, 1982). Computer self-efficacy represents

> an individual's perceptions of his or her ability to use computers in the accomplishment of a task (i.e., using a software package for data analysis, writing a mail merge letter using a word processor), rather than reflecting simple component skills (i.e. formatting diskettes, booting up a computer, using a specific software features such as 'bolding text' or 'changing margins') (Compeau & Higgins, 1995, p. 191).

Findings from research studies revealed that computer use is correlated with computer self-efficacy (Compeau & Higgins, 1995; Compeau, Higgins, & Huff, 1999; Hasan, 2003; Marakas, Yi & Johnson, 1998; Pamuk & Peker, 2009; Potosky, 2002; Wilfong, 2006). However, literature on the effects of computer self-efficacy on exemplary science teachers is not found. Exemplary science teachers should already have high self- efficacy in teaching science. However, there is no research in the literature regarding exemplary science teachers' self efficacy in teaching with computers.

2.2. Pupil control ideology

Dole (1986) suggested that one of the major tasks for teachers is to establish and maintain order in the classroom. Demmon-Berger (1986) found that effective teachers are good managers of their students and classroom, and they maintain good discipline in their classrooms. Pupil control is defined as the teacher's stated belief regarding the control of students in classrooms and schools (Willower, Eidell, & Hoy, 1973). Pupil control has been conceptualized along a continuum ranging from custodialism at one end to humanism at the other (Willower, et al., 1973). The Pupil Control Ideology Form (PCI) was constructed by Willower, et al. to measure a teacher's pupil-control ideology on a humanistic to custodial continuum. The model of the custodial orientation is the rigidly traditional classroom that institutes a highly controlled environment to maintain order. This orientation also stresses impersonality, distrust of students, and pessimism. In contrast to the custodial orientation, a humanistic pupil-control orientation classroom is viewed as an educational community in which students learn through experience and cooperative interaction with each other. The humanistic orientation puts emphasis on the psychological and sociological bases of students' learning and behavior. Humanistic teachers are optimistic, patient, easily approachable, and they encourage student self-discipline and independence.

Classroom control in science teaching is important, especially if teachers utilize a hands-on approach to science teaching (Enochs, Scharmann, & Riggs, 1995). According to Enochs, et al., activity-based science instruction can make some teachers uncomfortable who view pupil control in a custodial fashion. The inquiry approach of science teaching and learning may be ignored by teachers who favor custodial classroom control. On the other hand, teachers with a humanistic orientation believe their students are capable of learning through cooperation and experience (Hoy & Woolfolk, 1990). Science teachers with a humanistic orientation may be more likely to utilize inquiry, cooperative learning, discussion groups, and other forms of student-centered instruction (Enochs et al., 1995).

Teachers' classroom management orientation is also related to computer use in the classroom (Bean, 1988). While much attention has been given to pupil control in the school climate, teacher ideology and teacher effectiveness (Cicmanec, Johanson, & Howley, 2001; Enochs et al., 1995; Hoy &Woolfolk, 1990), relatively little attention has been given to the influence of pupil control on computer use in the classroom. There is no study examining exemplary science teachers' classroom management orientation and its influences on technology use in the classroom. This study investigates whether or not teacher-pupil control ideology is associated with exemplary science teachers' level of computer use.

2.3. Computer experience

When attempting to measure teachers' use of computers in teaching, it is necessary to consider their experience (Marcinkiewicz, 1991). Potosky and Bobko (1998) defined computer experience as

> the degree to which a person understands enough how to use a computer. That is, an experienced computer user understands enough about computers in order to use them, more or less independent of specific software packages, reasons for use, and computer hardware features. (p.338)

Computer experience is also defined as how one feels and thinks about existing computing events (Smith, Caputi, Crittenden, Jayasuriya, & Rawstorne, 1999). Experience is also one of the important elements of Rieber and Welliver's (1989) description of the familiarization level in the model of Instructional Transformation (Marcinkiewicz, 1991). At the familiarization level, teachers get familiar with computers through their experiences with them.

Although there is not a consistent or universal definition of the term "computer experience" (Smith, et al., 1999), computer experience is often measured in terms of the amount of computer use by the individual. However, researchers have argued that measuring computer experience as a single component (i.e., amount of experience) has resulted in the oversimplification of computer experience (Szajna & Mackay, 1995). Jones and Clarke's (1995) defined computer experience in terms of four components: amount of use, opportunities of use, diversity of experience, and sources of information. Thus, by using the definition of Jones and Clarke (1995), computer experience is organized as the sum of all computer-related events in this study. These events include (1) current knowledge/skills for each computer application; (2) frequency of instructional use of each application in the classroom; (3) frequency of student use of each application; (4) amount of experience teachers have in using computers for personal use, classroom productivity, and instruction; (5) length of time spent in learning to use computers; (6) number of hours spent using a computer for personal use, classroom preparation, and for instruction; and (7) source of computer knowledge and the most significant computer learning experience for the participant.

Based on a review of the literature, significant factors influencing teachers' use of computers include: personal self-efficacy in teaching with computers (Compeau & Higgins, 1995; Compeau, Higgins, & Huff, 1999; Hasan, 203; Marakas, Yi & Johnson, 1998; Pamuk & Peker, 2009; Potosky, 2002); outcome expectancy; pupil control ideology (Cicmanec, Johanson, & Howley, 2001; Enochs et al., 1995; Hoy &Woolfolk, 1990; Niederhauser & Perkmen, 2010); age (Becker, 1999; Jennings & Onweuegbuzie, 2000; Weiss, Smith, and Malzahn, 2001), gender (Akkoyunlu & Orhan, 2003; Ayersman & Reed, 1996; Busch, 1995; Cassidy & Eachus, 2002; Chua, Chen, & Wong, 1999; Durndell & Haag, 2002; Isılsal & Askar, 2003; Jennings & Onweuegbuzie, 2001; Karsten & Roth, 1998; Loyd & Gressard, 1984b; Murphy, Coover,& Owen, 1989; Ropp, 1999; Rosell & Gardner III, 2000; Rosen & Maguire, 1990; Roussos, 2007; Sam, Othman, & Nordin, 2005; ; Smith & Necessary, 1996; Torkzadeh & Koufteros, 1994; Torkzadeh, Pflughoeft, & Hall, 1999; Whitley, 1997), teaching experience; personal computer use; professional computer use; and science teachers' level of knowledge/skills in using specific computer applications/tools for science instruction. As evident from the literature, it's important to examine exemplary science teachers' knowledge/skills in using specific computer applications for science instruction, their use of computer-related applications/tools during their instruction, how often they required their students to use those applications in or for their science class and factors influencing their decisions in using technology in the classroom.

3. METHODOLOGY

3.1. Selection of the Participants

Middle and high school science teachers who received the Presidential Award for Excellence in Science Teaching (PAEST) from the White House and the National Science Foundation from all 50 states and U.S territories are the sample of this study. When the study completed, 355 middle and high school science teachers (grades 7 through 12) have been awarded by the PAEST.

3.2. Data Collection and Survey Responses
The main instrument of the study was a web-based questionnaire. In the data collection process, e-mail or a letter about the survey (with a return envelope) was sent to all award winning science teachers. The survey instruments posted online and e-mail message was sent to all of the award winning science teachers who provide their e-mail addresses (n=293) requesting to participate in the study by following the included URL address to access the web-based survey. After one week, another e-mail message was sent to the all of the science teachers who did not respond to the survey. At the end of the second contact with the science teachers, 82 award winning science teachers responded. Of those, 72 (28.6%) science teachers' surveys were valid. Not the entire award winning science teachers provided their e-mail addresses (n=62). A total of 103 packets of survey instrument with a postage-paid return envelope were mailed via U.S. postal service to the science teachers who did not provide e-mail address (n= 62) and to the science teachers whose e-mail addresses were returned as invalid (n=41). A total of 20 responses were received from those science teachers. A total of eleven envelopes were returned as undeliverable. Of the total 334 award winning science teachers, usable responses to the survey instrument is a total of 92 science teachers that makes a response rate of 27.5%.

3.3. Description of the Participants
Of the 92 respondents, 35 (38%) were male and 55 (59.8 %) were female. Two respondents did not report their gender. Eighty-nine of the respondents reported information about their ages. The age of respondents ranged from 33 to 65 years. Ages were reported in 10 year increments with 10 (10.9%) subjects falling into the 30 to 39-year-old bracket; 37 (40.2%) in the 40 to 49-year-old bracket; 37 (40.2%) in the 50 to 59-year-old bracket; and 5 (5.4%) in the 60 to 69-year-old bracket.

3.4. Instrumentation
Instruments used in this study include *Microcomputer Utilization in Teaching Efficacy Beliefs Instrument (MUTEBI)* (Enochs, Riggs, & Ellis, 1993), the *Level of Computer Use* assessment (Marcinkiewicz & Welliver, 1993), *The Pupil Control Ideology (PCI)* (Willower, Eidell and Hoy, 1973) and the *Technology Use in Science Education Scale* (TUSES) (developed for this study) and demographic information. The number of items, reliability coefficients and types of instrument (i.e., adapted or researcher-created) are summarized for each component of the survey in Table 1.

Table 1. List of number of items, reliability and source of each scale

Description	#of Items	Reliability Coefficient	Source
Self-efficacy in Teaching with Computers (MUTEBI)	21		Enochs, Riggs, & Ellis, 1993
Outcome expectancy	7	.84	
Personal self-efficacy	14	.92	
Levels of Computer Use (LCU)	4	.95	Marcinkiewicz & Welliver, 1993
Technology Use in Science Education Scale (TUSES)	34		Researcher-created
Teachers' level of knowledge/skills in using specific computer applications for science instruction	34	.96	
Science teachers' use of computer related application/tool during their instruction	34	.90	
Their students' use of computer applications/tools in or for their science class	34	.92	
Pupil Control Ideology Scale (PCI)	10	.75	
Demographic Information	17		Researcher- created

3.4. 1. Instrument development procedures for the *Technology Use in Science Education Scale* (TUSES)
The *Technology Use in Science Education Scale* (TUSES) was developed for this study to gather information about a science teacher's computer use. This scale was developed based on an extensive literature review of the different ways science teachers use computers in the teaching of science.

The *Technology Use in Science Education Scale* (TUSES) consists of 72 items in two sections. The first section measures a respondent's personal use of computers in science education (21 items). For each item, a teacher's current level of knowledge and skills is measured using a 5-point Likert scale: "0" indicating none of knowledge; "1" indicating a little, "2" moderate level; "3" a high level; and "4" indicating expert. A teacher's personal use of technology is measured using a 4-point Likert scale: "0" indicating no personal use of computer application; "1" indicating use of application less than six times a year; "2" one to three times a month; and "3" more than once a week.

The second section covers 51 items associated with a respondent's use of specific computer applications for science instruction. Each item in the second section is measured in three ways: a teacher's current level knowledge/skills; a teacher's instructional use of each application; and students' use of specific computer applications. A teacher's current level of knowledge and skills of a specific computer application for science instruction is measured using a 5-point Likert scale: "0" indicating none of knowledge; "1" indicating a little; "2" moderate level; "3" a high level, and "4" expert. A teacher's instructional use of each application and students' use of specific computer applications is measured using a 4-point Likert scale: "0" indicating no personal use of computer application; "1" indicating use of application less than six times a year; "2" one to three times a month; and "3" more than once a week.

3.4. 2. Pilot study

A panel of eight experts (three science education professors, one instructional technology professor, one science education doctoral student with an instructional technology emphasis, and three instructional technology doctoral students with an science background) validated the content and face validity of the instrument. A Content Expert Review Questionnaire and A Survey of Technology Use in Science Education Evaluation Form were provided to all the experts so they could provide their best professional judgment on the relevance, clarity, and appropriateness of each item and identify potential survey problems, such as ambiguous or difficult questions, irrelevant items, missing items, terms that need clarification, or survey format. On the basis of their response, modifications to the instrument were made before the pilot test was distributed. One of the items was divided into two parts because of the ambiguity of the item. Nine of the items from the second part of the survey were eliminated on the basis of the experts' suggestions because of the potential confusion of the items. Survey items were reorganized on the basis of the similarities of the items.

The *Technology Use in Science Education Survey,* an online survey and paper version of the survey (a total of 63 items), was pilot-tested by administering it to the members of the Florida Science Teachers Associations. The researcher sent an e-mail to a selected list of science teacher listserv moderators to seek permission to send e-mail seeking study participants to the organization's listserv. Once permission was given, the researcher sent an email to the listserv members, which included an introduction to the study, informed consent documents, inclusion criteria, and a link to the online survey. In both data gathering procedures, a reminder e-mail was sent one week after the original e-mail. The Survey Instrument was pilot-tested by administering it to the science teachers attending the University of Florida Mini Med School Workshop (n=15) (paper version) and the Florida Association of Science Teachers Conference (n=59) (14 paper version and 45 web-version). A total of 74 middle and high school science teachers completed the survey. Before the final distribution of the survey, the survey instrument was revised based on the results of the pilot study. By using the pilot study data, an item analysis was conducted on all items. Item analysis enables the evaluation of the quality of the items. If all the respondents answered the same way on one item, there is no variability in the response (spread), and the item is not providing enough information to discriminate against the respondents. Therefore, these items either should be revised or removed from the survey instrument on the basis of the importance of the item for the survey.

Based on the results of the pilot study, the survey was revised before its final distribution. Using the result of the pilot study, the quality of the survey items was evaluated by performing an item analysis using SPSS. The following items were eliminated from the study: items 28 (calculator based laboratory), item 29 (word processing), item 36 (Hyperstudio, Hypercard), item 38 (digital microscopy), item 47 (microcomputer-based laboratories), item 51 (discussion groups (listserv and newsgroups), and item 61 (participating in joint projects). Item 48 was divided into two items as "online communication between teachers and students (e-mail)" and "online communication between teachers and students (online discussions)'. A total of 56 items remained for the survey. Reliability analysis of each component of the survey is provided in Table 2. It should be noted that it is possible that there was no spread of responses on certain items because those specific technology applications/tools were uniformly used or not used by science teachers in this study. Nonetheless, items not providing sufficient information to discriminate were eliminated. Because of the length of the survey, only the second part of the survey was used in this study.

Table 2. Reliability – Cronbach's Alpha values

Cronbach's alpha	
Section 1-Professional use of computers in science education	
Teachers' knowledge/skills	0.95
Teachers' professional use	0.86
Section 2- Use of specific computer application for science instruction	
Teachers' knowledge/skills	0.96
Teachers' instructional use	0.90
Students' use of technology	0.92

3.5. Data Analysis Techniques

This was a descriptive study of an exploratory in nature. As stated by Creswell (2003) when "not much has been written about the topic or the population being studied" (p. 30), exploratory studies provide more information and has many advantages. Descriptive statistics of frequency, percentages, means and standard deviations were reported. This study aimed to focus on exemplary science teachers' use of technology. To determine the relationship between each of independent variables and teachers use of technology correlation analysis was conducted. Furthermore, independent sample t-test analysis was carried out to explore whether there was a significant differences between limited students' use of computer applications/tools and higher students' use of computer applications/tools on exemplary science teachers' self-efficacy, outcome expectancy and pupil control ideology.

4. RESULTS

4.1 Description of the participants

The number of years served as a science teacher ranged from 8 to 41 years with a mean of 22.13 years. Teaching experience was reported in 10-year increments with 2 (2.2%) subjects in the 8 to 9-year range of teaching experience; 32 (35.6 %) falling in the 10 to 19-year range; 37 (41.1 %) falling in the 20 to 29-year range; 18 (20.0 %) falling in the 30 to 39-year range; and 1 (1.1%) falling in the 40 to 41-year range. Teachers reported that they taught grades 6 to 8 (20%) or grades 9 to 12 (69.6%) with only a small percentage of teachers instructing grades 7 through 12 (5.7%). Twenty-nine taught courses in biology (31.6%), 23 in physics (25%), 22 in chemistry (23.8%), 9 in physical science (9.8%), and 32 in the other sciences (34.92%). Table 3 represents the demographic information of participants.

Table 3. Some demographic characteristics of the participants (n=92)

Characteristics		n	%
Teaching experience (n=90)	1-9	2	2.2
	10-19	32	35.6
	20-29	37	41.1
	30-39	18	20.0
	40-41	1	1.1
Computer experience			
Personal use of computers (n=90)	6 to 9 years	5	5.4
	10 to 19 years	49	53.3
	20 to 29 years	34	37.0
	30 to 35 years	2	2.2
Professional use of computers (n=90)	0 to 9 years	20	21.7
	10 to 19 years	54	58.7
	20 to 25 years	16	17.4

The *Technology Use in Science Education Scale* asked for information about exemplary science teachers' access to computers in their home, in the science classroom/science lab, in the computer lab at school, and in the library/media center. Of all the respondents, 89 (97.8%) had access to computers in their home, 85 (96.6%) in their science classroom/science lab, 81 (93.1%) in computer lab at school, and 81 (97.6%) in the library/media center. Figure 1 presents the number of computers available in science classrooms/science labs, in computer labs at school, and in the library/media center. While 72.8% of teachers reported having more than three computers in their classroom, all of the teachers reported that six or more computers were available in computer labs at school.

When asked if they have Internet access and the speed of that access, 97.7% of the science teachers reported having Internet access at their home. Of those who have access to the Internet, 58.1% of them have high speed

Internet access. Ninety-seven percent of science teachers reported having internet access in science classrooms/science labs, and 89.5% had high speed Internet connection in science classrooms/science labs. All the participants reported that computers in the computer lab were connected to the Internet, and 87.7% of them have a high speed connection. Ninety-eight percent of the respondents reported having Internet access in libraries/media centers, 87.7% of them having a high speed Internet connection.

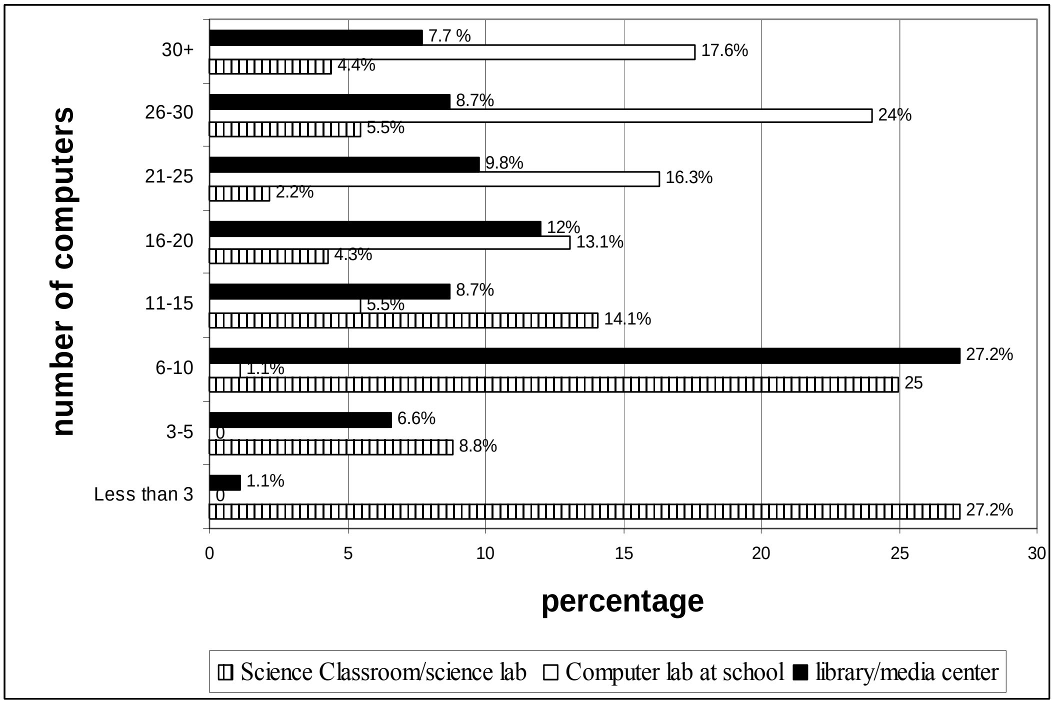

Figure 1. The number of computers available in science classrooms/science labs, computer lab at school, and in the library/media center

Exemplary science teachers indicated that they learned how to use technology through different professional development activities (see Table 4). Ninety-five percent of the exemplary science teachers reported that they learned how to use technology by themselves ("learned on my own"). Educator conferences and state/district/school level workshops also provided information on how to use technology (82% and 83.9%, respectively). Fifty-five percent of the respondents indicated university coursework helped them learn how to use technology.

Table 4. Percent of teachers reporting participating in professional development activities (n=92)

Professional Development Activities	Frequency	Percent (%)
Educator conference	72	82.0
University course work (for credit)	48	55.1
State/district/school level workshop	73	83.9
Non-school sponsored workshop	48	55.2
Private vendors	30	34.4
Learned on my own	83	95.4
Web-based instruction	35	40.2

Exemplary science teachers were asked what they considered the best source of professional development in learning how to use technology. "Learned on my own" was identified by 39.1% of the exemplary science teachers as the best source of learning. Twenty-one percent of science teachers reported educator conferences as the best source.

4.1. Exemplary science teachers' knowledge/skills in using computer applications

Exemplary science teachers were asked to indicate their present level of knowledge/skills in using the specified technology. Science teachers rated their level of knowledge/skills [i.e., "0", none; "1", a little; "2", moderate; "3" high; "4", expert] in two sections of the survey. Nineteen items covered specific computer applications for science instruction, and 15 items covered use of the Internet for science instruction. Some of the items were provided at the Table 5.

Results of the study showed that science teachers are most proficient in: information retrieval via the Internet (M= 3.31); presentation tools (M = 3.1); online communication (e-mail) between teacher and students (M= 3.27); digital cameras (M=2.76); data collection probes (M=2.62); and encyclopedias and other references on CD-ROM (M= 2.62). These findings show that most of the exemplary science teachers have little or moderate level of knowledge/skills in using specific computer applications for science instructions. While 44.9% of science teachers reported their level of knowledge/skills in using presentation tools as "expert," they reported not having any knowledge/skills on: modeling software (60.7%); problem-solving software (54.4%); statistical programs (51.1%); educational games (46.7%); individualized instruction tutorials (34.1%); concept mapping software (33%); and drill and practice programs (31.9%). While more than half of the science teachers reported that their level of knowledge/skills in information retrieval via the Internet and online communication as expert, they reported not having any knowledge/skills on video conferencing with others (47.8%) and use of the remote Web Cam to observe distant locations (46.7%). Only 34.5% of the exemplary science teachers reported that they have high/expert level of knowledge on collecting real-time data. While 15.6% of the science teachers reported that their level of knowledge/skills in Webquest as an expert, 34% of them reported not having any knowledge/skills in Webquest. While 27.3% of the science teachers reported that their knowledge/skills in conducting web-based Internet labs as high/expert, 26% reported not having any knowledge/skills in conducting web-based Internet labs.

4.2. Exemplary science teachers' use of computer applications/tools in their instructions

Science teachers reported how often they used the specific computer applications/tools in their instruction. Science teachers rated their use of the specific computer applications/tools in science instruction [i.e., "0," none; "1," less than six times a year; "2," one to three times a month; "3," more than once a week] in two sections of the survey. The most frequently used computer applications/tools are: information retrieval via the Internet (M=2.16); online communication (M=1.71); presentation tools (M=1.65); digital cameras (M=1.65) and data collection probes (M=1.40). The least frequently used computer applications/ tools are: modeling software (M=0.25); video conferencing with others (M=0.25); problem-solving software (M=3.33); and statistical programs (M=3.3). Findings of the study reveal that science teachers do not frequently use technologies in teaching science. While 80% of the science teachers never used the modeling software in teaching science, 75 % never used problem-solving software and educational games in science instructions. The most commonly used computer applications/tools are presentation tools. Twenty-four percent of the science teachers used presentation tools more than once a week. Information retrieval via the Internet is the most commonly used application for science instruction. Forty percent of the science teachers used the Internet for information retrieval more than once in a week. Thirty-four percent of the science teachers used online communication more than once. On the other hand, 73% of the science teachers never used remote Web Cam to observe distance location. More than 50% of the science teachers never used: online communication (online discussion board) between teacher and students; online communications between students; or video conferencing with others. Fifty percent never: collected real time data; accessed online data bases; conducted web-based Internet labs; took virtual trips to museums, zoos, science centers; used remote Web Cam to observe distance locations; and Webquest. Study findings revealed that online communication and information retrieval are the most commonly used Internet applications by exemplary science teachers. Study findings also revealed that only few exemplary science teachers used the new forms of Internet application in teaching science more than once a week. More than half of the exemplary science teachers never used 10 out of 15 Internet applications/tools in teaching science.

Table 5. Science teachers' present level of knowledge/skill in using specific computer applications for science instruction and using internet for science instruction

	None	A little	Moderate	High	Expert		
	0	**1**	**2**	**3**	**4**	**M**	**S.D.**
1. Digital cameras		7.7	29.7	41.8	20.9	2.76	0.87
2. Video editing software (e.g., Video Maker, iMovie)	39.3	18.0	27.0	10.1	5.6	1.25	1.24
3. Graphing Calculators	14.4	13.3	34.4	23.3	14.4	2.1	1.24
4. Presentations (e.g., PowerPoint, KidPix)	1.1	3.4	24.7	1.1	44.9	3.1	0.97
5. Statistical programs (e.g., SPSS)	51.1	25.6	14.4	4.4	4.4	0.86	1.11
6. Spreadsheets (e.g., Excel)	4.4	14.4	31.1	31.1	18.9	2.46	1.09

7. Concept mapping software (e.g., Inspiration)	33.0	24.2	15.4	14.3	13.2	1.51	1.42
8. Simulations (e.g., ExploreScience, Frog Dissection, etc.)	21.1	13.3	28.9	23.3	13.3	1.94	1.33
9. Individualized instruction-tutorials (e.g., ChemTutor, Science For Kids, The Learn About)	34.1	25.3	19.8	13.2	7.7	1.35	1.29
10. Problem solving software (e.g., Botanical Gardens, Thinkin' Science ZAP!)	54.4	21.1	16.7	3.3	4.4	0.82	1.11
11. Modeling Software (e.g., Model It)	60.7	19.1	11.2	9.0	0	0.69	1
19. Data Collection probes and computers (e.g., Vernier, PASCO, Texas Instrument)	4.5	13.5	25.8	28.1	28.1	2.62	1.16
20. online communication **(e-mail)** between teacher and students	1.1	5.5	11.0	29.7	52.7	3.27	.94
21. online communication **(online discussions board)** between teacher and students	29.7	11.0	23.1	19.8	16.5	1.82	1.47
22. online communication between students and science Experts/ Mentors/ Scientists (e.g., Ask a Scientist)	22.5	19.1	22.5	19.1	16.9	1.89	1.40
23. video conferencing with others	47.8	17.8	17.8	10.0	6.7	1.10	1.29
24. analyze online science data	21.1	23.3	27.8	17.8	10.0	1.72	1.26
25. access online databases (e.g., test locator database)	29.7	23.1	23.1	15.4	8.8	1.51	1.30
26. conduct web-based Internet labs	26.1	19.3	27.3	12.5	14.8	1.70	1.37
27. take virtual science trips to museums, zoos, science centers, etc.	33.7	20.2	19.1	11.2	15.7	1.55	1.45
28. use remote Web Cam to observe distant location	46.7	15.6	16.7	10.0	11.1	1.23	1.41
29. Webquests	34.4	15.6	21.1	13.3	15.6	1.60	1.47

4.3. Students' use of computer applications/tools in or for their science class

Science teachers reported how often they required their students to use technology applications/tools in or for their classroom. Science teachers rated their students' use of the specific computer applications/tools in science instruction [i.e., "0", none; "1," less than six times a year; "2," one to three times a month; "3," more than once a week] in two sections of the survey. Students' technology use indicated the most often used: information retrieval via the Internet (M=2.20); online communications between teacher and students (M=1.61); graphing calculators (M=1.45); data collection probes (M=1.39); graphing software (M=1.31); and presentations (M=1.28). Study findings revealed that student use of technology was limited to the few computer applications/tools in science lessons. Thirty-two percent of the exemplary science teachers reported that their students used graphing calculators in or for their science class more than once a week. Seventy-seven percent of the exemplary science teachers reported that their students used data collection probes and computers more than once a year. On the other hand, more than 60% of the exemplary science teachers reported that their students never used: concept mapping software; video editing software; statistical programs; webpage authoring software; drill and practice programs; individualized instruction-tutorials; problem-solving software; and modeling software. While 84% of the exemplary science teachers reported that their students never used video conferencing with others as part of science lesson, 47% of them never used online communication between students and science experts/mentors/scientists. More than 50% of the exemplary science teachers reported that their students: never used online communications between teacher and students; video conferencing; collected real-time data; analyzed online science data; accessed online science databases; accessed to online journals; conducted web-based Internet labs, took virtual trips to museums, zoos, science centers, used remote Web Cam to observe distance locations, and Webquests. Study findings revealed that there is a consistency between science teachers' level of knowledge/skills and their use of that technology or their students' use of that technology in or for their science class.

4.4. Descriptive statistics and correlation

The descriptive statistics for two subscales of *The Microcomputer Utilization in Teaching Efficacy Beliefs Instrument* (MUTEBI): personal self-efficacy; outcome expectancy; pupil control ideology scale; level of computer use; science teachers' level of knowledge/skills in using specific computer applications for science instruction; science teachers' use of computer-related applications/tools during their instruction; and their students' use of computer applications/tools in or for their science class are listed in Table 6.

Table 6. Descriptive statistics of the variables and their reliabilities

	N	Min score	Max Score	Mean	Std. Dev.	Reliability
Level of computer use (LCU)	89	4	8	6.4	1.81	0.95
Personal self-efficacy (SE)	90	21	69	57.3	1.04	0.92
Outcome expectancy (OE)	90	9	33	20.9	0.54	0.84
Pupil control ideology (PCI)	90	10	35	21.1	0.58	0.75
Teachers' knowledge/skills	92	0.21	3.68	1.87	0.086	0.96
Teachers' instructional use	92	0.09	2.06	0.81	0.046	0.90
Student use of technology	92	0.09	1.97	0.76	0.045	0.92

Correlations were computed among the teachers' level of knowledge/skills in using specific computer applications for science instruction, the teachers' use of computer-related applications/tools during their instruction, the students' use of computer-related applications/tools in or for their science class; science teachers' personal efficacy; science teachers' outcome expectancy; pupil control ideology; age; teaching experience; how long they have been using computers for personal use; how long they have been using computers in their classroom for professional purposes; and how many hours of professional development related to the use of computers they participated within the last five years and number of computers in their science classroom/science labs (see Table 7).

Table 7. Pearson Product –Moment correlation between variables

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Level of computer use (LCU)	1.000	.199	**.278****	.199	**.333****	0.189	-.063	-.009	-.040	**.215***	.154	.019	.181
2	Teachers' knowledge/skills		1.000	**.715****	**.621****	**.576****	**.256****	-.076	-.179	-.200	.146	.144	.126	.147
3	Teacher's instructional use			1.000	**.912****	**.437****	**.315****	-.006	.064	.021	**.220***	**.295****	**.252***	.135
4	Students' use of technology				1.000	**.366****	**.214****	-.088	.060	-.013	.185	**.275***	.156	.164
5	Personal efficacy					1.000	.208	**-.263***	-.132	-.081	.175	.195	-.015	.147
6	Outcome expectancy						1.000	.082	.010	.092	.072	.189	.089	-.117
7	Pupil Control Ideology							1.000	.099	.146	-.172	**-.219***	.063	**-.247***
8	Age								1.000	**.729****	**.337****	**.278***	-.047	-.023
9	Teaching experience									1.000	**.250***	**.287****	.017	-.005
10	Personal computer use										1.000	**.620****	.056	.064
11	Professional computer use											1.000	.085	.005
12	Professional development												1.000	.082
13	Number of computers													1.000

Note. *$p< .05$, ** $p< .001$ N= 87

Exemplary science teachers' level of computer use and exemplary science teachers use of computer related applications/tools in their instruction were positively correlated (r =.278, p =.009). Exemplary science teachers' level of computer use was also correlated with science teachers' personal efficacy (r = .330, p=0.002), and how long they have been using computers in their classroom for professional purposes (r = .215, p=.048). Exemplary science teachers' level of computer use was not correlated with their level of knowledge/skills in using specific computer applications for science instruction and the number of computers in the science classroom/science lab.

At the 0.01 level of significance, science teachers' level of knowledge/skills in using specific computer applications for science instruction was correlated with: the frequency of use of computer-related applications/tools in their instruction (r =.715, p= 0.00); how often they required their students to use computer-related applications/tools in or for their science class (r = .621, p=0.00); and science teachers' personal efficacy (r = .576, p=0.00). At the 0.05 level of significance, science teachers' level of knowledge/skills in using specific computer applications for science instruction was correlated with science teachers' outcome expectancy (r = .256, p=0.017).

Correlation did not exist between science teachers' level of knowledge/skills in using specific computer applications for science instruction and their pupil control ideology, age, and teaching experience. There is also no correlation between science teachers' level of knowledge/skills in using specific computer applications for science instruction and how long they have been using computers for personal purposes, how long they have been using computers in their classroom for professional purposes, and how many hours of professional development related to use of computers they participated.

Science teachers' frequency of computer-related applications/tools use in their instruction was statistically significant with: how often they required their students to use computer-related applications/tools in or for science class (r = .912, p=0.00); science teachers' personal efficacy (r = .437, p=0.00); science teachers' outcome expectancies (r = .315, p=0.003); how long they have been using computers in their classroom for professional purposes (r = .295, p=.006); how many hours of professional development related to use of computers they participated (r = .252, p=0.028); and how long they have been using computers for personal purposes (r = .220, p=.045). Correlation did not exist between science teachers' frequencies of computer-related applications/tools use in their instruction with their pupil control ideology, age, and teaching experience.

How often they required their students to use computer-related applications/tools in or for their science class was correlated with: the teachers' personal efficacy (r = .336, p=.001); the teachers' outcome expectancies (r = .214, p=.048); and how long they have been using computers in their classroom for professional purposes (r = .275, p=.011).

Science teachers' personal efficacy was negatively correlated with their pupil control orientation (r = -.263, p=.014). The age of science teachers significantly correlated with: their teaching experience (r = .729, p=.00); how long they have been using computers for personal purposes (r = .337, p= .002); and how long they have been using computers in their classroom for professional purposes (r = .278, p=.010).

5. FURTHER ANALYSES

Study findings revealed that while some exemplary science teachers reported that their students use certain applications/tools, others reported that their students do not use them at all. For this reason, the researcher decided to look at the characteristics of the science teachers whose students use technology often and those who do not use this technology often.

This study used 34 items measuring students' use of computer-related applications/tools in or for their science class. Science teachers rated their students' use of the specific computer applications/tools in science instruction [i.e., "0," none;"1," less than six times a year; "2," one to three times a month; "3," more than once a week] in the survey. Teachers' responses to each of the applications/tools were summed. If the total value was less than 34, it was accepted as limited students' use of computer-related applications/tools (LSU). If the total value was higher than 34, it was accepted as higher students' use of computer-related applications/tools (HSU).

The following three additional hypotheses were investigated in further analyses.

H_{01}: There will be no significant difference between LSU and HSU groups on exemplary science teachers' personal self-efficacy.

H_{02}: There will be no significant difference between LSU and HSU groups on exemplary science teachers' outcome expectancy.

H_{03}: There will be no significant difference between LSU and HSU groups on exemplary science teachers' pupil control ideology.

5.1. Results for further analysis

H_{01}: There will be no significant difference between LSU and HSU groups on exemplary science teachers' personal self-efficacy.

The independent-samples t-test analysis indicates that the 65 low level of students' use of computer-related applications/tools had a mean of 65.0 total points in personal self-efficacy; the 22 high level of students' use of computer-related applications/tools had a mean of 61.36 total points in personal self-efficacy. There was a statistically significant difference between the conditions (t=-2.292, df =85, p=.024, two-tailed). This means that exemplary science teachers who a reported higher level of students' use of computer-related applications/tools have higher personal self-efficacy. The results are found in Table 8.

Table 8. Personal self-efficacy

	N	Mean	SD	*t*	DF	*p*
LSU	65	56.0000	10.1458	-2.292	85	.024
HSU	22	61.3636	7.1083			

H_{02}: There will be no significant difference between LSU and HSU groups on exemplary science teachers' outcome expectancy.

The independent-samples t-test analysis indicates that the 65 low level of students' use of computer-related applications/tools had a mean of 20.55 total points in outcome expectancy; the 22 high level of students' use of computer-related applications/tools had a mean of 21.86 total points in outcome expectancy. There was no statistically significant difference between the conditions (t=-2.053, df =85, p=.295, two-tailed). This result means that outcome expectancy of the exemplary science teachers is not different in both high and low level of students' use of computer-related application/tools. The results are found in Table 9.

Table 9. Personal outcome expectancy

	N	Mean	SD	*t*	DF	*p*
LSU	65	20.55	4.98	-2.053	85	.295
HSU	22	21.86	5.25			

H_{03}: There will be no significant difference between LSU and HSU groups on exemplary science teachers' pupil control ideology.

The independent-samples t-test analysis indicates that the 65 low level of students' use of computer-related applications/tools had a mean of 21.37total points in pupil control ideology; the 22 high level of students' use of computer-related applications/tools had a mean of 20.72 total points in pupil control ideology. There was no statistically significant difference between the conditions (t=-2.053, df =85, p=.636, two-tailed). This result means that exemplary science teachers' pupil control ideology is not different in both high and low level of students' use of computer-related application/tools. The results are found in Table 10.

Table 10. Pupil control ideology

	N	Mean	SD	*t*	DF	*p*
LSU	65	21.37	5.44	.474	85	.636
HSU	22	20.72	5.62			

6. DISCUSSION, CONCLUSIONS AND RECOMMENDATION

Exemplary science teachers have a variety of knowledge/skills in using computer related applications. The most commonly used computer applications/tools are information retrieval via the Internet, online communication, presentation tools, and data collection probes. Dickson and Irving (2002) mentioned the Internet enables science teachers to find resources on their topic, lesson plans, and other curricular materials, and through the Internet they enhance their science teaching. Data from the survey revealed exemplary science teachers have less knowledge of computer applications/tools related to the use of the Internet for science instruction such as video conferencing, taking virtual trips to museums and zoos, and science centers, Webquest, use of the WebCam to observe distant locations, accessing online databases, and collecting real-time data. Use of the Internet provides a broad range of information to the science classroom. Wallace (2004) reported that use of the Internet might cause some problems for science teachers who do not feel comfortable answering students' questions about unfamiliar content. Although this issue may not a problem for exemplary science teachers, use of Internet-related computer applications by exemplary science teachers responding to this study's survey are less than other computer-related applications/tools.

Exemplary science teachers are fairly proficient in some of the computer technologies. Most of the exemplary science teachers are familiar with common educational technologies although their proficiency levels are different. The most frequently used computer applications/tools are presentation tools, information retrieval via the Internet, online communication, digital cameras, and data collection probes. The least frequently used computer applications/tools are modeling software, video conferencing, problem-solving software and statistical programs. Findings from the study revealed that science teachers do not frequently use technologies in teaching science. The most commonly used computer applications/tools are presentation tools. Twenty-four percent of the science teachers used presentation tools more than once a week. Information retrieval via the Internet is the most commonly used Internet tool for science instruction.

Class interaction between teacher and students and also between students and students may be synchronous or asynchronous through the use of e-mail, online discussions board, websites and listservs. Data from the surveys revealed limited use of online communication between exemplary science teachers and students and among students. The lack of these live telecommunication technologies may be explained by a possible fear of losing control of their students (Wallace, 2004). To improve teachers' knowledge and skill in using those telecommunication tools, workshops targeting the effective use of this specific technology should be offered.

Teachers in this study reported that student use such as information retrieval via the Internet, online communications between teacher and students, graphing calculators, data collection probes, graphing software, and presentations are most often used. Study findings revealed student use of technology is limited to a few computer applications/tools in science lessons. More than 60% of exemplary science teachers reported their students never used concept mapping software, video editing software, statistical programs, webpage authoring software, drill and practice programs, individualized instruction-tutorials, problem-solving software, and modeling software.

Science teachers' use of technology is higher than their students' use of computer-related applications and tools. This provides evidence that science teachers first experienced the technology in the classroom before they required their students to use that technology in or for their science class. Effective integration of technology in the classroom will be determined by some factors such as the degree to which teachers practice their skills in the science classroom as part of their daily profession (Lewis, 1999) and their ability to learn science themselves using the technology before actually trying to teach with it (Friedrichsen, Dana, Zembal-Soul, Munford, & Tsur, 2001). Some studies suggest that teachers need specific training to infuse technology in their curriculum (Ogle, 2000).

Seventy-three percent of the award-winning science teachers reported their students use data collection probes during their science class. This finding is consistent with the Weiss, Smith and Malzahn (2001) study that found 70% of the award-winning teachers reported their students collect data using sensors or probes. The same study found that only 49% of the national sample of secondary science teachers uses probes to collect data. In the current study, sixty percent of the award-winning science teachers reported their students never use computers for drill and practice. This finding is higher than the Weiss et al. (2001) study and possibly reflective of the fact that exemplary science teachers may have a greater repertoire of instructional strategies and rely less on drill and practice activities.

A review of exemplary science teachers' characteristics for this study revealed participating science teachers had higher personal computer self-efficacy, which is slightly above the average outcome expectancy, and they leaned toward a humanistic end of pupil control orientation. Personal computer self-efficacy correlated with science teachers' level of knowledge/skills in using specific computer applications, frequency of science teachers' use of computer-related applications/tools in their instruction and their students' use of computer applications in or for their science class. Findings from this study are consistent with the previous studies. Previous research has found that teachers' self-efficacy predicted the teachers' technology use (Albion, 1999; Becker & Anderson, 1998; Maracas, Yi, & Johnson, 1998). Teachers' level of computer use also is correlated with their personal self-efficacy. Personal self-efficacy is also one of the significant factors that explain the variance in teachers' level of computers use. If science teachers do not have higher self-efficacy, we might expect that teachers think that computer technology is indispensable for their teaching. Their low level of personal self-efficacy might inhibit their progress through the five stages of the Hooper-Reiber Model of Technology Adoption in the Classroom (Hooper & Reiber, 1995). Personal computer self-efficacy beliefs do not correlate with the teachers' teaching experience, personal or professional computer use, and participating in professional development related to computer use. Hasan (2003) found significant relationships between computer experience and computer self-efficacy. He cited that previous research supports the idea that computer experience is the precursor of self-efficacy. This study did not find any relationship between an exemplary science teacher's computer experience and his or her personal computer self-efficacy.

This study found negative correlation between teachers' personal computer self-efficacy and their pupil control orientation. Consistent with the previous literature, exemplary science teachers with higher computer self-efficacy scores also had more a humanistic orientation toward pupil control ideology (r = - 263; $p< 0.05$). This can be interpreted in the following ways: If an exemplary science teacher believes in his own abilities to use computer technology for teaching science, he is also more likely to believe his students would be more responsible in the classroom. Woolfolk and Hoy (1990) found the same correlation between pre-service teachers' general teaching efficacy and pupil control orientation. Similarly, Enochs, et al., (1995) found significant correlation between pre-service elementary school science teachers' personal science teaching self-efficacy beliefs and their pupil control orientations.

Prior research indicates that computer self-efficacy is positively correlated with an individual's willingness to participate in computer-related activities (Compeau & Higgins, 1995; Murphy, Cover, & Owens, 1989). This study did not find any correlation between exemplary science teachers' computer self-efficacy and their participation in professional development activities related to the use of computers.

An exemplary science teacher's knowledge/skills in using specific computer applications in science instruction is correlated with how often that teacher uses computers in his instruction and requires his students to use those applications/tools in or for their science class. There is no significant correlation between exemplary science teachers' level of knowledge/skills and their participation in professional development activities related to the use of computers. One reason for this result might be self-training in learning how to use technology as the best source of knowledge for exemplary science teachers. Self-training and risk-taking are the characteristics of exemplary teachers (Beisenherz, 1993). Science teachers' use of computer applications/tools in their instruction is correlated with their participation in professional development activities related to the use of computers. This study suggests that exemplary science teachers might improve their knowledge using computer applications/tools by themselves, but they need help in learning how to use those technologies in the classroom. Self-training is not enough to use those technologies in the classroom. If teachers do not know about new available technologies in science teaching, we cannot expect them to use those technologies in the classroom. Professional development activities might help them to become informed about new technologies and help them learn different ways of using those instructional technologies in the science classroom.

Results of this study revealed students' use of technology in or for their science classroom is highly correlated with the frequency of the science teachers' use of computer applications/tools in their instruction. Students' use of computers in science classrooms is also correlated with the number of years of teachers' use of computers in the classroom for professional purposes. There is no significant correlation between duration of teachers' use of computer for personal purposes and students' use of technology in science teaching. This study suggested if teachers have more experience with technology in the classroom, there is a higher chance they will require their students to use computer-related applications/tools in their class.

Further analyses of this study revealed that exemplary science teachers who reported higher level of student's use of computer related application/tools have higher personal self-efficacy. This finding is consistent with other findings that found that computer self-efficacy has been identified as one of the key factors among the various factors (Marakas, Yi, & Johnson, 1998; Potosky, 2002). Outcome expectancies and pupil control ideology of the exemplary science teachers are not different in both high and low level of students' use of computer –related application/tools. Although researchers mentioned that teachers' classroom management orientation is related to their use of computer in the classroom (Bean, 1988; Honey & Moelly, 1990; Sandholtz, Ringstaff, & Dwyer, 1997), this study revealed that exemplary science teachers does not have problem in pupil control on computer use in the classroom.

7. IMPLICATIONS AND SUGGESTIONS

The findings of this study have implications that should be considered by teacher educators, classroom teachers, administrators, and researchers who study factors influencing teachers' integration of computers in science teaching. This study also provides information to those who wish to better understand the beliefs and practices of exemplary science teachers.

Further validation of the Technology Use in Science Education Scale with regular science teachers in United States of America and, in other is necessary. This scale provides substantial information on science teacher's level of knowledge and their use of specific computer applications for science instruction. This survey instrument can be used to gather information on in-service science teachers' level of knowledge and their practice. This study instrument was created on the basis of extensive research on technology use in science teaching. If technology use is expected by science teachers, pre-service science teachers programs must create an environment to help future science teachers in improving their knowledge and skills in using new technologies appropriate for science instruction. Pre-service science teachers could improve their knowledge on specific computer applications/tools through technology and science methods courses. Before pre-service science teachers graduated from their program, they should have knowledge on each specific computer applications/tools for science instruction. Items in the instrument can be used as in both formative and summative ways in the Pre-service Science Education Program.

Exemplary science teachers were not using the Internet as engaging research activities. This finding is consistent with the previous studies (Becker, Ravitz, & Wong, 1999; Songer, Lee, & Kam, 2002). Findings of the study revealed that science teachers should be informed about instructional uses of the Internet through professional development courses or workshops. The purpose of the professional development courses and workshops should be to show different Internet sites, how to become involved in collaborative projects, how to collect real-time data, how to access online databases, how to conduct web-based Internet labs, and how to use to virtual libraries. Internet-oriented workshops would give science teachers an opportunity to experience how the Internet can be part of their instruction. Most of the Internet sites were not created for instructional purposes. Hence, it becomes the teachers' responsibility to create the lessons by using the information from that site (Wallace, 2004). Providing the webpage address of the Internet sites that are appropriate to integrate science instruction is not sufficient enough for science teachers to use in their lessons. Lesson plans and appropriate pedagogies should be provided with that user information through workshops or other professional development efforts.

Exemplary science teachers identified "learned on my own" as the best source of their learning about technology. This study showed that learning on your own does not seem to result in extensive use of technology in teaching by teachers and their students. It is obvious that learning new technologies by yourself might help you to learn some basics of that technology. However, science teachers need help in learning how to integrate those technologies in their teaching in ways that strongly support student learning. If a teacher does not know new technologies exist, we can not expect them to learn how to use those technologies in science teaching. Professional development activities on new technologies are necessary for science teachers to improve their knowledge and learn how to use those technologies in support of student learning. Professional development activities on technology use specifically for science teaching appear to be not common. Since science-specific technologies and their integration in science teaching is different from other subject areas, professional development activities specifically for science teachers might be more helpful than general professional development opportunities. During the professional development activities, teacher might be provided with databases of exemplary technology integrated activities and some scientific websites for teaching science concepts. Knowing the available sources might be helpful for science teachers to explore those resources and integrate them in their instruction.

On the basis of finding of this study, professional development activities suggested. Professional development activities can be arranged in four levels. The first step is to inform the science teachers about available technologies for science teaching. This section of the professional development activity might help science teachers become aware of new or unfamiliar technologies. They might not have those technologies right now. If they know that new technologies are available for them to use, they might want to obtain and use those technologies.

The second step is to create a positive learning environment for science teachers in learning how to use those new technologies. This might help them to ease their fear in using those technologies and see the benefits in learning science subject matter. Learning new technologies with other science teachers might create a learning environment with support and encouragement from each other. After they feel comfortable in using those technologies, a third step of the professional activity can be introduced to science teachers. At this point they can learn how to integrate new technology in science teaching. Samples of technology-integrated lesson plans linked to state science standards and their school's curriculum can be provided to the science teachers. Those lessons plans might help them explore new ways of using technology as a thinking tool in science teaching. Science teachers might be faced with many challenges during the integration process. Another part of the professional development activity should cover the challenges of the integration of technologies. By working through challenges, teachers can improve their confidence in their abilities to use new technologies and be free to think about ways that technology will successfully enhance their instruction and help their students develop richer and deeper understanding of science concepts. The fourth and last step of the professional development activity can be helping science teachers to create their own technology integrated lesson plans and help them to incorporate those lessons in their own science instruction. This way they might use these activities as a model in creating additional technology-integrated science lessons.

The use of the computer and related technologies whether required students to use of those technologies are depending on the teachers decisions. This study revealed that teachers' believes influence their level of knowledge/skills in use of technologies which in turn influence their teachers' decisions to use technologies in the classrooms. This study examined only some of the factors. Other factors might influence science teachers' decision to integrate technology while they are teaching. Those factors should also be studied to better understand the exemplary science teachers.

REFERENCES

Akkoyunlu B. & Orhan, F. 820039 Bilgisayar ve Öğretim Teknolojileri Eğitimi (BÖTE) Bölümü Öğrencilerinin Bilgisayar Kullanma Öz Yeterlik İnancı İle Demografik Özellikleri Arasındaki İlişki, *Turkish Online Journal of Educational Technology* 2(3) Article 11.

Albion, P. R. (1999). Self-efficacy belief as an indicators of teachers' preparedness for teaching with technology. *Technology and Teacher Education Annual 1999*, (Society for Information Technology & Teacher Education). Charlottesville, VA

Anderson, S. E., & Maninger, R. M. (2007). Preservice teachers' abilities, beliefs, and intentions regarding technology integration. *Journal of Educational Computing Research*, 37(2), 151–172.

Ayersman, D. & Reed, W. M. (1996). Effects of learning styles, programming and gender on computer anxiety. *Journal of research on Computing Education*. 28, 148-161.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 37, 122-147.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Bean, B. L. (1988). *Microcomputers: Developing teacher confidence and management skills.* Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 5-9, 1988)

Becker, H. J. (1994). How exemplary computer using teachers differ from other teachers: implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education*, 26(3), 292-321.

Becker, H. J. (1999). Internet use by teachers: Conditions of professional use and Teacher directed student use (Teaching, Learning, and Computing -1998 National Survey, Report #1). Retrieved May 3, 2004, from http://www.crito.uci.edu/TLC/findings/Internet-Use/startpage.htm

Becker, H. J. & Anderson, R. E. (1998). Teaching, learning, and computing: 1998, A national survey of school and teachers describing their best practices, teaching philosophies, and uses of technology.

Becker, H. J., Ravitz, J. L., & Wong, Y. (1999). Teacher and teacher-directed student use of computers and software (Report No. 3). Irvine, CA: Center for research on Information Technology and organizations, University of California, Irvine.

Beisenherz, B. C. (1993). "E" is for exemplary- Yes! You, too, can be an exemplary science teacher. *Science and Children* 31(1), 22-24.

Berg, S., Benz, C. Lasley, T.& Raisch, C. D. (1997); The Coordinators and the Teachers: A description of exemplary use of technology in elementary Classrooms. Paper presented at the annual meeting of the Mid-western Educational research Association Annual Meeting. Chicago, IL, October, 1997. (Eric Document reproduction service No. ED414 877).

Bonnstetter, R.J., Penick, J. E., & Yager, R. E. (1983). *Teachers in exemplary programs: How do they compare?* Washington, DC: National Science Teachers Association.

British Educational Communications and Technology Agency (BECTA). (2010). *Leading next generation learning*. Retrieved on April 2010, from http://www.education.gov.uk

Busch, T. (1995). Gender differences in self- efficacy and attitudes toward computers. *Journal of Educational Computing research*, 12, 147-158.

Bybee, R. W. (1993). *Reforming Science Education*. New York: NY: Teachers college Press.

Cassidy, S., & Eachus P.(2002). Developing the computer user self- efficacy (CUSE) scale: Investigating the relationship between computer self-efficacy, gender and experience with computers. *Journal of Educational Computing Research*, 26(2), 133-153.

Chen, C. H. (2008). Why do teachers not practice what they believe regarding technology integration? The Journal of Educational Research, 102(1), 65–75.

Chua, S. L. , Chen, D., & Wong, A. (1999). Computer anxiety and its correlates: A meta-analysis. *Computers in Human Behavior*, 15(5), 609-623.

Cicmanec, K. M., Johanson, G. & Howley A. (2001). High school mathematics teachers: Grading Practice and Pupil Control Ideology. Paper presented at the Annual Meeting of the American Educational Research Association (Seattle, WA, April10-14, 2001)

Clark, C. M. & Peterson, P. L. (1985). Teachers' thought process. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching* (pp. 255-296). New York: Macmillan

Compeau, D. & Higgins, C. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, 19(2), 1989-211.

Compeau, D., Higgins, C. A. & Huff, S. (1999) Social cognitive theory and individual reactions to computing technology: a longitudinal study, *MIS Quarterly*, 23(2), 145-158.

Creswell, J. W. (2003). Research design: qualitative, quantitative, and mixed methods approaches (2nd ed.). Beverley Hills, CA: Sage Publications.
Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.
Delcourt, M. A., & Kinzie, M. B. (1993). Computer technologies in teacher education: The measurement of attitudes and self-efficacy. *Journal of Research and Development in Education*, 27(1), 35–41.
Demmon-Berger, G. (1986). *Effective teaching: Observations from research*. Arlington, VA: American Association of School Administrators. ED274087
Dickson, L. A. & Irving, M. M (2002). An internet survey: Assessing the extent Middle /high school teachers use the Internet to enhance science teaching. *Journal of Computer in Mathematics and Science Teaching* 21 (1), 77-97.
Doyle, W. (1986). Classroom organization and management. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching* (3rd ed., p. 392-431). New York: Mackmillan
Durndell, A., & Haag, Z. (2002). Computer self-efficacy computer anxiety, attitudes toward the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behavior*, 18, 521-535.
Enochs, L. G., Scharmann, L. C. Riggs, I. M. (1995). The relationship of pupil control to pre-service elementary science teacher self-efficacy and outcome expectancy. *Science Education*, 79(1), 63-75.
Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47(4), 47-61.*
Ertmer, P. A., Gopalakrishnan S.,& Ross, E.M. (2001). VisionQuest: Helping our future teachers envision and achieve technology integration. Paper presented at SITE conference.
Evertson C. M. (1986). Do teachers make a difference? *Educational and Urban Society*, 18(2), 195-210.
Fraser, B. J., & Tobin, K. (1989). Student perceptions of psychosocial environments in classrooms of exemplary science teachers. *International Journal of Science Education*, 11 , 19-34.
Fredrichsen, P. M., Dana, T. M., Zembal-Saul, C., and Tsur, C. (2001). Learning to teach with technology model: Implementing in secondary science teacher education. *Journal of Computers in Mathematics and Science Teaching*, 20(4), 377-394.
Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. *American Journal of Education, 101* , 281-315.
Hasan, B. (2003). The influence of specific computer experiences on computer self-efficacy beliefs. *Computers in Human Behavior*, 19, 443-450.
Honey, M., & Moeller, B. (1990). *Teachers' beliefs and technology integration: Different values*, *different understandings* (Technical Report 6). New York: Center for Technology in Education.
Hoy, W. K., & Woolfolk, A. E. (1993). Teachers' sense of efficacy and the organizational health of schools. *The Elementary School Journal*, 93, 356-372.
International Technology Education Association (ISTE), (2000). *Standards for Technological Literacy: Content for the Study of Technology*, Reston, Virginia:
International Society of Technology Education (ISTE) Accreditation Committee (1992). *Curriculum Guidelines for Accreditation of Educational Computing and Technology Programs*. Eugene, Oregon: ISTE.
International Society for Technology in Education (ISTE) (2000).*National education technology standards for teachers.* Eugene, OR: International Society for technology in Education (ISTE) NETS Projects. Available:http://cnets.iste.org/index3.html
Isıksal, M., & Askar, P. (2003). İlköğretim öğrencileri için matematik ve bilgisayar öz-yeterlik algısı ölçekleri. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 25, 109–118.
Jennings, S. E., & Onweuegbuzie, A. J. (2001). Computer as a function of age, gender, math attitude, and developmental status. *Journal of Educational Computing Research*, 25(4), 367-384.
Karsten, R., & Roth, M. R. (1998). The relationship of computer experience and computer self-efficacy to performance in introductory computer literacy courses. *Journal of Research on Technology Education*, 31(1), 14-24.
Lehman, J.R. (1994). Secondary science teachers' use of microcomputers during instruction. *School Science and Mathematics* 94(8), 413-420.
Loyd, B. H. & Gressard, C. (1984). The effect of sex, age, and computers experience on computer attitudes, *AEDS Journal*, 18, 67-77.
Marakas, G. M., Yi, M. Y., & Johnson, R. D. (1998). The multilevel and multifaceted character of computer self-efficacy: Toward clarification of the construct and an integrative framework for research. *Information Systems Research*, 9(2), 126-163.
Marcinkiewicz, H. R. (1991). The relationships of selected personological variables to the use of available microcomputers by elementary school teaches. Unpublished doctoral dissertation, he Pennsylvania State University, Pennsylvania.

Marcinkiewicz, H. R. (1993). *The relationships of personological variables to computers use by elementary school teachers: Report of phase one – base line data*. Paper presented at the Convention of the Association for Educational Communications and Technology, Washington.
Marcinkiewicz, H. R., & Grabowski, B. L. (1992). *The relationships of personological varables to computer use by elementary school teachers: Report of phase data*. Paper presented at the Convention of the Association for Educational Communications and Technology, Washington.
Marcinkiewicz, H. R., & Welliver, P. (1993). *Procedures for assessing teachers' computer use based on instructional transformation*. 5th Annual proceedings of Selected Research Presentations at National Convention of the Association of Educational Communications and technology (New Orleans, LA)
Murphy, C. A., Coover, D., & Owen, S. V. (1989). Development and validation of the computer self efficacy scale, *Educational and Psychological measurement*, 49, 893-899.
National Research Council (1996). *National Science Education Standards*. Washington,DC: National Academy Press.
National Board for Professional Teaching Standards (1999). *Guide to national certification. Washington, DC: Author*
Niederhauser, , D. S., & Perkmen, S. (2010). Beyond self-efficacy: Measuring pre-service teachers' instructional technology outcome expectations. Computers in Human Behavior, 26, 436–442.
Niederhauser, D. S., & Lindstrom, D. L. (2006). Addressing the NETS for students through constructivist technology use in K-12 classrooms. Journal of Educational Computing Research, 34(1), 91–128.
Office of Technology Assessment. U.S. Congress (1995). *Teachers and Technology: Making the Connection*. Washington, DC: U.S. Government print production
Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62(3), 307-332
Pajares, F. (2009). Overview of social cognitive theory and of self-efficacy. Retrieved December 10, 2009, from http://www.emory.edu/EDUCATION/mfp/eff.html.
Pamuk, S., & Peker, D. (2009). Turkish pre-service science and mathematics teachers' computer related self-efficacies, attitudes, and relationship between these variables. *Computers & Education*, 53, 454–461.
Paraskeva, F.; Bouta H.; Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice *Computers & Education*; 50, 1084–1091.
Penick, J., & Yager, R. (1993). The search for excellence in science education. *Phi Delta Kappan*, 64(9), 621-623.
Potosky, D. (2002).A field study of computer efficacy beliefs as an outcome of training: the role of computer playfulness, computer knowledge, and performance during training. *Computers in Human Behavior*, 18(3), 241-255.
Potosky, D., & Bobko, P. (1998). The computer understanding and experience scale: a self-report measure of computer experience. *Computers in Human Behavior*, 14(2), 337–348.
Rieber, L.P., and Welliver, P.W. (1989). Infusing Educational Technology into Mainstream Educational Computing. *International Journal of Instructional Media,* 16(1). 21-32.
Ropp, M.M. (1999). Exploring individual characteristics associated with learning to use computers in pre-service teacher preparation. *Journal of Research on Computing in Education*, 31(4), 402-424.
Rosell, E. J. & Gardner III, W. L. (2000). Cognitive, motivation, and affective process associated with computer-related performance: a patch analysis. *Computers in Human Behavio*r, 16, 199-222.
Rosen, L. R. & Maguire, P. (1990). Myths and realities of computerphobia: A metaanalysis. *Anxiety Research*, 3, 175-191.
Rosenshine, B. (1979). Content, time, and direct instruction. In A. Walbert, & P. Peterson (Eds.) *Research on Teaching: Concepts, Findings, and Implications*. Berkeley, CA:McCutchan.
Roussos, P. (2007). Greek computer attitude scale: Construction and assessment of psychometric properties. *Computers in Human Behavior*, 23(1), 578-590.
Sam, H. K., Othman, A. E. O., & Nordin, Z. S. (2005). Computer self-efficacy, computer anxiety and attitudes toward the Internet: A study among undergraduates in Unimas. *Educational Technology and Society*, 8(4), 205–219.
Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with Technology: Creating Student-Centered Classrooms*. New York: Teachers College Press.
Schrage, F. (1995). Teachers accountability: A philosophy view. *Phi Delta Kaplan*, 76(8). 642-644.
Smith, B. L., Caputi, P., Crittenden, N., Jayasuriya, R., & Rawstorne, P. (1999). A review of the construct of computer experience. *Computers in Human Behavior*, 15, 227-242.
Songer, N. B.,Lee, H.S. & Kam, R. (2002). Technology-rich inquiry science in urban classrooms: What are the barriers to inquiry pedagogy? *Journal of Research in Science Teaching,* 39(2), 128-150.

Szajna, B. &Mackay, J.M. (1995). Predictor of computer-user training environment: a path analytic study. *International Journal of Human-Computer Interaction*, 7(2), 167-185.
Tobin, K., & Fraser, B. (1987). *Exemplary practice in science and mathematics education*. Perth, Western Australia: Curtin University of Technology.
Torkzadeh, G. & Koufteros, X. (1994). Factorial validity of a computer self efficacy scale and the impact of computer training. *Educational and Psychological Measurement*, 54(3), 813-921.
Torkzadeh, G., Pflughoeft, K. & Hall, L. (1999). Computer self efficacy, training effectiveness and user attitudes: An empirical study. *Behaviour and Information Technology,* 18(4), 299-309.
Treagust, D. F. (1991). A case study of two exemplary biology teachers. *Journal of Research in Science Teaching*, 28, 329-342.
Waldrip, B. & Fisher, D. (2001). Perception of students-teachers interactions in exemplary science teachers' classroom. Paper presented at Australian Association for Research in Education, Brisbane, Australia.
Wallace, R. M. (2004). Framework for understanding teaching with the Internet. *American Educational Research Journal,* 41(2), 447-488.
Wang, L., Ertmer, P.A., & Newby, T.J. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology in Education*, 36(3), 231-252.
Weiss, I., & Raphael, J. (1996). *Characteristics of presidential awardees: How do they compare with science and mathematics teachers nationally?* Chapel Hill, NC: Horizon Research.
Whitley. B. E. (1997). Gender difference in computer–related attitudes and behavior: A meta analysis. *Computers in Human Behavio*r, 13(1), 1-22.
Wilfong, J. D. (2006). Computer anxiety and anger: The impact of computer use, computer experience, and self-efficacy beliefs. *Computers in Human Behavior*, 22(6), 1001-1011.
Willower, D., Eidell, T., & Hoy, W. (1973). *The school and pupil control ideology* (revised) University park, PA: Pennsylvania State University studies.
Zhao, Y., Byers, J., Mishra, P., Topper, A., Chen, H., Enfild, M., Ferdig, R., Frank, K., Pugh, K. and Tan, S. H. (2001). What do they know? A comprehensive portrait of exemplary technology-using teachers. *Journal of Computing in Teacher Education*, 17(2), 25-37.

INSTRUCTIONAL APPROACHES ON SCIENCE PERFORMANCE, ATTITUDE AND INQUIRY ABILITY IN A COMPUTER-SUPPORTED COLLABORATIVE LEARNING ENVIRONMENT

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ABSTRACT
This study examined the effects of an inquiry-based learning (IBL) approach compared to that of a problem-based learning (PBL) approach on learner performance, attitude toward science and inquiry ability. Ninety-six students from three 7th-grade classes at a public school were randomly assigned to two experimental groups and one control group. All groups received the same web-based curriculum on the scientific topic of the greenhouse effect. These IBL groups, though, were asked to actively participate in the processes of predicting, hypothesizing, and testing, while the PBL groups were instructed to follow a specific problem-solving process. The results revealed that all students performed equally in science performance despite of the treatment groups. In terms of attitude toward science, the findings indicated that students participated in IBL or PBL groups reported more positive attitudes toward learning science and resulted in higher inquiry abilities than those who were in the control group. This study concerns itself with the features of the experimental treatment that may have contributed to these results, the implications of which are also considered.

INTRODUCTION
Recently, the design and use of computer-supported collaborative learning (CSCL) has received a growing interest. Many authors have described the principles of learning and instruction that underlie the construction of such environments (Feltovich, Spiro, Coulson, & Feltovich, 1996; Hewitt, 2002). Although the terminology used to describe the principles varies among authors, a set of common ideas appears in most of their descriptions. These principles include the assignment of learning tasks that are relevant to learners, the encouragement of learners to take ownership of the learning process, the requirement of learners to work together to address the learning tasks, and the construction of learning tasks that are situated within a complex and realistic context (Koschmann, Kelson, Feltovich, & Barrows, 1996).

While a number of experimental and quasi-experimental studies have compared the effects of CSCL environments with traditional lecture and discussion-type instructional approaches, results have varied greatly. In some instances, students who were taught in accordance with traditional lecture and discussion practices demonstrated learning outcomes that were equal to those demonstrated by students who were placed in computer-supported learning settings (Tutty & Klein, 2008; Yildirim, Ozden, & Aksu, 2001). In other cases, students in computer-supported environments learned more and retained longer learning effects than did students who received a lecture and discussion approach (Yu, She, & Lee, 2010). When the computer-supported approach proved to be superior, however, the researchers were unable to ascertain which features of the computer-supported learning environment were primarily responsible for the improvement in learning and attitudes.

Given the mixed results and the difficulty that previous researchers have had in isolating the most important features of CSCL, we thought it would be beneficial to conduct a study that focused on how to connect the features of CSCL to maximize its instructional advantages. As noted above, one of these features involves the degree of contextualization in which a learning task is presented to learners. Contextualization, defined by Mazzeo, Rab, & Alssia (2003) as "a diverse family of instructional strategies designed to more seaminglessly link the learning of foundational skills and academic or occupational content by focusing teaching and learning squarely on concrete applications in a specific context that is of interest to the student" (pp. 3-4). Numerous terms regarding contextualization are used interchangbly with basic instruction or a specific content that is meaningful and useful to students such as contextualized instruction, situated cognition, problem-based learning, and inquiry-based instruction (Gijbels, Dochy, Van den Bossche, & Segers, 2005; Hattie, Biggs, & Purdie, 1996). Regardless of the term used, all of these applications center on the practice of systematically connecting instructional task to life goals, which places students' interests and needs at the center of education (Dewey, 1966; Dowden, 2007). Perin (2011) reviewed sixteen studies on contextualized instruction and concluded that the outcomes of contextualized instruction were positive unless it is coupled with explicit strategy instruction. For example, De La Paz (2005) found that students received contextualized writing instruction with self-regulation and historical reasoning strategies showed greater gain on essay length, numbers of arguments in the essay, persuasive quality, and historical accuracy than those who received traditional instruction.

To take the full potential of contextualized instruction, learning tasks that encourage deep or meaningful learning are critical. However, the extent of how varying degrees of contextualized instruction affect the acquisition and transfer of skills and knowledge when coupling with other instruction appears to have little consensus within the instructional design community. Problem and inquiry-based instruction were of particular interest to the current study. This study focused on these two instructions that had not been rigorously examined in the context of computer-supported collaborative learning environment yet had been shown to enhance learning outcomes and affective changes.

Some theorists have emphasized the value of problem-based learning (PBL), in which content is presented indirectly through a rich simulation of a real-world, problem-centered environment (Hmelo-Silver, 2004; Lee, Shen, & Tsai, 2008). In the literature, PBL has been defined and described in several ways. Evenson and Hmelo (2000) state PBL is one of many contextualized approaches that much of the learning and teaching is anchored in concrete problems. In spite of many literatures on PBL, the core model of PBL is based on the ideas that learning should occur in concrete situations that have a relationship with students' prior knowledge and experiences (Barrows, 1986). Over the last five decades, PBL has been applied globally in many disciplines such as medicine (Barrows & Tamblyn, 1976), economics (Garland, 1995), business (Merchand, 1995), and psychology (Reynolds, 1997). One of the key features of PBL is collaborative problem-solving groups (Hmelo-Silver, 2004). Studies have found collaborative PBL alone does not help establish productive learning, but the learning should contextualize within the framework of higher order thinking and shared knowledge construction (O'Donnell, 1999; Palincsar & Herrenkohl, 1999). There is not yet evidence that PBL with contextualized instruction helps students become better collaborators or problem solvers (broadly defined). Therefore, the examination of PBL in the context of CSCL should shed lights on the overall effectiveness of contextualized instruction in PBL.

Others, have argued in favor of a highly contextualized inquiry-based learning (IBL), in which explicit prediction, hypothesizing, and testing is involved (de Jong, 2006; Oliver, 2008). In IBL, students learn content as well as domain-specific knowledge and skills by collaboratively engaging in investigations (Quintana et al., 2004). Frequently implemented in the science education, IBL focuses on enabling students to take ownership of learning through experimentation and exploration. Chang and his colleagues (2003) found that collaborative IBL facilitates college students' knowledge elicitation and exchange of inner thinking. Similar findings are discovered in many domains such as history (Yang, 2009), statistics (Schwartz & Martin, 2004), and social work (Plowright & Watkins, 2004). There is an extensive body of research on scaffolding learning in inquiry-based environments (e.g., Chen, Wu, & Lan, in press; Guzdial, 1994; Reiser, 2004; Toth, Suthers, & Lesgold, 2002). While many would agree that IBL with substantial student collaboration is effective at facilitating student learning, few studies in IBL has examined the activity of collaboration in the process of inquiry or acquiring new knowledge.

As noted by Hmelo, Duncan, and Chinn (2007), PBL and IBL are instructional approaches that situate learning in a practical task. In PBL, students learn by solving problems using their experiences or knowledge. In IBL, students learn by engaging in investigations of hypotheses, predictions, and evidence. Although PBL and IBL share several features, the distinctions between them have not been thoroughly examined. In a study that examined the introduction of PBL and IBL into the social work curriculum, Plowright and Watkins (2004) found that PBL is better at fostering the development of knowledge and skills within a professional discipline, while IBL divides the development of knowledge and skill into discrete units and imposes an assessment regimen that provides little opportunity for making connections between different subject areas.

Accordingly, research has shown that student performance and the transfer of newly acquired skills are largely affected by the degrees of contextualization in instruction and in the assessment or transfer environment. It has been found that contextualized instructional approaches, such as PBL, are most suitable for supporting the process of solving a problem and acquiring knowledge and that an active learning approach, such as IBL, is most suitable for supporting the acquisition of complex problem-solving strategies. Although no research has been published that compare the effectiveness of PBL to IBL, some research does support the notion that IBL increases certain aspects of motivation and engagement (Lynch, Kuipers, Pyke, & Szesze, 2005), while other research has pointed to PBL as a facilitator of future learning (Schwartz & Martin, 2004).

Despite steady growth in intellectual writing and theorizing on the impact of PBL or IBL approaches on instructional effectiveness, research in the area of CSCL environments remains very limited. Furthermore, most researchers have approached the issue by comparing the impact of a particular instructional strategy to instructional settings that are frequently characterized as traditional, classroom-based teaching. Research studies comparing the effectiveness of a particular instructional strategy in the public school setting often fail to acknowledge that the instructional strategies used by instructors may vary significantly from one case to another. As a result, these research studies provide little clarity concerning the measure of comparison used to determine the effectiveness of a particular instructional strategy.

THE PURPOSE OF THE STUDY

The purpose of this study was to determine the impact of varying degrees of contextualization of instruction on learner performance, attitude toward science, and inquiry ability. Specifically, the study compared the performance, attitudes, and inquiry abilities of learners who received instruction through one of two different approaches while engaging in the CSCL context. The first instructional approach was problem-based learning (PBL). The PBL simulates the complexities of real-world settings in which the learner might be expected to apply the skills and knowledge acquired through the instruction. Learners were required to gather necessary information from the material presented and collaboratively solve the problem as given by following a step-by-step problem-solving procedure (e.g., representation of problem(s), development of solutions, and monitoring and evaluation of a plan of action). The second instructional approach was inquiry-based learning (IBL) with content presented in a contextualized manner. Information was first presented through a description of abstract concepts and conceptual relationships, and then it was placed in context through a series of guided examples. The practice activities provided as part of this strategy were of gradually increasing levels of complexity and contextualization. The first activities were largely contextualized in nature, whereas the final practice activity simulated the ill-structured, complex nature of real-world problems.

METHOD

Participants

The participants in the study were 96 7th-grade students, who were attending a middle school in Taiwan. The participants were from three different classrooms, and all three classrooms were taught by the same instructor for the nature science subject. This study took place during the students' regularly scheduled science period. The average age of the children was 12 years and three months (SD=1.3). In total, 45 of the children were male and 51 were female. The level of science achievement among the participants was typical of their level in the school.

Materials

Instructional website. Regardless the treatment group, all students had to access the instructional website on nature science (see also Figure 1). The instructional website contains five elements: (1) News, (2) Resources, (3) Courseware, (4) Simulation, and (5) Evaluation and Survey. News reports what was happening at the time of data collection. Resources include the internet resources that students can find relevant information on the topics of the study. Courseware is educational material intended as kits for students to use. Courseware encompasses the topics related to the greenhouse effect. As illustrated in Figure 2, topics such as greenhouse effect and solar radiation and the earth are listed in the left hand side, and students can click on the topic(s) to study further. The design of the courseware content was in reference to Gagne's events of instruction. For example, a list of learning objectives (inform objectives), description of the relationship of the instructional contents (present stimulus material), a case study that is related to the subject (provide learning guidance), and a series of self-guided activities (elicit performance). Simulation page directs students to access a free online physics, chemistry, biology, earth science, and math simulations created by the University of Colorado called PhET. Evaluation and Survey page links to the database, where students were asked to complete pre/posttests and all of the questionnaires.

Figure 1. Instructional website

Figure 2. Screenshot of e-learning courseware

Problem-based learning (PBL) booklet. PBL booklet was the instructional manual that taught students how to solve problems step-by-step, following the processes of problem-solving which involve constructing problem space, choosing and generating solutions, monitoring and evaluating (i.e., Chen, 2010; Ge & Land, 2004; Sinnott, 1989). Booklet included external scaffolds aligned with the processes of problem-solving were designed by the researchers and content experts. Scaffolds included thirteen questions, and the sample questions were “what have caused the greenhouse effect?”, “where do you gather information on the causes of greenhouse effect”.

Inquiry-based learning (IBL) booklet. IBL booklet was the instructional manual that taught students how to perform scientific inquiry like those of experts. Scientific inquiry involves predicting, hypothesizing, and testing. Booklet included external scaffolds following the steps of inquiry were designed by the researchers and content experts. The sample questions were “what happened if the factory reduces energy fuel?”, “what is the possible sources of methane?”.

Instruments

Pretest and posttest. A 20-item multiple-choice question test was developed to assess student performance. The test was developed by the teachers who taught earth science class for more than five years. The test was also evaluated by college professors to ensure that they were appropriate. The test included declarative knowledge (10 items) and application knowledge (10 items). Each item was worth 5 point, and the maximum score was 100. Sample item for declarative knowledge was “Which of the following best explains the source of methane? (A) forest fire; (B) fossil fuel; (C) animal; (D) air conditioning.” Sample item for the application knowledge was “Which of the following cannot prevent global warming? (A) recycling; (B) eliminate energy fuel reduction; (C) raise cattle and sheep in the farm; (D) ride bicycle. The split-half internal consistency for the test was .81. The test was distributed prior and after the study as reference to pretest and posttest.

Attitude toward science. In order to better understand student science attitude, we adopted Cheng and Yang's (1995) Attitudes toward Biology Scale (ATBS) because this scale offers psychometric quality and provides both reliable (Cronbach alpha was between .87 and .92) and valid evidences allowing others researchers to apply to the context of this study. Before using the scale, minor modifications were made to accommodate this study's subject area (earth science) and participants. Reasons for using ATBS were its prior usage in the Cheng and Yang (1995)'s study shows stable reliability and steady construct validity. The instruction for completing the scale was given in the beginning: This survey contains a number of statements about science. You will be asked what you think about these statements. There are no "right" or "wrong" answers. Your opinion is what is wanted. For each statement, choose a specific numeric value corresponding to how you feel about each statement. 5 as strongly agree, 4 as agree, 3 as neutral, 2 as disagree, and 1 as strongly disagree. The survey with a total of 28 items includes five distinct science-related attitudes. The first factor is social implications of science. Here is a sample statement measuring it: "I think science is very meaningful to everyday life." The second subscale is career related to science: "I think science can be my future career." Enjoyment of science class is the third subscale: "I think science is an interesting subject to learn." The fourth subscale is normality of scientists: "The life of scientists is boring and lonely." Attitude to participating scientific inquiry activities is the fifth subscale: "When I encounter science related problem, I like to spend time to research and problem solve." The subscale reliabilities for this study were as follows: social implications of science (Cronbach's alpha = .84), career interest in science (Cronbach's alpha = .87), enjoyment of science class (Cronbach's alpha = .78), normality of scientists (Cronbach's alpha = .81), and attitude toward scientific inquiry (Cronbach's alpha = .86).

Inquiry ability. In addition to the measurement of students' performances and attitudes toward science, our study used 23 items from the Student Inquiry Ability Self-assessment Scale (SIASS) designed by Yang and Wang (2007) to assess students' inquiry abilities. Reasons that this scale was chosen were because it was used previously with fifth grade Taiwanese students and showed .84 internal consistency which is considerably high and stable. The scale included five factors: problem identification (3 items), information exploration (5 items), experiment validation (7 items), explanation (4 items), and transfer (4 items). Sample items for each factors were: "I can define the problem from observing the phenomena."; "I can utilize the library to collect information."; "I can design the steps of an experiment."; "I can predict the experiment outcomes."; and "I can use the collected information to solve the problem." The internal reliability of each subscale for this study was .88, .82, .87, .90, and .91.

Procedure

In this study, three intact classes of participants were randomly divided into three groups: the problem-based learning group (N=31), the inquiry-based learning group (N=33), and the control group (N=32). The members of three groups were equivalently sound. Each of the groups participated in the study for two days over a period of two weeks, dedicating one hour and 45 minutes of instructional time on each day. Only those students who were present all phases of the study, and for whom completed data were obtained, were included in the final analysis.

The actual study took place in the computer classroom with a teacher and three researchers present throughout. On the first day of the study, participants arriving in the computer classroom were told who their cooperative team members would be and were then seated in front of a computer. Once seated, participants were introduced to the research team, informed of the general purpose of the study, and given a description of the procedures and the lesson materials. After the orientation, students were given approximately 15-20 minutes to individually complete a pretest.

Upon the completion of the pretest, students assigned to PBL groups were oriented toward the instructional website and the paper-based PBL booklet. Students assigned to IBL groups were oriented toward the instructional website and the paper-based IBL booklet. For PBL and IBL groups, they worked collaboratively with their team members and wrote down the answers in the booklet. Students assigned to the control groups were oriented only toward the instructional website, and no further instruction or booklet was given.

The assessment procedures were identical for all treatment groups, and the assessment itself was carried out two days after each group received their treatment. All groups were told to individually complete assessments in the following order: posttest, attitude toward science, and inquiry ability questionnaires.

RESULTS

This study included three classes of dependent measures: (1) performance, (2) attitude, and (3) inquiry ability. As a dependent variable, performance was measured in the form of scores on declarative and application knowledge. The measurements and standard deviations of the test scores for performance on the pretest and posttest are presented in Table 1, which shows that the total mean score for the posttest was 64.47. In treatment group, the mean posttest score for the IBL groups was substantially higher than the mean score for the control and the PBL groups. Two t-tests were used to determine the effects of the types of instructional approaches (IBL or PBL) on learner performance. For the scores from the posttest, a review of the distribution of the scores did not indicate any serious violation of the normality assumption. With the alpha set at .05, as well as with 32 participants in IBL groups, the probability of detecting a large effect size was .71. All three groups of participants made significant improvements after the completion of this study. For equality of means on the posttest scores, $F(2, 92)=2.49$, $p>.05$, $ES=.05$. This result indicated that there were no statistically significant differences between the performances of groups.

Table 1: *Mean scores and standard deviations in science performance by treatment group*

Group	Pretest		Posttest		t	p	ES
	Mean	SD	Mean	SD			
IBL	58.55	16.53	69.68	14.66	-4.76	.000	.71
PBL	55.61	19.44	63.13	16.43	-2.17	.020	.49
Control	54.53	14.39	60.61	19.87	-3.40	.040	.27

The dependent variable of attitude was measured in terms of the social implications of science, career interest in science, enjoyment of science class, normality of scientists, and attitude toward scientific inquiry. Means and standard deviations of these measures concerning all groups are presented in Table 2. Following the descriptive statistics, an ANOVA test was performed to evaluate the differences between groups. The results showed a statistically significant difference among groups on the following subscales: social implications of science ($F(1, 96) =7.18$, $p<.05$), normality of scientists ($F(1, 96) =3.28$, $p<.05$), and attitude toward scientific inquiry ($F(1, 96) =5.04$, $p<.05$). To further explore the trend shown in the means, a post hoc univariate test was conducted. The results showed significant differences between the social implications of science of IBL (M=3.83; SD=.43) and control (M=3.61; SD=.56) groups. The differences between the normality of scientists of IBL (M=3.84; SD=.64) and control groups (M=3.71; SD=.61) and those of PBL (M=3.83; SD=.54) and control groups were found to be significantly different. The results showed a statistically significant difference between the attitude toward scientific inquiry of IBL (M=3.66; SD=.74) and control groups (M=3.43; SD=.54), and those of PBL (M=3.64; SD=.45) and control groups.

The last dependent variable of this study concerned students' self-reported inquiry ability, which showed a significant group difference: $F(1, 96) =4.13$, $p<.05$. The IBL groups (M=3.73; SD=.58) reported significantly higher inquiry ability than did control groups (M=3.56; SD=.41).

Table 2: *Mean scores and standard deviations by treatment group*

Dependent variables	N	Mean	SD
*Social implications of science**			
IBL	31	3.83	.43
PBL	33	3.68	.56
Control	32	3.61	.56
Total	96	3.71	.52
Career interest in science			
IBL	31	3.25	.79
PBL	33	3.16	.57
Control	32	3.19	.55
Total	96	3.20	.64
Enjoyment of science class			
IBL	31	3.56	.85
PBL	33	3.54	.63
Control	32	3.55	.60
Total	96	3.55	.69

*Normality of scientists**			
IBL	31	3.84	.64
PBL	33	3.83	.54
Control	32	3.71	.61
Total	96	3.79	.59
*Attitude toward scientific inquiry**			
IBL	31	3.66	.74
PBL	33	3.64	.45
Control	32	3.43	.54
Total	96	3.57	.59
*Inquiry ability**			
IBL	31	3.73	.58
PBL	33	3.68	.44
Control	32	3.56	.41
Total	96	3.65	.47

*Note. *p<.05*

DISCUSSION

The purpose of this study was to examine the effect of PBL and IBL on learner performance, attitudes toward science, and inquiry ability. There were no statistically significant differences in the science performance of the IBL group, PBL group, and control group. Findings indicate that IBL and PBL groups, given their larger effect size, scored higher on the posttests than did the control group. The lack of statistically significant differences in learner performance as a result of either IBL or PBL may suggest that a critical factor in determining instructional effectiveness in the CSCL is not only the level of contextualization employed, but the type of instructional approaches is designed and implemented. Hmelo and her colleagues (2007) argue both PBL and IBL are not minimally guided instructional approaches but rather as extensive scaffolding and guidance to facilitate student learning. Our finding further supports that both approaches are effective in promoting student learning. The PBL or IBL provides open ended and complexity in a context which is personally relevant to stimulate real world experience (Harwell & McCampbell, 2002; Uden & Beaumont, 2006). As a result, students involved in PBL and IBL processes seem to find it more enjoyable and stimulating (Ma, O'Toole, & Keppell, 2008).

Findings from students' attitudes toward the use of instructional strategies had relatively encouraging outcomes. Both IBL and PBL approaches were found to have a significant impact on several aspects of students' attitudes toward science except career interest in science and enjoyment of science class. This result indicates that learner attitude was impacted by the type of instructional strategy employed while engaging in the CSCL environment. An abundance of applied practice questions were employed in both of the instructional treatments. Motivational components were also incorporated into the design of both strategies through such factors as cooperative group work arrangements and numerous opportunities for learners to reflect and articulate. This study found that students who received IBL responded in a highly positive way to their perceived utility of science in daily life and society, normality toward scientists, and attitudes toward learning science through inquiry. This reiterates the effectiveness of instructional approaches in meeting the affective needs of learners, while pointing to the critically important merits of including a motivational design (Chen & Howard, 2010). This finding also supports the previous research contextualized in student-centered learning environments, showing that IBL that engages students in observing, inferring and measuring, and communicating can help them acquire inquiry skills (Pedaste & Sarapuu, 2006). Additionally, findings showed not all attitudes toward science were improved significantly after experiencing PBL or IBL. It is possible that PBL or IBL triggers uses of inner knowledge and ultimately, promotes deep learning, but such learning context induces heavy learning load which may hinder positive attitude for students who lack of adequate knowledge base (Simsek & Kabapinar, 2010).

IMPLICATION AND LIMITATION

The results of this study yield several theoretical and practical implications. Theoretically, this study extends the current literature on examining both PBL and IBL instructional approaches at the same time and their effects on student performance, attitude toward science, and inquiry ability. Although both instructional approaches present different degree of contextualization, the distinctions between them are very limited based on the results of this study. Practically, this study reassures PBL and IBL learning contexts offers meaningful learning experience that science teachers or curriculum developers can implement in their course design to support students at a metacognitive level as they engage in new learning. Teachers need to uniquely positioned and equipped to provide soft scaffolding to meet students' metacognitive needs.

One of the limitations of current research on the use of various instructional strategies is that it has focused on comparing the impact of a carefully-designed instructional strategy to a control treatment based on the teaching strategies employed by teachers on a daily basis. Under these conditions, inconsistent measures of comparison are used, thus yielding research results that often favor the instructional strategy of interest toward the researcher. In this research study, an effort was made to compare two distinct strategies that had both been developed according to specific instructional design approaches. As a result, a comparison of the impact of each of the strategies on learner performance indicated a lack of statistically significant findings, thereby suggesting that on average, both instructional strategies had a similar impact on learner performance.

Several limitations to the findings of this study merit special attention. In the first instance, participants in the study may not have performed at their highest ability level, given that student performance on the posttests was not considered to be part of the final science grade for the semester. In conducting the study, an effort was made to minimize the potential impact of this limitation in two ways. First, the 7^{th}-grade science instructor remained present in the computer classroom where students engaged in CSCL, thereby ensuring that students continued to feel accountable for their performance and attitude. Second, the instructor communicated to the students that their willingness to actively participate in the study was a factor in assigning their participation grade for the science class. This further encouraged students to put effort into their learning process while receiving their treatment.

Another limitation of the study was the administration of the instructional website. The greenhouse effect website contains instruction on the topic. Research has found that both learner performance and learner attitude are impacted in important ways by the use of different types of instructional media (Kozma, 1991). It is thus conceivable that the data gathered on learner performance or attitude may have been confounded by the use of different media. Furthermore, the administration of treatment was restricted by the regular class hours. The results of different instructional approaches on learner performance or attitude may be influenced by the participation time.

The conclusion of this study suggests more research in the area of examining different types of instructional approaches in the CSCL should be conducted, so that more conclusive findings in learner's performance and attitude can be ensured. The use of qualitative analysis methods could provide valuable insight into the differences in learning processes as a result of each of the instructional strategies. Additional research should also be done to determine the impact of cooperative group work arrangements on individual learning and performance in CSCL settings. Finally, further research could be done to determine whether the use of different media delivery systems in different instructional approaches confounded the research findings.

REFERENCES

Barrows, H. S. (1986). A taxonomy of problem-based learning methods. *Medical Education, 20*, 481-486.

Barrows, H. S., & Tamblyn, R. M. (1976). An evaluation of problem-based learning in small groups utilizing simulated patient. *Journal of Medical Education, 51*, 52-56.

Chang, K. E., Sung, Y. T., & Lee, C. L. (2003). Web-based collaborative inquiry learning. *Journal of Computer Assisted Learning, 19*, 56-69.

Chen, C. H., Wu, Y. C., & Lan, F. L. (in press). Designing online scaffolds for an interactive computer simulation. *Interactive Learning Environments*.

Chen, C. H. (2010). Promoting college students' knowledge acquisition and ill-structured problem solving: Web-based integration and procedure prompts. *Computers & Education*, *55*(1), 292-303.

Chen, C. H., & Howard, B. (2010). Effect of live simulation on middle school students' attitudes and learning toward science. *Journal of Educational Technology and Society*, *13*(1), 133-139.

Cheng, Y.-J., & Yang, K.-Y. (1995). The development and validation of attitudes toward biology scale. *Chinese Journal of Science Education*, *13*(2), 189-212.

de Jong, T. (2006). Technological advances in inquiry learning. *Science, 312*, 532-533.

De La Paz, S. (2005). Effects of historical reasoning instruction and writing strategy mastery in culturally and academically diverse middle school classrooms. *Journal of Educational Psychology, 97*, 139-156.

Dewey, J. (1966). *Democracy and education*. New York, NY: Free Press.

Dowden, T. (2007). Relevant, challenging, integrative and exploratory curriculum design: Perspectives from theory and practice for middle level schooling in Australia. *Australian Educational Researcher, 34*, 51-71.

Evenson, D. H., & Hmelo, C. E. (Eds.). (2000). *Problem-Based Learning: A research perspective on learning interactions*: Lawrence Erlbaum Associates.

Feltovich, P. J., Spiro, R. J., Coulson, R. L., & Feltovich, J. (Eds.). (1996). *Collaboration within and among minds: Mastering complexity, individuality and in groups*. Mahwah, NJ: Lawrence Erlbaum Associates.

Garland, N. J. (1995). Peer group support in economics: Innovations in problem-based learning. In W. Gijselaers, D. Tempelaar, P. Keizer, E. Bernard & H. Kasper (Eds.), *Educational innovation in economics and business administration: The case of problem-based learning* (pp. 331-337). Dordrecht: Kluwer.

Ge, X., & Land, S. M. (2004). A conceptual framework for scaffolding ill-structured problem-solving processes using question prompts and peer interactions. *Educational Technology Research and Development, 52*(2), 5-22.

Gijbels, D., Dochy, F., Van den Bossche, P., & Segers, M. (2005). Effects of problem-based learning: A meta-analysis from the angle of assessment. *Review of Educational Research, 75*, 27-61.

Guzdial, M. (1994). Software-realized scaffolding to facilitate programming for science learning. *Interactive Learning Environments, 4*(1), 1-44.

Harwell, R., & McCampbell, B. (2002). Using the Internet to facilitate problem-based learning. *Principal Leadership, 2*(6), 63-65.

Hattie, J., Biggs, J., & Purdie, N. (1996). Effects of learning skills interventions on student learning: A meta-analysis. *Review of Educational Research, 66*, 99-136.

Hewitt, J. (2002). From a focus on tasks to a focus on understanding: The cultural transformation of a toronto classroom. In T. Koschmann, R. Hall & N. Miyake (Eds.), *CSCL2: Carrying forward the conversation.* (Vol. 2, pp. 11-41). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235-266.

Hmelo, C., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist, 42*(2), 99-107.

Koschmann, T., Kelson, A. C., Feltovich, P. J., & Barrows, H. S. (1996). Computer supported problem-based learning: A principled approach to the use of computers in collaborative learning. In T. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm* (pp. 83-124). Mahwah, NJ: Lawrence Erlbaum Associates.

Kozma, R. (1991). Learning with media. *Review of Educational Research, 61*(2), 179-212.

Lee, T.-H., Shen, P.-D., & Tsai, C.-W. (2008). Applying web-enhanced problem-based learning and self-regulated learning to add value to computing education in Taiwan's vocational schools. *Educational Technology & Society, 11*(3), 13-25.

Lynch, S., Kuipers, J., Pyke, C., & Szesze, M. (2005). Examining the effects of a highly rated science curriculum unit on diverse students: Results from a planning grant. . *Journal of Research in Science Teaching, 42*, 921-946.

Ma, A. K. F., O'Toole, J., & Keppell, M. (2008). An investigation of student teachers' attitudes to the use of media triggered problem based learning. *Australasian Journal of Educational Technology, 24*(3), 311-325.

Mazzeo, C., Rab, S. Y., & Alssid, J. L. (2003). *Building bridges to college and careers: Contextualized basic skills programs at community colleges.* Brooklyn, NY: Workforce Strategy Center.

Merchand, J. E. (1995). Problem-based learning in the business curriculum: An alterative to traditional approaches. In W. Gijselaers, D. Tempelaar, P. Keizer, E. Bernard & H. Kasper (Eds.), *Educational innovation in economics and business administration: The case of problem-based learning* (pp. 261-267). Dordrecht: Kluwer.

O'Donnell, A. M. (1999). Structuring dyadic interaction through scripted cooperation. In A. M. O'Donnell & A. King (Eds.), *Cognitive Perspectives on Peer Learning* (pp. 179-196). Mahwah, NJ: Erlbaum.

Oliver, J. S. (2008). Engaging first year students using a web-supported inquiry-based learning setting. *Higher Education, 22*, 285-301.

Palincsar, A. S., & Herrenkohl, L. R. (1999). Designing collaborative contexts: Lessons from three research programs. In A. M. O'Donnell & A. King (Eds.), *Cognitive Perspectives on Peer Learning* (pp. 151-178). Mahwah, NJ: Erlbaum.

Pedaste, M., & Sarapuu, T. (2006). Developing an effective support system for inquiry learning in a Web-based environment. *Journal of Computer Assisted Learning, 22*, 47-62.

Perin, D. (2011). Facilitating student learning through contextualization: A review of evidence. *Community College Review, 39*(3), 268-295.

Plowright, D., & Watkins, M. (2004). There are no problems to be solved, only inquiries to be made, in social work education. *Innovations in Education & Teaching International, 41*(2), 185-206.

Quintana, C., Reiser, B. J., Davis, E. A., Krajcik, J., Fretz, E., Duncan, R. G., et al. (2004). A scaffolding design framework for software to support science inquiry. *Journal of the Learning Sciences, 13*(3), 337-386.

Reiser, B. J. (2004). Scaffolding complex learning: The mechanisms of structuring and problematizing student work. *Journal of the Learning Sciences, 13*, 273-304.

Reynolds, F. (1997). Studying psychology at degree level: Would problem-based learning enhance students' experiences. *Studies in Higher Education, 22*(3), 263 - 275.

Schwartz, D. L., & Martin, T. (2004). Inventing to prepare for future learning: The hidden efficiency of encouraging original student production in statistics instruction. *Cognition and Instruction, 22*(2), 129-184.

Simsek, P., & Kabapinar, F. (2010). The effects of inquiry-based learning on elementary students' conceptual understanding of matter, scientific process skills and science attitudes. *Procedia Social and Behavioral Science, 2*, 1190-1194.

Sinnott, J. D. (1989). A model for solution of ill-structured problems: Implications for everyday and abstract problem solving. In J. D. Sinnott (Ed.), *Everyday problem solving: Theory and applications* (pp. 72-99). New York: Praeger.

Toth, E. E., Suthers, D. D., & Lesgold, A. M. (2002). Mapping to know: The effects of representational guidance and reflective assessment on scientific inquiry. *Science Education, 86*, 244-263.

Tutty, J. I., & Klein, J. D. (2008). Computer-mediated instruction: A comparison of online and face-to-face collaboration. *Educational Technology Research and Development, 56*(2).

Uden, L., & Beaumont, C. (2006). *Technology and problem-based learning*. Hershey, PA: Information Science Publishing.

Yang, H.-T., & Wang, K.-H. (2007). Investigating effectiveness of implementing guided inquiry teaching on students' science learning in the elementary school. *Chinese Journal of Science Education, 15*(4), 439-459.

Yang, S.-C. (2009). A case study of technology-enhanced historical inquiry. *Innovations in Education and Teaching International, 46*(2), 237-248.

Yildirim, Z., Ozden, M. Y., & Aksu, M. (2001). Comparison of hypermedia learning and traditional instruction on knowledge acquisition and retention. *The Journal of Educational Research, 94*(4), 207-214.

Yu, W.-F., She, H.-C., & Lee, Y.-M. (2010). The effects of Web-based/non-Web-based problem-solving instruction and high/low achievement on students' problem-solving ability and biology achievement. *Innovations in Education & Teaching International, 47*(2), 187-199.

INTERACTING WITH VISUAL POEMS THROUGH AR-BASED DIGITAL ARTWORK

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ABSTRACT
In this study, an AR-based digital artwork called 'Mind Log' was designed and evaluated. The augmented reality technique was employed to create digital artwork that would present interactive poems. A digital poem was generated via the interplay between a video film and a text-based poem. This artwork was created following a rigorous design flow, including: (1) conceptual formation, (2) prototype design, (3) expert-based evaluation that consisted of both a cognitive walkthrough and a heuristic evaluation, (4) the final artwork design combining a visual poem generator and an AR system, and (5) a series of evaluations from an audience's perspective. The system usability scale evaluation results show that this work achieved positive usability, audiences enjoyed the interaction with the artwork, and most people accepted AR-based digital poems.
Keywords: augmented reality technique, digital artwork, digital poem, virtual poem, system usability scale

INTRODUCTION
Typically, artists present their work using non-interactive visual media. With the ongoing development of information technology (Chang & Lee, 2010; Isman & Celikli, 2009; Liu & Lin, 2010) and interactive technology (Chiang et al., 2011; Lin & Li, 2008; Liu, 2010), people can create art using digital multimedia in addition to the traditional forms; the methods for creating art have changed dramatically. Through this evolution, digital art creation has become more lively and interesting given that the materials/technologies used to create digital art also enhance artists' creativity by allowing them to express their thoughts and ideas in new ways. Today, artists can create artwork with the help of powerful computing technology that incorporates input information in real time. The process of creating artwork is fascinating, as it is a manifestation of an experience and not just a presentation of a phenomenon (Hsieh et al., 2010; Lin & Li, 2009)

This paper presents a way to employ Augmented Reality (AR) technology to create digital artwork to present a series of interactive poems. This artwork is named 'Mind Log'. Audiences can interact with the digital poem via pre-designed postcards that are composed of AR markers. The postcards are real objects, whereas the digital poems are virtual sights. In this way, audiences can situate themselves in an environment that is both virtual and real.

LITERATURE REVIEW
Interaction is an important characteristic of digital artwork. Nevertheless, the evolution of the esthetic viewpoint is seldom mentioned. Participation is essential in the creation of artwork. It gradually forms a kind of esthetics based on interactive design. The concepts discussed here are crucial in new media art (Kirk & Gopnik, 1990; Manovich, 2001).

In "The End of Art" (Danto, 1998a, 1998b), Arthur C. Danto stated that the function of art imitation and reappearance had disappeared. The emphasis on verisimilitude imitation was also redefined in art history (Oliver, 2003). This redefinition included concepts such as having the text be writable and created by readers. Moreover, readers, rather than authors, interpret the meaning of the text. This redefinition is the known as the "writable text" concept (Zucker, 1997).

AR is a new technique of the computer vision application used to facilitate interaction in the digital arts. Recently, many scholars and institutes have conducted research examining AR, which is also called Mixed

Reality (MR) given that it is an extension of Virtual Reality (VR). Using computer graphics, VR can simulate objects in the real world and create an environment in which people can interact with the simulated objects. AR is the image, object, or scene that is generated by a computer to blend with the real environment to enhance the visual experience. To summarize, AR adds virtual objects to the real environment. AR technology must possess three characteristics: the combination of virtual objects and the real world, real-time interaction, and the representation of 3D space.

Milgram and Kishino (1994) treat the real environment and the virtual environment as a continuum. The real environment is on the left end and the virtual environment is on the right end. VR typically replaces the real world, whereas AR augments the virtual images produced by the computer with objects from the real environment. Presently, AR is applied extensively in the fields of education, medical technology, military training, engineering, industrial design, arts, and entertainment (Azuma, 1997; Azuma, Baillot, & Behringer, 2001).

AR combines virtual objects with the real environment and displays the virtual objects generated by computers to users. Milgram and Kishino (1994) define two ways of displaying AR: See-Through AR and Monitor-Based AR. In See-Through AR, the users can see the surrounding environment through a monitor that also displays the virtual image. Accordingly, the effect of the augmented environment is strongest with See-through AR. In Monitor-Based AR, a computer combines images captured by a webcam with virtual images. The final image after this combination is displayed on a Head-Mounted Display (HMD) or on a computer monitor. HMDs are either pure or equipped with a small webcam. The former system is small and can be equipped with a head-mounted tracking instrument that tracks the viewing angle and the direction the user's head is facing. This pure HMD is more suitable for research and for the application of AR. The HMD with a small webcam has an immersion effect (Hsieh & Lin, 2009; Hsieh & Lin, 2010).

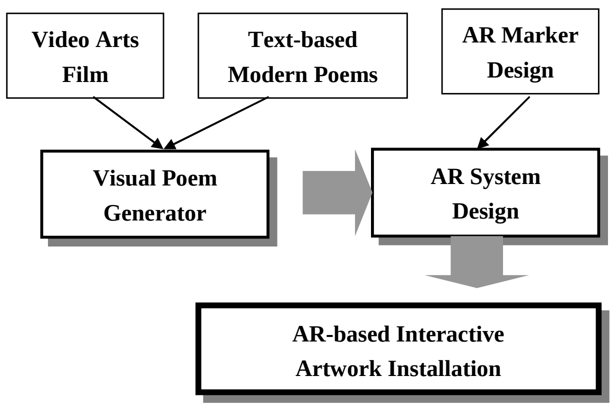


Figure 1 Conceptual Model and System Architecture.

METHOD

Conceptual design

The conceptual model and system architecture are shown in Figure 1. The visual poem and AR system design are introduced in detail in subsequent sections. This section explains the artistic concept behind the creation of this artwork. Given that this concept could be both naive and profound, this work will attempt to expand on fragments from a series on the phenomenology of inconspicuous things. The work describes both doubt and depression, humorously examining life's predicaments and the absurdities of the senses. We are the city wanderers who observe various surrounding symbols without probing into their significance. Subjective regularity helps us gain insight into true cleverness.

This artwork is based on the identical digital space with concurrent portrait and enjoyment. It attempts to elucidate the background of the personal contemporary state through an immersion in "digital vacancy." The author wants the audience to engage in a combination of videos and poetry using interactive media, and further pushes the audience to consider their expectations. As in life, the crowd passes each other in the city while alternating and switching between consciousness and predicaments. Among the images and signs is the image of dust, which generally embodies endless vacancy due to vision and wisdom. People often become immersed in the beauty of ambiguity when thinking about the multiple levels of possibility. This cognitive approach reflects the nature and details of things while estimating the length and scale of seemingly familiar yet strange surrounding sceneries, which offers a taste of such inspiration.

Design and evaluation flow

The creation of this artwork followed a fluent design and evaluation framework, including (1) the conceptual formation discussed in this section, (2) the prototype design, (3) an expert-based evaluation that consisted of a cognitive walkthrough and heuristic evaluation, (4) the design of the final artwork, which combines a visual poem generator and an AR system, and (5) a series of evaluations from audiences members' perspectives. The design and evaluation flow is depicted in Figure 2.

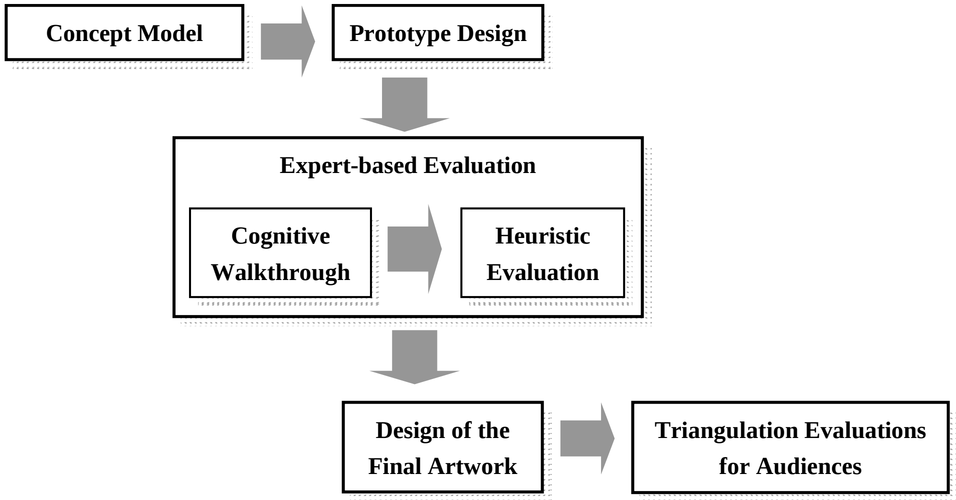


Figure 2 Design and Evaluation Flow.

Research questions

This study investigated the following research questions:

- Is AR-based artwork acceptable?
- Is the AR system designed in this study usable?
- Do audiences feel satisfied with the exhibition?
- Are the visual poems comprehensible?
- Does the exhibition provide a good learning environment for art and design?

SYSTEM DESIGN

Visual poem generator

A system (written in the processing programming language) was established in which a digital poem was generated via the interplay between a video film and a text-based poem. In other words, the system consumed two kinds of inputs: (1) a video file produced by the artist and (2) a modern poem written by the artist. The poem consisted of a sequence of Chinese characters. Figure 3 is the transformation program written in Processing.

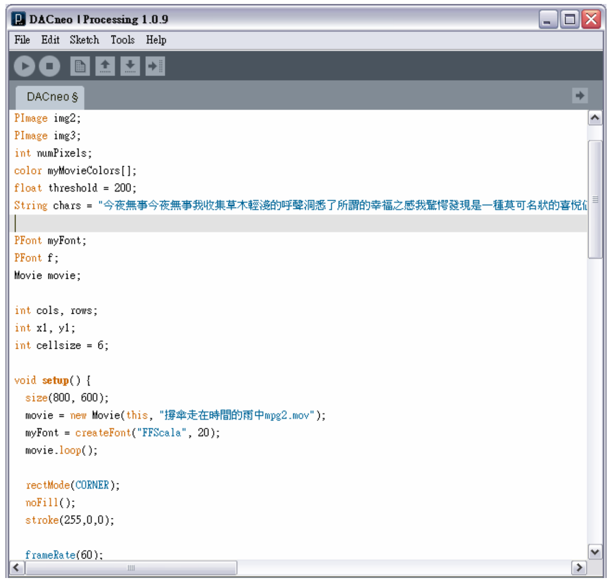


FIGURE 3 The Transformation Program Written in Processing.

Figure 4 The Video File before Transformation.

After these two inputs were fed to the system, each frame in the video was transformed to an image constructed of text. The transformation process was conducted as follows: a “cell size” was defined in the program, and each cell contained several pixels, for example, four pixels. The cell size determined the style of the resulting image. For each cell in the frame, the content was replaced with a Chinese character from the poem. The order of the applied characters was dependent on the characters’ positions in the poem.

The color of the Chinese character was based on the color of the cell in the same position. The designer can also define the font size of the character. If the font size is larger than the cell size, then characters in the image may overlap such that the colors will blur, causing the frame to appear similar to a painting.

An interactive “digital poem” in video form was produced when all of the frames were generated and filled with colors using the process described previously. Figure 4 shows a snapshot of the video in a QuickTime file before transformation. Figure 5 shows a frame following the transformation process in which pixels in this frame were replaced with text from the poem. Figure 6 is a snapshot of the generated film after the transformed frames were combined together. Figure 7 shows a second example of a digital poem produced using the program.

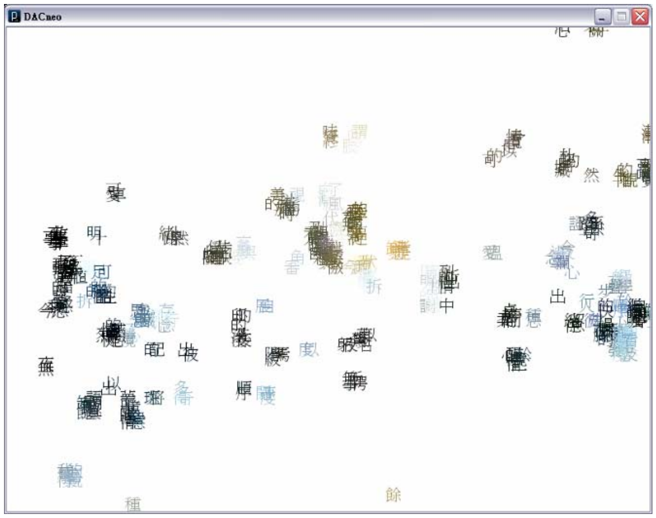


Figure 5 A Frame after Transformation. (Pixels in this Frame Were Replaced with Text from a Poem).

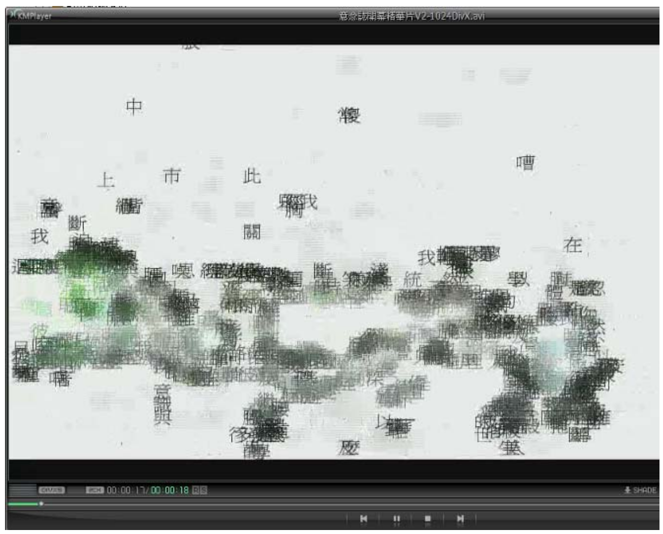


Figure 6 A Snapshot of the Generated Film after the Transformed Frames Were Combined together.

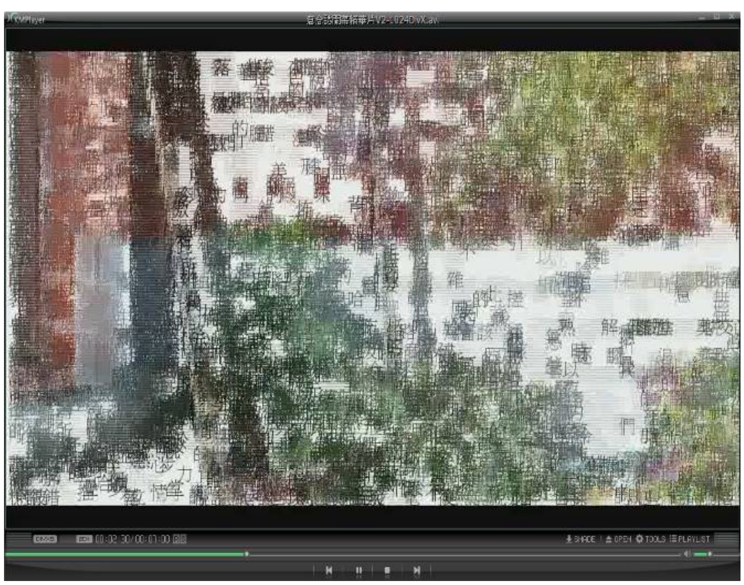


Figure 7 A Second Example of a Digital Poem Produced Using the Program.

Prototyping
When the final artwork was exhibited, the digital poems (as described in the previous section) were displayed using the process of AR interaction. A sophisticated design process was employed in this research; before the final version of the AR-based digital poem was designed, a low-fidelity prototype was developed. In this research, a card-based prototype was employed in which the sequence of screens was depicted as consisting of several cards. These cards simulated how the digital poems might display during the AR interaction. An evaluation of the card-based prototype is introduced in the next section.

EXPERT EVALUATION

Cognitive walkthroughs
Five experts were recruited to collaborate with designers to evaluate the prototype. Two kinds of expert-based evaluation methodologies were used: cognitive walkthroughs and heuristic evaluations (Sharp et al., 2008). The backgrounds and specialties of the experts are listed in Table 1. The advantages of using cognitive walkthroughs are the following: (1) the ability to focus more on identifying specific users' higher-level and detailed difficulties, (2) no real users are needed, and (3) only simple prototypes are used in the process, such that the prototypes are not expected to be able to execute real functions. Nielsen and Mark have stated, "Cognitive walkthroughs involve simulating a user's problem-solving process at each step in the human-computer dialog, checking to see if the user's goals and memory for actions can be assumed to lead to the next correct action" (Nielsen & Mark, 1994, p. 6). Listed below are the steps of the cognitive walkthrough as used in this research:

(1) The characteristics of typical audience members who would attend an art exhibition were identified and documented.
(2) Some sample actions that the audience might take were developed.
(3) The card-based prototypes were designed.
(4) Designers and experts collaborated to perform the analysis.
(5) The analysts practiced the sequence for each sample action that an audience member might engage in during AR interactions with the digital poems. They attempted to answer the following questions regarding typical scenarios:
   - Were the correct actions obvious enough for the audience to engage in?
   - Would the audience notice that the correct action was available?
   - Would the audience associate and interpret the AR response from the action correctly?
(6) The findings were documented with the aim of improving the design of the artwork. These findings are summarized following a description of the heuristic evaluation.

Table 1 The Backgrounds and Specialties of the Experts.

Expert	Specialty	Background
A	Augmented Reality, Multimedia Design	Computer Science and Information Engineering
B	Digital Arts	Fine Arts and Digital Arts Creation
C	Poem Creation, Writing Skills	Literature, Chinese Language Education
D	Usability Engineering, Human Computer Interaction	Human Computer Interaction
E	Usability Engineering, Interaction Design	Visual Communication Design

Heuristic evaluation
The use of experts' suggestions for finding evaluation indicators is feasible (Liu & Lin, 2009). Following the cognitive walkthrough, a heuristic evaluation, as developed by Jakob Nielsen (Nielsen, 1994; Nielson & Molich, 1990), was performed. The evaluation was conducted according to usability-exploring rules, known as heuristics, and whether the user interface elements were based on these rules. Nielsen's research showed that four to six experts could usually discover approximately 75% of usability problems. Therefore, this research included five experts.

The advantages of using a heuristic evaluation are that it saves both time and money and is easily conducted. A heuristic evaluation also offers suggestions for improving the system design and helps system designers find and fix problems. The disadvantage of using a heuristic evaluation include the difficulty in choosing experts because researchers define experts differently and because experts may influence the design project progress based on personal preferences. Experts were provided with a set of heuristic evaluation rules based on the "Usability Principles" applied to the rules (Nielsen, 1994; Nielsen & Molich, 1990), including (1) the visibility of the system status; (2) the match between the system and the real world; (3) user control and freedom; (4) consistency and standards; (5) error prevention; (6) recognition rather than recall; (7) flexibility and efficiency of use; (8) esthetic and minimalist design; (9) the ability to help users recognize, diagnose, and recover from errors; and (10) help and documentation.

Each expert examined the prototype twice over the course of one to two hours. First, the experts learned the background and procedures regarding the manipulation of the whole interactive interface. Then, the experts checked for usability problems in the design. Finally, the experts discussed their evaluations in a group, prioritized the problems, and offered solutions.

Results of expert evaluation
A set of prioritized findings and suggestions was collected according to the experts' opinions regarding the interface design of the AR-based artwork "Mind Log" prototype following the cognitive walkthroughs and the heuristic evaluations. The qualitative method was employed to qualitatively analyze and derive relevant information (Glaser & Strauss, 1967; Strauss & Corbin, 1990). Twenty-six chunks/subcategories were determined, which led to the five main categories listed below:

- **Audio/Video Integration:**
  Background music or sound should be incorporated into the film that showed the digital poems.
- **Usage Assistance:**
  "Mind Log" lacked instruction as to how to use it. The audience may not be certain about how to manipulate the artwork. It would be better to display manipulation instructions some time before the audience begins to interact with the work.
- **Webcam Installation:**
  The position of the webcam should be determined carefully.
  The webcam should be decorated so that the audience can become more immersed in the exhibition environment.
- **Artwork Exhibition and Installation:**
  It would be better to project the video film on a wall instead of displaying it on a computer monitor.
- **AR Marker Design and Recognition:**
  The accuracy of the AR marker recognition system should be improved.
  The visual design style of markers should be consistent.

Design improvement
After reviewing the experts' feedback, the prototype was improved in the following manner:
- A famous sound artist was invited to join the design team. He composed music for each film.
- Some instructions that hinted about how to interact with the work were placed on the wall of the exhibition hall.
- The angle and position of the webcam were adjusted according to respective experiments.
- The webcam was decorated to look like a lamp. Moreover, the exhibition hall was designed to look like a study room.
- The visual poem was projected onto the wall in the study room, taking on the characteristics of a large mirror.
- The AR markers were re-trained on site by the ARtoolkits utility software to improve the recognition accuracy.
- All of the AR-based postcard markers were re-designed so that their appearances were more consistent.

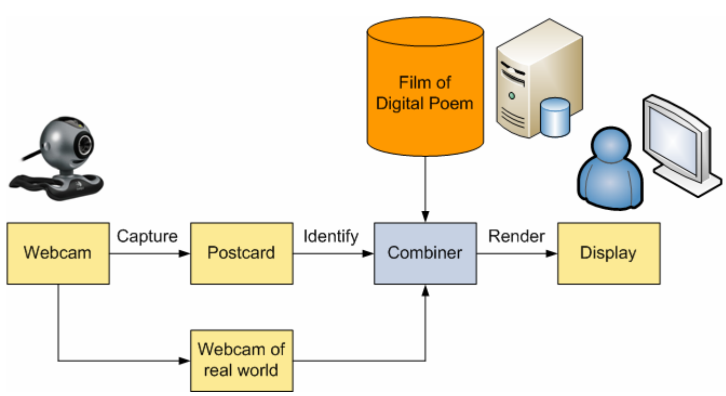


Figure 8 A Flowchart of the Digital Poem Presentation.

Final design: AR-based digital poems

The digital artwork was created for presenting interactive poems by taking advantage of AR technology. This work was implemented in the Processing programming language and developed based on ARToolKit. Figure 8 depicts a flowchart of the AR-based digital poem presentation.

A webcam captured video of the real world and sent it to a computer. The system searched through each video frame for any black squares. If a square was found, the system used mathematics to calculate the position of the webcam relative to the black square. Once the position of the webcam was determined, a film of a digital poem was drawn from that same position on top of the video of the real world in such a way that it appeared to be stuck on the square marker. The final output was shown on the wall via a CCD projector so that when the audience looked through the display, they saw a film of digital poems overlain onto the real world. Figure 9 shows the digital poem presentation based on our system as it is written in processing language. First, the image textures and corresponding vertices were created. Then, the four vertices of a film were matched with the four vertices of an image texture and the film was drawn on the image texture. The four vertices in the image texture were expressed as vertex x, y, u, and v. The x and the y were coordinates of the vertex, the u was a horizontal coordinate for the texture mapping, and the y was a vertical coordinate for the texture mapping.

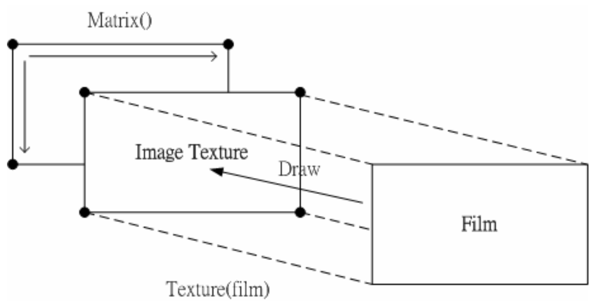
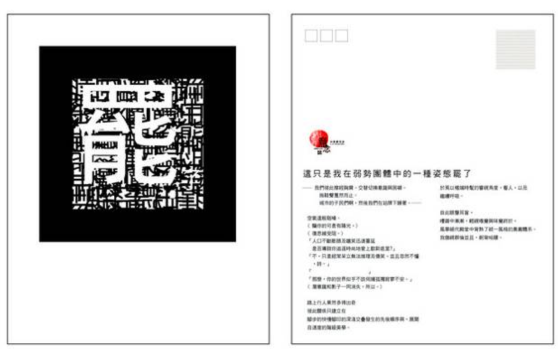


Figure 9 The Film Draws on Image Texture.

With regard to the development environment, we used a PC with Pentium(R) Dual-Core 2.6GHz CPU and a Logitech Orbit as the webcam, which captured 30 frames per second. The frame size was 640×480. The distance between the webcam and the postcard was 50 centimeters. The AR marker on the postcard was 4.55 cm in length and width.

The interactive content of the work was with the video form. Each poem from the postcard matched a virtual digital poem. The audience could interact with the postcard by directly manipulating it. Figure 10 provides an example of the front and back of a postcard. Each postcard corresponded to a video film of digital poems. There were twelve postcards and twelve video films. Figure 11 presents the twelve postcards.



(1) (2)

Figure 10 (1) The Back of the Postcard Has an AR Marker. (2) The Front of the Postcard Has a Poem.

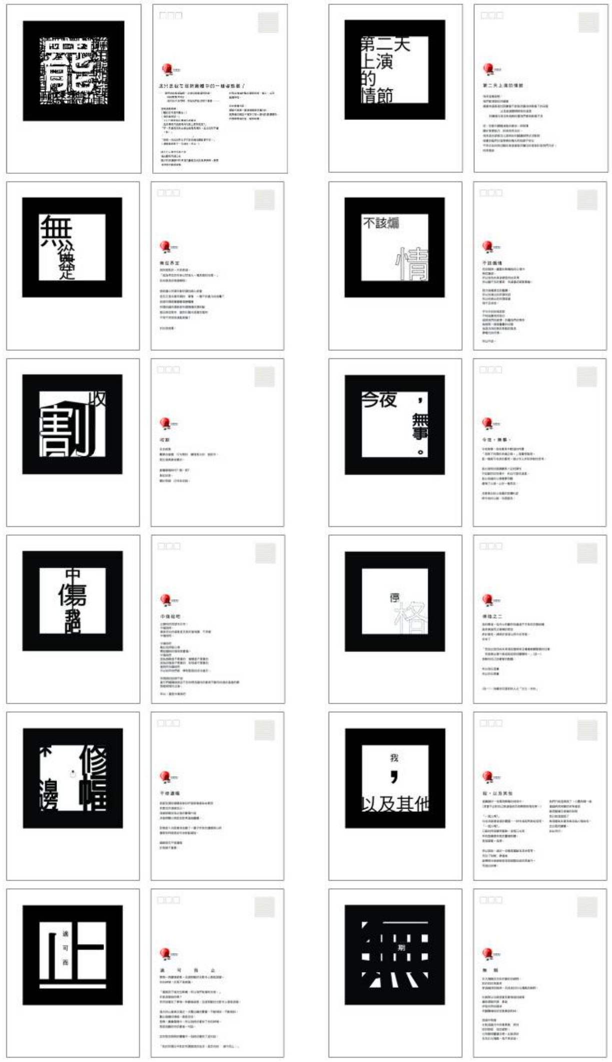


Figure 11 The Twelve Postcards.

The necessary elements of the ‘Mind Log’ exhibition included a webcam attached to a lamp, a reading desk, a projector, and a white wall. Figure 12 provides a picture of the installation of the artwork. There were several postcards on the reading desk, and the lamp was installed at a higher position to present a broad view.

Figure 12 The Installation of Artwork.

EXHIBITION EVALUATION

An evaluation of the interaction between the audience and the artwork was conducted using the triangulation method, which included questionnaires, observations, and interviews.

Triangulation refers to the use of more than one approach to investigate the research questions to enhance the confidence in the ensuing findings (Liu et al., 2008). Often, social science research is conducted using a single research method and suffers from limitations associated with the single method or from the specific application of the method. The term triangulation is derived from surveying, which uses a series of triangles to map out an area (Webb, Campbell, Schwartz, & Sechrest, 1996) and describes one of several methods of conducting multi-method research.

Questionnaire

The well-known questionnaire, System Usability Scale (SUS), was utilized to evaluate system usability (Isman & Isbulan, 2010). The questionnaire was revised with recommendations from experts who had significant experience in related fields. A 7-point scale, ranging from 1, meaning strongly disagree, to 7, meaning strongly agree, was used for this measurement. The revised version of the SUS questionnaire is presented in Table 2 (Brooke, 1986; Tullis & Stetson, 2004). The revision mainly focused on making the SUS more suitable for artwork evaluation.

Table 2 The SUS Questionnaire and the Statistics for Each Item.

System Usability Scale	Mean	SD
1. I think that I would like to interact with this work more frequently	3.20	0.82
2. I find the work unnecessarily complex	2.38	0.93
3. I suppose the work is easy to use	3.28	0.83
4. I think that I would need the support of a technician to help me use this work	2.17	1.17
5. I find the various functions in this work are well integrated	3.28	0.70
6. I suppose there is too much inconsistency in this work	2.31	0.61
7. I would imagine that most people may learn to use this work very quickly	3.22	0.75
8. I find the work to be not very user-friendly	2.22	0.67
9. I feel very confident while using the work	3.41	0.71
10. I need to learn a lot of things before I can get used to this work	2.67	0.99

The SUS is a questionnaire to estimate users' subjective feelings and their degree of satisfaction with regard to the system. Concerning usability evaluation, the SUS is an efficient, time-conserving, and labor-saving way of gaining a subjective estimate, and it is widely applied to system usability. After users answer ten questions, the scale transforms the subjective feelings of the users into objective data for analysis. That is, a score on the SUS is used to evaluate the usability of the system. The range of estimate scores is from 0 to 100. The higher the score, the more useful the system is and the more easily users can interact with it.

Population
Participants in this study were 162 audience members who attended the opening ceremony of the Mind Log artwork exhibition. The majority of audience members were students, and the rest were professors, artists, journalists, reporters, and other visitors.

Sample
There were 458 audience members in total who attended the opening ceremony. In this study, 162 subjects were randomly selected from among the audience members who entered the exhibition room of Mind Log and were issued the SUS questionnaire. Subjects completed the questionnaire on site with a 100% response rate. The age of the subjects ranged from 18 to 43 years of age (97 females and 65 males). The ratio of males to females was close.

Table 3 Descriptive Statistics of the SUS Questionnaire.

	N	Mean	Median	Min	Max	SD
Stat	162	75.4	72.5	55	100	10.5

Listed in Table 3 are the SUS scores with regard to the AR-based artwork. The mean SUS score was 75.4, the median was 72.5, the maximum was 100, and the minimum was 55. Given that the mean and the median were 75.4 and 72.5, respectively, these scores indicate that the Mind Log AR system is usable. This result means that audiences accept this kind of artwork and that there is potential for installation art use.

In addition to an SUS score that showed the usability of Mind Log, the survey presented in Table 2 also revealed the following findings:

- The 9th item had the highest mean, which indicates that most audience members felt very confident while using the AR system.
- The next three items with high ranks were the 3rd, 7th, and 1st items, indicating that this work had positive characteristics, including being easy to use, quick to learn, and attractive to interact with.
- The standard deviation of the 4th item was relatively high, which indicates that some audience members were familiar with AR techniques before attending the exhibition and some members were not. Thus, some members needed technical support and others could use the work without outside assistance.
- The 10th item revealed that some audience members were not confident about understanding the poems. Therefore, they thought they should learn how to analyze poems before visiting the artwork exhibition.

Observation
During the exhibition, the interaction between audience members and the AR digital poems was video-recorded and the members' behaviors were analyzed. According to our observations, the audience members were very interested when there was a dynamic film presented from the postcard. One possibility is that people had never seen this type of interactive device before. During the observation, it's found that the audience members were curious about what was hidden in the postcard. However, most of the audience members accidentally occluded the black frame of the postcard or left the black frame outside of the camera's capturing area. They may have blocked the black frame purposefully out of curiosity. Moreover, some audience members turned the postcard at certain angles that then made it difficult for the postcard to display its film. These manipulations resulted in difficulties that were common among audience members. It's also observed that audience members "read" the content of the poems by manipulating the postcards, so that the digital films "hidden" behind the AR markers could be displayed. Examples of audience members interacting with the installation during the exhibition of this artwork are shown in Figures 13 and 14.

Figure 13 An Audience Member Interacting with an AR Digital Poem.

Interview

The audience members were interviewed to explore their ideas about AR digital poems after they had interacted with the artwork and completed the SUS questionnaire. The approach was qualitative, and the method was a semi-structured face-to-face interview. A series of in-depth interviews with various audience members were conducted to examine the usability of our design.

Eighteen audience members were interviewed. Ten members were female and eight were male. The members were between the ages of 21–42. Interviewees included professors, artists, journalists, reporters, students, and members of the general public. The interviews, which lasted 5–12 minutes, were recorded in both video and written form.

Many of the interviewees attempted to illustrate how the artwork was presented, with some members describing their feelings. The Ground Theory was employed again to synthesize useful information methodically. Thirty-four chunks/subcategories were determined, which lead to seven main categories. The following were the feedback categories created from the interviews:

- **Interaction:**
  Some audience members thought that the AR interaction was quite attractive.
  They hoped that we could add more appealing elements to the artwork, such as more interaction and content from the audience members' perspective (ex: 010, 012).
- **Technology Acceptance:**
  Some members said it was their first time interacting with this kind of advanced technology, but that they felt excited when attending the exhibition (ex: 010, 012).
- **Learning on Artwork Design :**
  Many audience members, especially professors and students, said that this exhibition provided a learning atmosphere that could improve their appreciation for esthetics and arts design (ex: 004, 011, 016).
- **Satisfaction:**
  Many audience members said that they felt emotionally fulfilled and mentally satisfied when interacting with the visual poems and the AR-based artwork (ex: 009, 018).
- **Inspiration and Instructiveness:**
  Most audience members found the digital artwork instructive.
  Most audience members responded that they had feelings while interacting with the artwork (ex: 007, 008).
- **Exploration and Comprehensibility:**
  Most of the interviewees said that they were very willing to explore the artwork.
  Most interviewees gained more comprehension through the combination of the AR cards with the presentation of the poems (ex: 011, 013, 018).
  It is remarkable that interviewee-017 thought that the artwork was not comprehensible and that interviewee-002 thought she should learn more about poems before attending the exhibition, which was equivalent with the 10th SUS item previously mentioned.
- **Imagination:**

Some audience members conveyed their feelings about the exhibition through the metaphor of the AR markers providing "passwords" to the virtual world, which inspired them to associate artwork, poems, and their imaginations (ex: 008, 014).

Figure 14 Audience Members Interacting with the Exhibition.

RESULTS OF TRIANGULATION

According to the triangle evaluation that included questionnaires, overviews, and observations, the results showed that this work achieved positive usability, the audiences enjoyed the interaction with the artwork, and, most significantly, AR-based digital poems were acceptable. Listed below were some results and findings from audience members using the triangulated evaluation:

- It was interesting to interact with this artwork.
- The exhibition provided a good learning environment for designing artworks.
- AR-based artwork was easy to interact with.
- The new AR technology was well accepted.
- The artwork and AR system were well integrated
- The design of AR markers and postcards were consistent.
- This work was easy to learn and instructive in creating imaginative associations.
- The AR system was user-friendly, and this made audiences feel confident when using it.
- The visual poems were comprehensible for most audience members.
- This work provided a high degree of satisfaction in that audience members were emotionally fulfilled.

CONCLUSION AND DISCUSSION

In this paper, a type of artwork that combined visual poems, an interactive installation, and an AR system was introduced. The development of this work incorporated both experts' and audience members' perspectives with regard to design and evaluation. The results of the experimental evaluation using the SUS questionnaire, observation, and interview revealed that audience members thought that AR digital poems were interesting and novel devices for creating artwork. Given that audience members had never interacted with this type of artwork before, this research suggests that they accepted this kind of interactive installation artwork.

According to both expert-based and audience-based evaluation, the research questions can be answered as follows:

- AR-based artwork is acceptable.
- The AR system designed in this study is usable.
- The audience felt satisfied with the exhibition.
- The visual poems were comprehensible.
- The exhibition provided a good learning environment for art and design.

From education and learning viewpoints, this study suggests the following benefits, which are seldom mentioned in previous research:

- Digital art provides different kinds of esthetic experiences, which is remarkable for art and design educators.

- AR techniques are helpful for the creation of art. Therefore, AR design and implementation skills should be included in digital art related courses.
- AR is an important learning technology for arts education.
- AR can make artwork more immersive, which is not easy to achieve in the traditional art appreciation process.
- The issues regarding interaction and usability should be emphasized when training visual designers.
- This study shows that the development of visual poems is promising. Thus, literary works can be complemented with digital artwork.

In the future, this work will be uploaded to the Internet and apply it more creatively so that audience members can manipulate and interact with AR digital poems on web pages. The setting and operation of this artwork will be made easier to interact with in such a way that the audience simply has to set up a webcam without additional hardware. In comparison with other AR equipment, the cost of this work is quite low, so it may be a new trend for creating AR-based digital art in the future.

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REFERENCES

Azuma, R. (1997). A survey of augmented reality. *Presence: Teleoperators and Virtual Environments, 6*, 355-385.

Azuma, R., Baillot, Y., & Behringer, R. (2001). Recent advances in augmented reality. *IEEE Computers and Graphic, 21*, 34–47.

Brooke, J. (1986). *System usability scale (SUS): a quick-and-dirty method of system evaluation user information*. Reading, UK: Digital Equipment Co Ltd.

Chang, C. Y., & Lee, G. (2010). A major e-learning project to renovate science leaning environment in Taiwan. *Turkish Online Journal of Educational Technology, 9*(1), 7-12.

Chiang, Y. T., Lin, S. S. J., Cheng, C. Y., & Liu, E. Z. F. (2011). Exploring online game players' flow experiences and positive affect. *Turkish Online Journal of Educational Technology, 10*(1), 106-114.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory*, Chicago: Aldine.

Danto, A. C. (1998a). *After the end of art: contemporary art and the pale of history*. Princeton University Press.

Danto, A. C. (1998b). The end of art: A philosophical defense. *History and Theory, 37*(4), 127-143.

Hsieh, M. C., & Lin, H. C. K. (2009), The establishment of an AR-based interactive English vocabulary learning system, *ICDC2009, The 2009 International Conference on Digital Content*, Chung-Li, Taiwan, Dec. 17-18.

Hsieh, M. C., & Lin, H. C. K. (2010), The establishment of the Augmented Reality online shopping system, *ICIM2010, The 2010 International Conference on Information Management*, Tainan, Taiwan, May 22.

Hsieh, M. C., Lin, H. C. K., Lin, J. W., & Chen, M. C. (2010). The establishment of an AR-based interactive digital artwork, *GJCST, Global Journal of Computer Science and Technology, 10*(5), 15-28.

Isman, A., & Celikli, G. E. (2009). How does student ability and self-efficacy affect the usage of computer technology? *Turkish Online Journal of Educational Technology, 8*(1), 33-38.

Isman, A., & Isbulan, O. (2010). Usability level of distance education website (sakarya university sample). *Turkish Online Journal of Educational Technology, 9*(1), 243-258.

Kato, H., Billinghurst, M., Blanding, B., & May, R. (1999). *ARToolKit. Technical Report* (Hiroshima City University), December.

Kirk, V., & Gopnik, A. (1990). *High and low: Modern art and popular culture*. New York: Museum of Modern Art.

Lin, H. C. K., & Li, F. (2008). Employing Max/MSP/Jitter and sobel operations to create digital art works based on the interaction among images, sounds, and MIDI music, *JSTS, Journal of Scientific and Technological Studies, 42*(2), 15-28.

Lin, H. C. K., & Li, F. (2009). The combination of information technologies and digital arts - from the interaction between images and sounds to the "empathy" status, *Proc. of ITIA09, the 2009 Conference on Information Technology and Industrial Application, in Technology and Science Institute of Northern Taiwan*, Beitou, Taipei, Taiwan, June 13.

Liu, E. Z. F. (2010). Early adolescents' perceptions of educational robots and learning of robotics. *British Journal of Educational Technology, 41*(3), E44-E47.
Liu, E. Z. F., Kou, C. H., Lin, C. H., Cheng, S. S., & Chen, W. T. (2008). Developing multimedia instructional material for robotics education. *WSEAS Transactions on Communications, 7*(11), 1102-1111.
Liu, E. Z. F., & Lin, C. H. (2009). Developing evaluative indicators for educational computer games. *British Journal of Educational Technology, 40*(1), 174-178.
Liu, E. Z. F., & Lin, C. H. (2010). The survey study of mathematics motivated strategies for learning questionnaire (MMSLQ) for grade 10–12 Taiwanese students. *Turkish Online Journal of Educational Technology, 9*(2), 221-233.
Manovich, L. (2001). *The language of new media*. Massachusetts: MIT Press
Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE Trans. Information Systems, E77-D*(12), 1321-1329.
Nielsen, J. (1994). Heuristic evaluation. In Nielsen, J. & Mack, R.L. (Eds.), *Usability inspection methods*. New York: John Wiley & Sons.
Nielsen, J., & Mark, R. L. (1994). *Usability Inspection Methods*. New York: John Wiley & Sons.
Nielsen, J., & Molich, R. (1990). Heuristic evaluation of user interfaces, *Proceedings ACM CHI'90 Conf.* (Seattle, WA, 1-5 April), 249-256.
Oliver, G. (2003). *Virtual art*. Massachusetts: MIT Press.
Sharp, H., Rogers, Y., & Sharp, H. (2008). *Interaction design, beyond human-computer interaction* (2nd ed.). New York: John Wiley & Sons, Inc.
Strauss, A., & Corbin, J. (1990). *Basic of qualitative research: Grounded theory procedures & techniques.* Thousand Oaks, CA: Sage.
Tullis, T. S., & Stetson, J. N. (2004). A comparison of questionnaires for assessing website usability. *Usability Professional Association (UPA) 2004 Conference*, Minneapolis, USA, June 7-11.
Webb, E. J., Campbell, D. T., Schwartz, R. D., & Sechrest, L. (1966). *Unobtrusive measures: Nonreactive measures in the social sciences*. Chicago: Rand McNally.
Zucker, S. D. (1997). The arts of interaction: interactivity, performativity and computers. *Journal of Aesthetics and Art Criticism (Special Issue on Art and Technology), 55*(2), 17-127.

RELATIONSHIP BETWEEN TEACHERS' ICT COMPETENCY, CONFIDENCE LEVEL, AND SATISFACTION TOWARD ICT TRAINING PROGRAMMES: A CASE STUDY AMONG POSTGRADUATE STUDENTS

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ABSTRACT
There are three main variables that would make the integration of ICT tools as an easy process. Those three variables are teachers' ICT competency, teachers' confidence level in using ICT, and teachers' satisfaction on ICT training programmes. This study investigated the relationships among these three variables and measured the levels of the correlation among them. In order to do that, this study used questionnaire method to collect the needed data from the teachers. The targeted sample was the postgraduate students, who are currently teachers in Malaysian schools, from Faculty of Education in one of the universities located in Johor State. A total of 184 questionnaires have been collected and analyzed. This research finding revealed that Malaysian teachers had a high level of ICT competency (mean = 3.95), confidence level in using ICT (mean = 4.01), and satisfaction towards ICT training programmes (mean = 4.02). The findings also showed that the correlation coefficient between teachers' ICT competency and teachers' confidence level in using ICT was high (r = .749). However, both correlation coefficients between teachers' ICT competency (r = .496) and teachers' confidence level in using ICT (r = .571) with teachers' satisfaction toward ICT training programmes were moderate.

INTRODUCTION
Information technology aims to improve students' performance by the intelligent application of technology and hopes this will increase the effectiveness and efficiency of teaching and learning process. There is now an irreversible trend among countries in Asia and the Pacific to transform their teaching force and educational staff into technology literate and skilled workers. In almost all countries in the region, including emerging countries, teachers in primary, secondary and tertiary levels are being trained in the use of information and communication technologies (ICTs) in education with varying degree and scope (UNESCO, 2003). It was observed that an increasing number of countries are now undertaking training to develop skills in the use of ICT in teaching and other school activities, including classroom management, to ensure the teachers bring their skills to actual classroom teaching. For example, Malaysian teacher training objectives are all directed towards developing the skills of teachers to use ICT in teaching in Malaysian schools.

The number of teachers being trained varies greatly from country to country. Inventoried programmes have reported having trained huge number of teachers, especially in those countries which have had a long history of training, are more financially endowed, and are more advanced in their ICT development. South Korea, for example, reported of having trained all teachers in selected subjects, or a total of 3,897 in-service teachers per year. Intel India has reported of training 230,540 in-service teachers across 35 cities in India and a total of 29,702 per-service teachers. Intel Malaysia has trained over 15,000 teachers to date, while the World Links-sponsored training programmes in India have trained 130,000 teachers. UNESCO (2003) also reported that the duration of training varies from country to country, for instance, Malaysia's Intel sponsored training programmes require 40 hours, whereas, South Korea uses 60 hours/ 30 hours/ 15 hours to measure the length of teacher training programmes.

The importance of ICT training comes from the fact that ICT adds value to the processes of learning, and in the organization and management of learning institutions. The use of ICT also cuts across all aspects of economic and social life. Technological developments in ICT are very rapid. Technology quickly becomes obsolete requiring new skills and knowledge to be mastered frequently. Adaptation is only possible when based on a sound understanding of the principles and concepts of ICT. In other hand, these rapid developments in ICT are difficult to manage by Ministries of Education, educational managers, and schools. Circumstances vary between countries and between schools within a country, and implementation factors have therefore to be taken into account when designing ICT curricula (UNESCO, 2002).

RESEARCH OBJECTIVES
From the prior scenario on the benefits that can be gathered from the good implementation of Information and Communication Technology (ICT). The main objectives of this study are:

i. To identify teacher's ICT competency, teacher's confidence level in using ICT, and teachers' satisfaction toward ICT training programmes.
ii. To examine the relationship between teacher's ICT competency and teacher's confidence level of using ICT and vice versa.
iii. To examine the relationship between teacher's confidence level of ICT and teacher's satisfaction toward ICT training programmes and vice versa.
iv. To examine the relationship between teacher's competency in using ICT and teacher's satisfaction toward ICT training programmes and vice versa.

RESEARCH METHOD

This study investigated the relationship between teacher's competency and teacher's confidence level toward using ICT tools, the relationship between teacher's confidence level and teacher's satisfaction toward ICT training programmes, and the relationship between teacher's competency and teacher's satisfaction toward ICT training programmes. Correlation research investigates the relationships among the various psychological variables (Mark, 2004). The quantitative approach is used for this research because quantitative data is more efficient and able to test the variables. Therefore, this study is considered as a correlation and quantitative study. Questionnaire method has been chosen to carry out a survey, to collect data in this research. The questionnaire has been designed for Malaysian teachers who are postgraduate students in UTM to answer a variety of questions that depict the previous three variables.

This study was conducted out in seven stages. First of all, the problem, objectives, and questions of the research have been identified. Second stage, the literature review and empirical studies that were related to the study had been collected and studied for deeply understanding of the problem and to choose the appropriate method to conduct the study and achieve its objectives. Third stage, the questionnaire method had been chosen and designed to collect the data needed. Fourth stage, a pilot study had been conducted to test the reliability and the validity of the questionnaire. Fifth stage, the questionnaire had been distributed to the targeted samples and then it had been collected from them. Sixth stage, the data collected had been analyzed using SPSS software. Finally, the findings had been obtained, organized and discussed.

Sampling method

There are two categories of sampling: random sampling and non-random sampling. Random sampling is the process of selecting sample that would be representative of the population of interest (Norazman et al, 2007). In contrast, non-random sampling does not provide an equal chance for every member of the population to be selected as sample in a research. Random sampling has been selected to conduct the survey of this research because in random sampling, every member of the population has an equal probability to be chosen to participate in the research. Another reason is that the results of the research would yield a representative sample (Norazman et al, 2007).

This research has been done in Malaysia. The targeted people in this research are the Malaysian teachers who are postgraduate students in one University located in Johor State. The number of the postgraduate students in the education faculty is 468 students according to the faculty administration office. This consideration has been adopted, so the questionnaire has been delivered to Malaysian students who claim that they are currently teachers in Malaysian schools. James et al (2001) mentioned that the alpha level is used in determining sample size on most educational research studies. He mentioned that t-value for alpha level of .05 is 1.96 for sample sizes above 120 and a sample size of 96 is appropriate when the population is 500. The data has been collected from 184 participants. This means that the sample size of this research exceeded the required number and the data is more accurate.

Instrumentation

Thirty two items of the questionnaire have been used to measure the constructs of this study which are teachers' competency, teachers' confidence level, toward using ICT, and teachers' satisfaction toward ICT training programmes. The measurements in the questionnaire have been designed to fit the purpose of this study. The survey has used Likert scale to examine respondents. Likert scale is the most common instrument used for assessing respondents' opinions of usability (Dumas, 1999).

Reliability and Validity of the Questionnaire

Reliability Analysis

A pilot study has been conducted to establish validity and reliability of the instrument. According to De Vos et al (2002), the purpose of the pilot study is "to improve the success and effectiveness of the investigation". A total of 19 teachers have been included in the pilot test and they are not repeated in the main sample size. Cronbach alpha reliability coefficient of each item of the questionnaire has been conducted using the reliability analysis with SPSS software. A Cronbach's alpha reliability coefficient (r) normally ranges between 0 and 1 (George and Mallery, 2003).

The survey instrument has been tested by using Cronbach's alpha to check the level of agreement between the various questionnaire items that were used to measure the target variables. According to Moore and Benbasat (1991), the reliability levels are acceptable values for Cronbach's alpha when equal to 0.7 or greater. The calculation indicates that the reliability level for teacher's competency is very high with a value 0.849 for Cronbach's alpha. Also it indicates high levels for both teacher's confidence level and teacher's satisfaction toward ICT training programmes with value 0.878 and 0.908 for Cronbach's alpha sequentially.

Factor Analysis

Factor analysis is a technique for identifying groups or clusters of variables (Field, 2005). It is used to assess construct validity which means the extent to which a scale is an appropriate operational definition of the variable. The analysis was conducted using Principal Component Analysis in SPSS data reduction factor analysis procedure. The results have been analyzed to check for the items which have low correlations with others.

KMO and Anti-Image Test

Another alternative is to use the Kaiser-Meyer-Olkin measure of sampling adequancy (KMO). The KMO can be calculated for individual and multiple variables and represents the ratio of the squared correlation between variables to the squared partial correlation between variables. The KMO statistics varies between 0 and 1. Else, the Anti-image test produces an anti-image matrix of covariance and correlations. These matrices contain measure of sampling adequacy for each variable along the diagonal and the negative of the partial correlation/covariance on the off-diagonals. The diagonal elements, like the KMO, should all greater than 0.5 at a bare minimum if the sample is adequate for a given pair of variables. The off-diagonal elements should all be very small (close to zero) in a good model (Field, 2005).

For the rest of the anti-image correlation matrix, the off-diagonal elements represent the partial correlation between variables. For a good factor analysis, these correlations should to be very small (Field, 2005). For the data of this study, the off-diagonal values are very small. For the data of this study, the value of KMO is .832 which falls into the range of being great. This means that factor analysis is appropriate for this data. Anti-image matrix resulted that all values are very high and above 0.5 (0.84, 0.83, 0.846, 0.722, 0.723, 0.871, 0.819, 0.779, 0913, 0.826, 0.823, 0.71, 0.944, 0.8, 0.7, 0.843, 0.87, 0.769, 0.739, 0.892, 0.91, 0.87, 0.776, 0764, 0.886, 0.896, 0.764, 0.732, 0.793, 0.865, 0.858, and 0.892).

Factor extraction

The first part of the factor extraction is to determine the linear components within the data set by calculating the eigenvalues of the R matrix (Field, 2005). The importance of a particular vector can be determined by looking at the magnitude of the associated eigenvalue. For the data of this study, SPSS listed the eigenvalues associated with each linear component before extraction, after extraction, and after rotation. Before the extraction, 21 linear components have been identified within the data set. The eigenvalues associated with each factor represent the variance explained by that particular linear component (Field, 2005).

For the data of this research and after extraction, seven factors have been left. Factor 1 accounted for considerably more variance than the remaining four (35.17% compared to 10.25, 6.1, 5.78, 4.63, 3.6, and 3.24). Table 1 shows the Component Matrix after deleting the values that are less than 0.4.

The communalities before and after extraction have been calculated using SPSS software. For the data of this study, by Kaiser's criterion, seven factors should be extracted. Both Kaiser's rules are accurate for this study because the sample size is 184 and the average of the communalities is .69 (22.01/32). Figure 1 shows the scree plot with an arrow indicating the point of inflexion on the curve. It is noticeable that the curve begins to tail off after four factors, and it is clear that the stable plateau is after five factors.

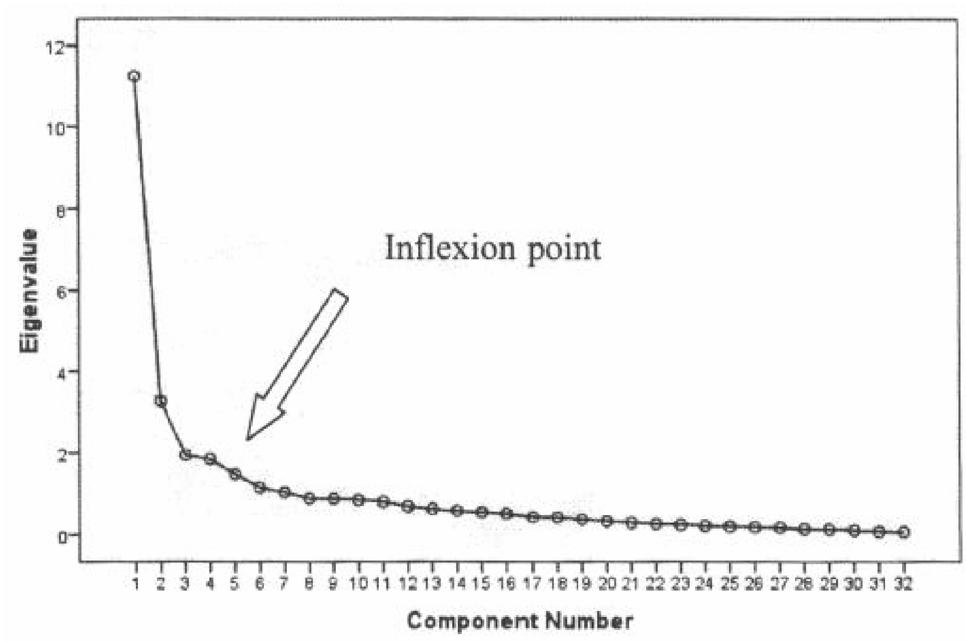

Figure 1: Scree plot

Table 1 shows the seven factors extracted and their components. The first factor which explains 35.17% and consists of a combination of the main three constructs which are teacher's competency, teacher's confidence level, and teacher's satisfaction toward ICT training programmes. This means that these three constructs are the most important factors. The other six factors have the lower impact.

Table 1: Component matrix

	Component						
	1	2	3	4	5	6	7
TC1	.604						
TC2	.649						
TC3	.585						
TC4	.455		.507	.478			
TC5	.436		.522	.538			
TC6	.621						
TC7	.448						
TC8	.650						
TC9	.646						
CL1	.649						
CL2	.666	.405					
CL3	.547	.429					
CL4	.681						
CL5	.642						
CL6	.529						
CL7	.573						
CL8	.557						
CL9	.570					.532	
CL10	.503						.505
CL11	.657						
TS1	.692						
TS2	.526						
TS3	.564						
TS4	.632						
TS5	.629						
TS6	.708						
TS7	.615						
TS8	.504			.448			

TS9	.582						
TS10	.532						
TS11	.609						
TS12	.586						

Extraction method: Principal component analysis; 7 components extracted
*TC = Teachers' Competency; CL = Teachers' Confidence Level; ST=Teachers' Satisfaction of ICT Training

DATA ANALYSIS

To identify the level of teacher's ICT competency; teacher's confidence level in using ICT; and teacher's satisfaction toward ICT training programmes, descriptive statistics such as mean and standard deviation were used. This study also has used a bivariate correlation to measure the extent of the relationships between the three variables (teacher's ICT competency, teacher's confidence level in using ICT, and teacher's satisfaction toward ICT training programmes). Pearson's product-moment correlation coefficient has been conducted for the bivariate correlation analysis. In order to obtain a good interpretation of these relationships, the correlation coefficient squared (R2) has been used. R2 is a measure of the amount of variability in one variable that is explained by the other (Field, 2005).

FINDINGS

The results of the descriptive analyses explain that Malaysian teachers have a high level of competency (nearly 4), they have a high level of confidence to use ICT (nearly 4), and they have a high level of satisfaction toward ICT training programmes (nearly 4). Table 2 shows the mean and standard deviation for the three variables.

Table 2: The Mean and Standard Deviation

	Mean TC	Mean CL	Mean TS
Valid	184	184	184
N Missing	0	0	0
Mean	3.9511	4.0069	4.0199
Std. Deviation	.63107	.51562	.555645

*TC = Teachers' Competency; CL = Teachers' Confidence Level; ST=Teachers' Satisfaction of ICT Training

Correlation Analysis

Table 3 shows the correlation analysis among the three variables which are teacher's competency, teacher's confidence level, and teacher's satisfaction toward ICT training programmes.

Table 3: Correlations

		Mean TC	Mean CL	Mean TS
Mean TC	Pearson Correlation	1.000	.749**	.496**
	Sig. (2-tailed)		.000	.000
	N	184.000	184	184
Mean CL	Pearson Correlation	.749**	1.000	.571**
	Sig. (2-tailed)	.000		.000
	N	184	184.000	184
Mean TS	Pearson Correlation	.496**	.571**	1.000
	Sig. (2-tailed)	.000	.000	
	N	184	184	184.000

** Correlation is significant at the 0.01 level (2-tailed).

The relationship between teachers' competency and teacher's confidence level towards using ICT

The result shown in Table 3 explains that teacher's competency is positively correlated to teachers' confidence level toward using ICT (0.749, $p<0.05$). The relationship is significant at the level 0.01 level. The value 0.749 indicates that the correlation is very high. By using the principal of R^2, R^2 is 0.56 (0.7492). Based on the R^2 value, it can be concluded that teacher's competency explains 56 percent of the variability in teacher's confidence level toward using ICT and vice versa.

The relationship between teachers' confidence level towards using ICT and teachers' satisfaction toward ICT training programmes

The result shown in Table 3 reveals that teacher's confidence level toward using ICT is positively correlated to teacher's satisfaction toward ICT Training Programmes (0.571, $p<0.05$). The relationship is significant at the 0.01 level. The value .571 indicates that the correlation is at a moderate level. By using the principal of R^2, R^2 is

0.33 (.5712). Therefore, teacher's confidence level toward using ICT explains 33 percent of the variability in teacher's satisfaction toward ICT training programmes and vice versa.

The relationship between teachers' competency and teachers' satisfaction toward ICT training programmes

The result shown in Table 3 also explains that teacher's competency is positively correlated to teacher's satisfaction toward ICT Training Programmes (0.496, $p<0.05$). The relationship is significant at the 0.01 level. 0The value 0.496 indicates that the correlation is moderate. By using the principal of R^2, R^2 is 0.25 (.4962). By referring to the R^2 value, teacher's competency explains 25 percent of the variability in teacher's satisfaction toward ICT training programmes and vice versa.

DISCUSSION

The results indicate that Malaysian teachers have a high level of ICT competency. This means that these teachers are able to use most ICT tools such as using computers, preparing slides to present their lessons, using internet to search for the updated information, designing simple web sites etc. The results also indicate that Malaysian teachers have a high level of confidence level in using ICT. This means that they trust that they can use ICT tools perfectively and that they are able to integrate these tools to their teaching process. Finally, the results indicate that Malaysian teachers have a high level of satisfaction toward ICT training programmes. Therefore, it can be concluded that teachers believe ICT training programmes provide them with the sufficient knowledge about ICT which in its role satisfies them and make them more encouraged and motivated.

For the relationship between teachers' competency (TC) and teachers confidence level towards using ICT(CL), the results indicate positive relationship between teacher's competency and teacher's confidence level toward using ICT. This means that the more teachers' competency the more confidence level of them for using ICT actually in Malaysian schools. Also the high level of confidence results the high level of competency, for example, the teachers who has a high confidence level will be motivated and encouraged to improve their competencies of using ICT, so they will trust that they are able to solve technological problems that faced by them. This results support the research findings by Becker and Riel (2000) and William (1993).

The results indicate positive relationship between teacher's confidences level and teacher's satisfaction toward ICT training programmes. It can be concluded that teachers' confidence level toward using ICT tools depends on their satisfaction toward ICT training programmes, for example, when a teacher believe that ICT training programmes meet his needs and they are high quality, he will trust that he will learn the sufficient knowledge about ICT that will enable him to conduct his teaching processes effectively and without any fear or anxiety.

The results also found that there is a positive relationship between teacher's competency and teacher's satisfaction toward ICT training programmes. The findings show that the level of teacher's satisfaction toward ICT training programmes influences the teacher's competency. If the teacher is satisfied about the programmes, he will easily improve his capabilities of using ICT, for example, he will learn ICT for pleasure because he is enjoyed for attending the ICT program; also he will be sure that he will find the timely help and answers for his questions. The results supported a research by Chwee et al (2007).

CONCLUSION

The findings show that teacher's competency, teacher's confidence level, and teacher's satisfaction toward ICT programmes are correlated among each other. Malaysian teachers have a high competency level toward using ICT tools where they know how to use most of the ICT tools (such as computer, internet, designing home pages, projectors etc.) an how to integrate these tools and knowledge in their teaching process. The findings also show that Malaysian teachers have a high confidence level toward using ICT and they trust that they can use ICT perfectively without any fear or anxiety. In terms of their satisfaction towards ICT training programmes conducted by the ministry, the study found that most of them highly satisfied toward the programmes. They believed by attending the training programmes, it would be able to increase their capabilities toward using ICT and their productivity. These research findings also indicate that teachers' satisfaction toward ICT training programmes is a very important factor that can increase the levels of the competency and confidence. Thus, ICT training programme s' decision makers must pay a great attention to this factor. Therefore, they must formulate strategies that not only may increase teachers' satisfaction but also exceed their expectations of the acquired knowledge that they may gain at the end of the course.

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REFERENCES
Becker, H. and Riel, M. (2000). Teacher Professional Engagement and Constructivist-Compatible Computer Use. *Teaching, Learning, and Computing: 1998 National Survey*, Report No 7.

De Vos, A. S., Strydom, H, Fouché, C. B., and Delport, C. S. L. (2005). *Research at grassroots: For `the social sciences and human service profession* (3rd ed.). Pretoria: Van Schaik.

Dumas, J.S. and Redish, J.C. (1999). *A Practical Guide to Usability Testing*. Intellect: Portland.

Chwee, B.L., Timothy, T., Ching, S.C., Doris, C., Ashley, T. and Jimmy, S. (2007). Closing the Gap: Pre-service Teachers' Perceptions of an ICT-Based, Student Centered Learning Curriculum. *ASCILITE*. Retrieved September 15, 2008 from www.ascilite.org.au/conferences/singapore07/procs/lee-cb.pdf

Field, A.P. (2005). *Discovering Statistics Using SPSS (2nd Edition)*. Sage: London.

George, G. and Mallery, P. (2003). *SPSS for Windows Step by Step: A Simple Guide and Reference, 11.0 Update*. Allyn and Bacon: Boston, MA.

James, E. B., Joe W. K., and Chadwick C. H. (2001). Organizational Research: Determining Appropriate Sample Size in Survey Research. Retrieved October 27, 2008 from www.osra.org/itlpj/bartlettkotrlikhiggins.pdf.

Mark R.L. (2004). *Introduction to Behavioral Research Methodology (5th Ed.)*. Pearson: Boston

Moore, G.C. and Benbasat, I. (1991). Development of an Instrument to Measure Perceptions of Adopting an Information Technology Innovation. Information Systems Research, 2(3), 192-222.

Norazman, Masdinah, Tina, Sahirah, Zanariah, Faruk, Siti and Rohayah. (2007). *Academic Report Writing. (2nd Ed.)*. Selangor-Malaysia: Prentice Hall.

UNESCO. (2002). Information and Communication Technology in Education. Division of Higher Education, France.

UNESCO Bangkok. (2003). Developing and Using Indicators of ICT Use in Education.

[WWW document] URL http://portal.unesco.org/education.en/ev.php

Williams, B. (1993). Barriers to New Technology Part I. from Now On, 4,1. Retrieved on August 15, 2008, from http://fno.org/FNOSept93.html

SEQUENTIAL PATTERN ANALYSIS: METHOD AND APPLICATION IN EXPLORING HOW STUDENTS DEVELOP CONCEPT MAPS

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ABSTRACT
Concept mapping is a technique that represents knowledge in graphs. It has been widely adopted in science education and cognitive psychology to aid learning and assessment. To realize the sequential manner in which students develop concept maps, most research relies upon human-dependent, qualitative approaches. This article proposes a method for sequential pattern analysis, inspired by sequential pattern mining algorithms generally applied to commercial forecast and decision supports. The method can be programmed for automatic execution and thus reasonably fast, yielding reproducible results. To validate the proposed method, 187 college students were recruited to create respective concept maps on a computerized concept mapping system. While the concept mapping data was analyzed by the sequential pattern analysis method, it was found that the mapping sequences used by students that created superior concept maps were similar and had a pattern in which propositions were formed in a temporal order from more inclusive to less inclusive. Conversely, no similarity was found in the concept mapping sequences by those who created inferior concept maps. The findings support theoretical expectations about concept mapping and are consistent with qualitative evidence based on student self-reports.

INTRODUCTION

Concept mapping is a technique developed by Prof. Joseph D. Novak at Cornell University in the 1960s to visually represent an individual's knowledge structure about a particular topic. The generated concept map is composed of nodes and links. The nodes represent concepts, while the links represent the relationships between the concepts. The concepts and propositions should be hierarchically structured. More inclusive, more general concepts and propositions are positioned at the top of the map (Novak & Gowin, 1984). Concept mapping is based on Ausubel's theory of meaningful learning. In the concept mapping process the learner is required to make a conscious effort to identify the key concepts in new information and relate them to concepts in his/her existing knowledge structure. Concept mapping has frequently been used as an instructional aid to promote learning and retention of new information. The map produced during the instruction would reflect the structure of the students' ideas and display the interrelationships among these ideas. Concept mapping, thus, could also be used to assess the varying degrees of student understanding (e.g., Hay, 2007; Markham, Mintzes, & Jones, 1994; Moreira, 1979, 1985; Schmid & Telaro, 1990).

Many studies showed that the concept maps of divergent learner groups exhibited different representational structures. Fraser and Edwards (1985), Novak (1988), and Winitzky, Kauchak, and Kelly (1994, p. 127) found that experts' concept maps presented more thorough, elaborate, complex, interconnected and hierarchical ordering. Novices' concept maps were less complex, less structured and organized in isolated bits or small chunks. Kinchin, Hay, and Adams et al. (2000) found that student concept maps could be categorized into three major patterns, including spoke, chain and net structures. The "spoke" structure is a radial structure in which all related concepts are linked directly to the core concept, but not linked directly to each other. The "chain" is a linear sequence of concepts in which each concept is linked to those immediately above and below. A logical sequence exists from beginning to end, but the hierarchical relation of many links is invalid. The "net" is a highly integrated and hierarchical network. To quantitatively assess such difference between concept maps, Novak and Gowin's (1984) scoring scheme has been often adopted. Experts would be expected to score higher on their concept maps than novices. This scheme scores the structural features of a concept map involving propositions, hierarchy, cross links and examples. The construct validity can be established because these features represent different aspects of meaningful learning, specifically concept differentiation and integration (Shaka & Bitner, 1996). Although subsequent researchers have made minor modifications (e.g. such as adding a branch count), all tended toward an aggregate score for the structural elements (e.g., Dorough & Rye, 1997).

While most studies emphasize measuring the produced concept map, some (e.g., Deguchi, Yamaguchi, Funaoi, & Inagaki, 2004; Karvonen, Rautama, Tarhio, & Turkia, 2001; McAleese, 1998; Rautama, Sutinen, & Tarhio, 1997; Wong, 1998) take notice of the importance of probing the manner in which a student proceeded to generate his/her respective concept map. It was suggested that examining the concept mapping process would help determine the mental activity and knowledge processing that led to the given results. Wong (1998) thus asked students to recall and provide their actions in generating a concept map. The student responses showed that both high achievers (scored at high levels on achievement tests) and low achievers knew what the components of a concept map should be, the need to consider how the concepts were related and that concepts should be positioned hierarchically. However, their thoughts and actions during generating a concept map seemed inconsistent. When asked how they went about organizing concepts and deciding on the links between concepts, high achievers emphasized the importance of understanding the concepts and forming meaningful relationships between the concepts. High achievers made an effort to identify the meanings and distinguish the concept features, organize the concepts into clusters of related concepts, form correct links between concepts in a cluster and between concepts in different clusters, and organize the concepts in the map hierarchically. Low achievers did not put in as much effort as the high achievers in identifying the meanings of concepts and forming meaningful relationships between concepts. Their responses showed a lack of understanding the concepts and their links, and a lack of effort at in-depth knowledge processing. This probably explains why the concept maps produced by low achievers were incomplete and had more inappropriate concepts, inappropriate links and incorrect hierarchical structure. Karvonen et al. (2001) and Rautama et al. (1997) also considered a concept map as a process rather than an image. They suggested implementing computing techniques to present this concept mapping process. A computer-aided design was proposed in 1997 and implemented in 2001 to trace, record, preserve and visualize a continuous set of mapping actions. The mapping process information was presented as a script that consisted of operations, like adding a new concept to the map and linking it to other concepts. Biswas and Sulcer (2010) and Deguchi, Yamaguchi, Funaoi, and Inagaki (2004) further developed computer programs that allowed playback of the mapping process. They expected that learners would study their own knowledge construction approaches and the teachers could inspect the students' learning problems through reviewing the mapping sequences. It is laborious and difficult for teachers and students to examine or realize concept mapping details. This paper therefore proposes an approach that could efficiently, reliably and validly disclose the pattern and useful information concerning student concept mapping sequences.

A METHOD FOR ANALYZING CONCEPT MAPPING SEQUENCES

Inspired by sequential pattern mining techniques in a large customer transactions database, an approach for exploring student sequential patterns in constructing concept maps is proposed. The sequential pattern is a temporal ordered list of elements that appear together in the concept mapping sequences produced by the involved or concerned students. The Direct Sequential pattern Generation (DSG), a graph-based algorithm proposed by Yen and Chen (1996) is borrowed and transformed in this work. Other discovering data sequences techniques (e.g., Agrawal & Srikant, 1995; Gomathi, Moorthi, & Duraiswamy, 2008; Tsai & Shieh, 2009) may also be suitable for use. This method is composed of the following stages.

Stage 1. Build temporal sequences consisting of theoretically meaningful actions. Because the proposition (i.e. concept-relationship-concept triple) is the basic unit of meaning in a concept map (Dochy, 1996), a proposition is taken as the essential element for processing mapping-sequence analysis. Therefore, at the first stage the log data by each student during concept mapping, consisting of low level events (e.g., forming concepts or relation-links), is organized into *a sequence of propositions* ordered by increasing proposition-generating-time. As shown in Figure 1, V_i, V_j and V_k are created concept nodes, e_{ij} and e_{jk} are created relation-links, and $\{V_i, e_{ij}, V_j\}$ and $\{V_j, e_{jk}, V_k\}$ are the formed propositions. These two propositions could be converted into two connected proposition nodes P_{ij} and P_{jk}. There is a common joint concept V_j between the propositions P_{ij} and P_{jk}. The direction of the link between P_{ij} and P_{jk} is determined by the proposition formation time.

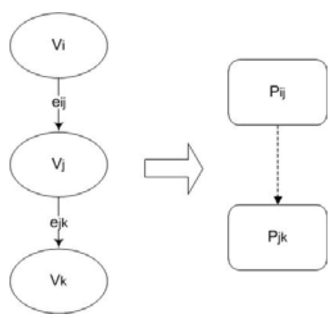

Figure 1: Build proposition-based sequences

Stage 2. Generate large 1-sequences and transform student-sequences. The following definitions are derived from Agrawal and Srikant (1995). It is defined that a student supports a sequence *s* if *s* is contained in his/her mapping sequence. The *support for a sequence* is the fraction of the total number of students that support this sequence. Each sequence that satisfies a certain minimum support threshold is a *large sequence*. A sequence of length *k* is called a *k-sequence* and a large sequence of length *k* a *large k-sequence*. To discover the sequential patterns is to find the maximal large sequence(s) among all large sequences. The stage involves finding all large 1-sequences. Afterward, each student-sequence is converted into a transformed student-sequence that is an ordered list of large 1-sequences. Table 1 presents an example of students' (No. 1-5) mapping sequences and illustrates how the original student-sequences are transformed to large 1-sequences with the support set to 100%.

Table 1: Concept mapping sequences of five exemplary students

Student	No. 1	No. 2	No. 3	No. 4	No. 5
Mapping sequence	ABCDE	BFACDE	ACGFBD	BGACD	GAECBD
Transformed mapping sequence	A, B, C, D	B, A, C, D	A, C, B, D	B, A, C, D	A, C, B, D

Note. A, B, C, D, E, F and G stand for proposition nodes

Stage 3. Construct association graph. This stage combines two large-1 sequences to generate a 2-sequence and scans all of the transformed student-sequences. When the support for a 2-sequence achieves the minimum support threshold, it is viewed as a large 2-sequence. A directed edge is then created from the first large 1-sequence to the second large 1-sequecne. If the *support* is set at 100%, the 2-sequence appeared in all transformed student-sequences. The algorithm can be simplified as follows:

```
LS1 = { large 1-sequences }
LS2 = ∅
if LS1 ≠ ∅ then begin
forall permutation 1x1y, where 1x and 1y are selected from LS1 do
        if 1x 1y appears in the same order in all transformed student-sequences then
        LS2= LS2∪{<1x1y >} \* generate large 2-sequences *\
        CreateEdge (1x, 1y) \* create an edge from 1x to 1y in the association graph *\
end
```

Using the example in Stage 2, all possible directed edges can be created to construct the association graph as shown in Figure 2(2).

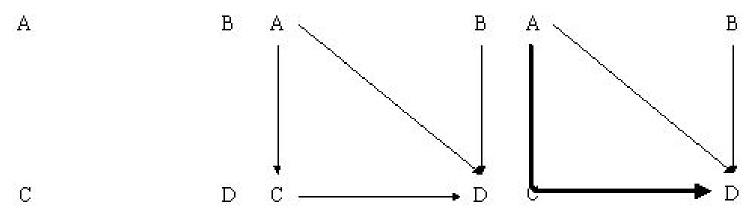

Figure 2: Procedure for discovering the sequential patterns in Table 1

Stage 4. Generate sequential patterns. Based on the association graph, a large n-sequence (n>2) can be generated. If there is a directed edge from the last large 1-sequence of a large 2-sequence found in stage 3 to another large 1-sequence, the large 2-sequence will be extended to a large 3-sequence. The sequence length is extended until no large k-sequence can be generated. As in the example in stage 2, the large 2-sequence <A→C> can be extended as shown by the bold lines in Figure 2(3). The resulting <A→C→D> is a large 3-sequence. After finding all large sequences, the large sequences that are subsequences of the other large sequences are deleted. The remaining large sequences are maximal large sequences, that is, they indicate student sequential patterns during concept mapping.

The sequential pattern analysis method can be programmed for automatic execution. The automated method can produce a computationally efficient and reliable analysis for unveiling student concept mapping sequences. It corrects some of the problems with reliability and computational inefficiency commonly observed with human-dependent approaches.

AN EVALUATION OF THE SEQUENTIAL PATTERN ANALYSIS METHOD FOR CONCEPT MAPPING

To evaluate the proposed method for probing student concept mapping sequences, a concept mapping activity on the topic of electrical energy was arranged. A computer system was utilized to support this activity and collect students' concept mapping data. In addition, students' concept map data were scored to estimate their understanding of electrical energy.

PARTICIPANTS

One hundred and eighty-seven students volunteered to participate in this study. They were enrolled in an elementary teacher preparation program at a teachers college in southern Taiwan, and were taking educational theory, curriculum design, and technology integration courses. The teacher preparation program was designed to cultivate elementary generalists because an elementary school teacher in Taiwan usually needs to teach many different school subjects. These students were all capable of using a word processing program, a painting program and an Internet browser.

CONCEPT MAPPING ACTIVITY

The participants attended a "selected terms" concept mapping (Schau, Mattern, Zeilik, Teague, & Weber, 2001) activity on electrical energy. Each participant was given 23 concepts and 6 links, and was asked to independently generate a concept map using only these concepts and links. The given concepts and links were extracted from an expert concept map negotiated by two college professors with expertise in electrical energy and elementary science education. Figure 3 presents the expert concept map. The concepts are arranged in a hierarchy with "electrical energy" at the top. As one travels down a map, the concepts become more and more specific and the map is anchored with examples.

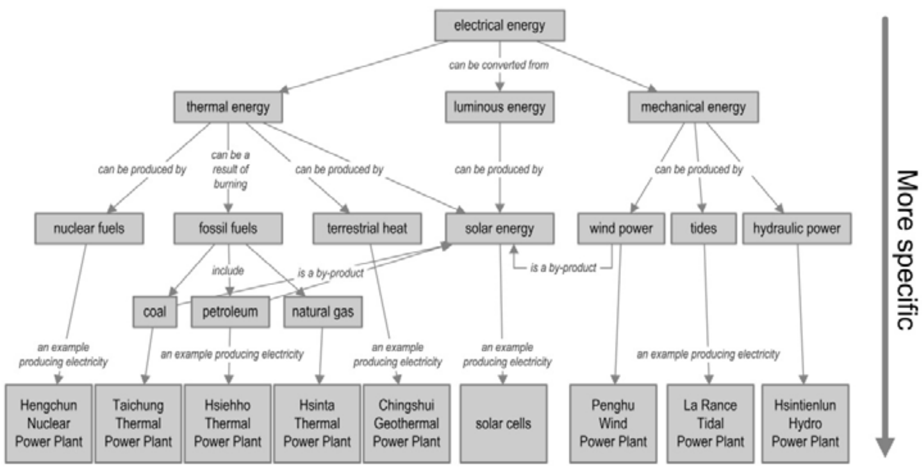

Figure 3: The expert concept map on the topic of electrical energy

CONCEPT MAPPING PLATFORM

A web-based concept mapping system was adopted to support the experimental activity. Figure 4 shows the user interface. The system modules used in this study are detailed as follows.

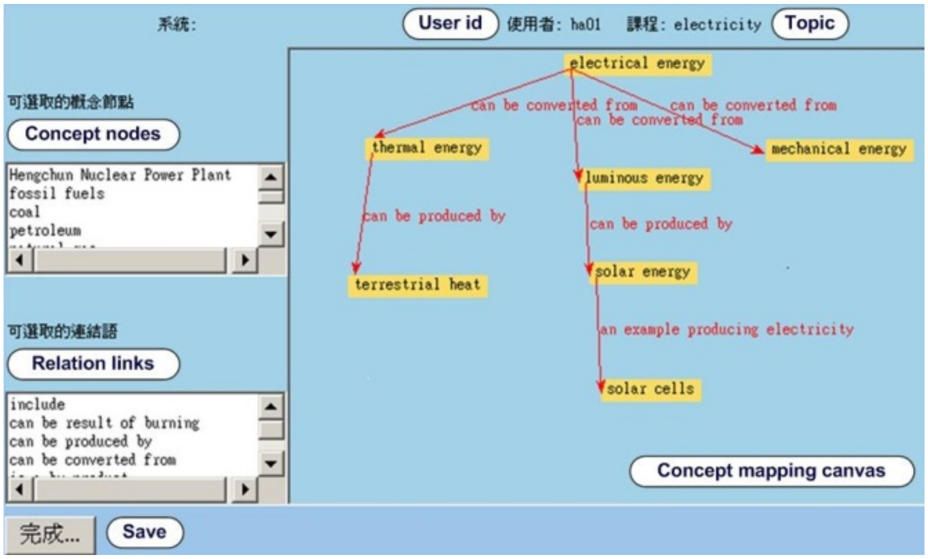

Figure 4: Interface for the web-based concept mapping system

Mapping module. The mapping module provided functions to generate a concept map on a computer screen. A user could arbitrarily add, change, delete, position or move concept nodes and relation links using a keyboard and a mouse. To decrease the cognitive demand in producing a complete concept map, this system could predefine concepts/links, or provide a partial map (fill-in-the-map) in advance.

Tracing module. The tracing module was used to trace and record the entire data in a concept mapping activity. The traced data included every action (such as adding, deleting, positioning and repositioning concept and link objects), the action time and the map generated by each individual user or collaborative group. The system stored these data in its database.

Scoring module. A scoring module was used to semi-automatically score a concept map in real time. The system evaluated the four structural components of a concept map, including the propositions, hierarchy levels, cross links and examples. The concept map to be scored was compared with a criterion concept map. The portions in the former map that also existed in the latter would be given numerical scores. However, it should be noted that not all scoring method take into considering all four components. Multiple combinations can be found from scoring methods that consider all components (Novak & Gowin, 1984) to methods that only consider propositions (McClure & Bell, 1990). In this evaluation study, the expert concept map (Figure 3) was used as the criterion concept map. The professors that provided the expert map determined the scoring rules as follows: (a) a valid proposition scored 1 point, (b) a valid hierarchy level scored 5 points, (c) a valid cross link scored 2 points, and (d) a valid example scored 1 point. The expert concept map scored 51 points according to the rules.

PROCEDURE

One by one the participant classes were arranged to carry out the concept mapping activity in a computer laboratory at the participants' college. The laboratory had IBM-compatible computers. Each participant was required to work independently on an assigned computer. Two sessions were allocated for each class. The first session was mainly used to introduce the participants to the concept mapping technique and how to use the concept mapping system to construct individual concept maps. This took about 30 minutes. In addition, a reference article on electrical energy was supplied to the participants to help them recall the related existing knowledge. Ten minutes was given for reading the reference. The second session was used for the formal concept mapping activity. The participants took 40 minutes to generate respective concept maps on electrical energy.

RESULTS

The concept mapping data sets, including mapping sequences and end map products, generated by the 187 participants were analyzed. The concept map products were scored numerically, with concept mapping sequences examined for sequential patterns. The results show that the mean concept map score was 24.87 (*SD* = 8.90). The range was 40, with the highest score = 40, and the lowest score = 0. Those maps with a score in the top 27 percentile (score ≥ 32) were classified as high score students. Those whose score was in the lower 27 percentile (score ≤ 19) were identified as low score students. The mean of the high score students (n = 52) was 34.38 (*SD* = 2.03), while the mean of the low score students (n = 52) was 13.21 (*SD* = 5.61). The mean for correct proposition numbers produced by the high score students was 16.79 (*SD* = 1.71) and the mean for the low score students was 6.58 (*SD* = 2.70). The mean length for the maximal large sequences by the high score students identical to that of experts was 6.83 (*SD* = 1.49), and the mean by the low score students was 3.10 (*SD* = 1.48). While the concept mapping sequences of the concept maps with a score of 40 were analyzed, it was found that 18 identical propositions appeared in student sequences and there existed a specific sequential pattern (the maximal large sequence) with length 11. The sequence analysis was reiterated by consolidating the next highest score mapping data (score=39). It was found that the number of identical propositions appearing in the mapping data was 18, but the length of the maximal large sequence dropped to 7. While the sequence analysis was reiterated by downward consolidating the third-highest score data (score=38), the fourth-highest score mapping data (score=37), and the fifth-highest score mapping data (score=36), the results show that the number of identical propositions appearing in concept mapping was 17, 12, and 9 respectively and the length of the maximal large sequence was 4, 2, and 0. The analysis iteration was terminated at the fifth-highest score data, because further consolidating lower score data would not generate any large sequences. Figure 5 presents the sequential pattern example by the students whose maps achieved higher scores.

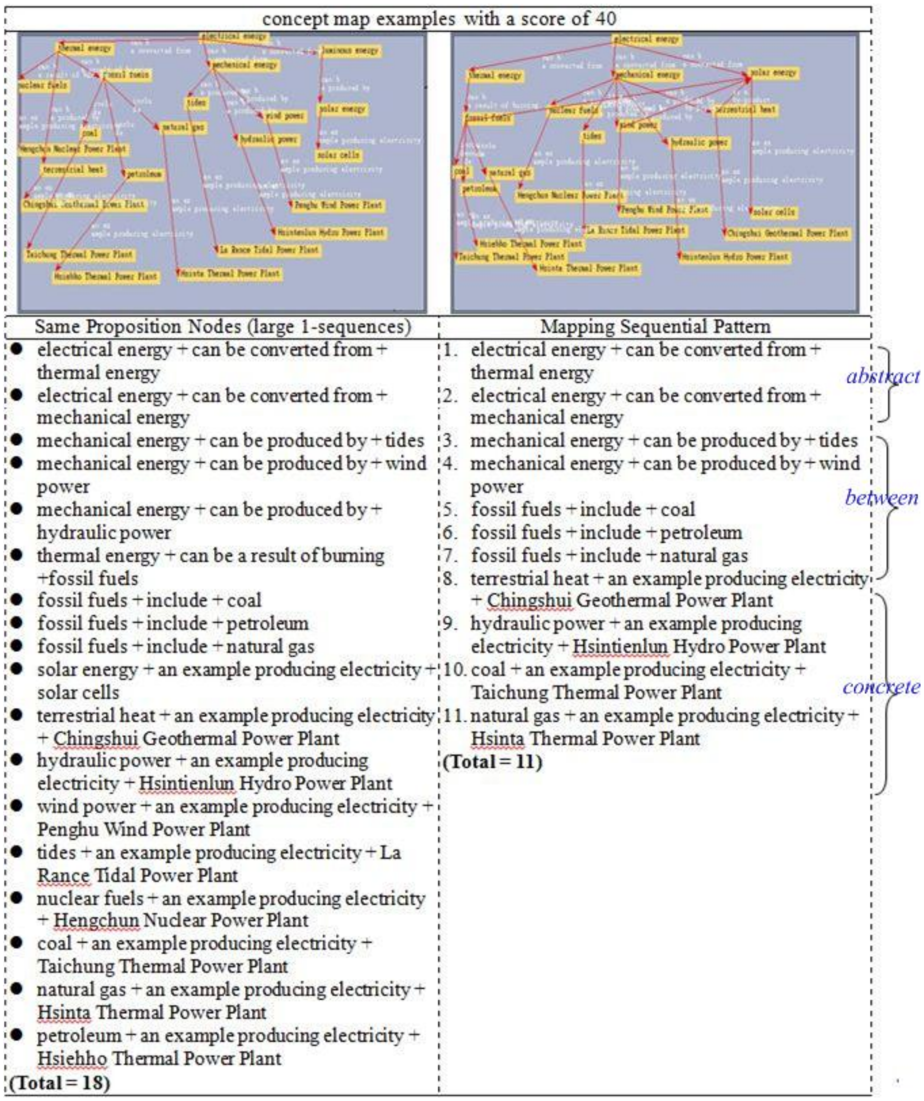

Figure 5: Sequential pattern example for superior concept maps

Comparatively, data sets with the lowest five scores were analyzed. The maps scored 0 shared no generated proposition similarity. No large k-sequences were found, i.e. they shared no common mapping sequences. If these data sets were consolidated with any other mapping data, the large sequence length would remain zero.

Therefore, 0-score data sets were excluded from the follow-up sequential pattern analyses. Still no common propositions and mapping sequences were found in the second- and third-lowest score (2 & 3) mapping data. The forth lowest score was 4. The analyses showed that an identical proposition existed with no identical mapping sequences. The fifth lowest score was 8. It was found that 6 identical propositions existed and the maximal large sequence length was 4 (see Figure 6).

Score	Same Proposition Nodes (large 1-sequences)	Mapping Sequential Pattern
0	empty	empty
2 3	empty	empty
4	● nuclear fuels + an example producing electricity + Hengchun Nuclear Power Plant **(Total = 1)**	empty
8	● thermal energy + an example producing electricity + Hsinta Thermal Power Plant ● thermal energy + an example producing electricity + Taichung Thermal Power Plant ● thermal energy + an example producing electricity + Hsiehho Thermal Power Plant ● terrestrial heat + an example producing electricity + Chingshui Geothermal Power Plant ● hydraulic power + an example producing electricity + Hsintienlun Hydro Power Plant ● wind power + an example producing electricity + Penghu Wind Power Plant **(Total = 6)**	1. thermal energy + an example producing electricity + Hsinta Thermal Power Plant 2. thermal energy + an example producing electricity + Taichung Thermal Power Plant 3. thermal energy + an example producing electricity + Hsiehho Thermal Power Plant 4. terrestrial heat + an example producing electricity + Chingshui Geothermal Power Plant **(Total = 4)** *concrete*

Figure 6: Sequential pattern example for inferior concept maps

DISCUSSION

By applying the sequential pattern analysis method proposed in this paper to the practical student concept mapping data, differences were found in the sequential patterns between students generating higher and lower-score concept maps. The sequential patterns among higher-score students were longer in length. Further, the higher-score students tended to established propositions from more inclusive ones to less inclusive ones in temporal order. To illustrate the finding, the mapping sequential pattern in two 40-score cases was taken as an example. Numbers 1 to 11, as shown in Figure 5, denote the temporal order of the composed proposition items. While referring to the hierarchy of the expert concept map on electrical energy (see Figure 3), the proposition items contained in the mapping sequential pattern can be roughly classified into three groups. Items No. 1 and No. 2 are subordinate directly to the concept "electrical energy" and are most inclusive, general and abstract in the subject domain electrical energy. Items No. 8 to No. 11 describe the relations with specific examples included in the subject domain electrical energy and thus are the least inclusive, most specific and most concrete. Comparatively, the other five items, from No. 3 to No. 7, are less inclusive than propositions No. 1 and No. 2, and are more inclusive than propositions No. 8 to No. 11. From the mapping sequential pattern, denoted by No. 1 to No. 11, the 40-score students showed a tendency to construct concept maps starting from more inclusive propositions to less inclusive ones. The mapping sequential patterns of 37-40 score, 38-40 score, and 39-40 score students also unanimously showed this trait. These high-score students first identified and selected the main idea of the concept mapping activity, "electrical energy," as the most super-ordinate concept of all other concepts. They then identified the concept categories under the super-ordinate concept. Coordinate concepts such as "thermal energy," "mechanical energy," or "luminous energy" were specified. These coordinate concepts were spaced below the super-ordinate and each was connected to it by a line to represent a relationship. After that, specific concepts related to one another within individual coordinate level categories were listed. These concepts were subordinate concepts. A line was drawn from each subordinate concept to its coordinate level concept and their relationships were specified. The sequential analysis indicated that subordinate terms like "wind power," "tides" and "hydraulic power" were first connected to their coordinate level concept, "mechanical energy"; and then "solar energy" to "luminous energy." However, the sequences connecting "terrestrial heat," "fossil fuels," "nuclear fuels" and "solar energy" with "thermal energy" were inconsistent. The students appeared indecisive in making these connections. Finally, they chose and linked appropriate examples to each specific concept, for instance, "solar cells" to "solar energy." These students could easily include and connect relevant examples. In contrast to the higher-scoring students, the mapping sequences produced by the lower-score students were quite different. The mapping sequences, starting points, and anchoring points among these students also varied from one another. However, they shared a feature that their first and the following correct propositions revolved around more subordinate concepts and examples. Although these students were given the same time as others for creating their respective maps, they could form propositions only for more concrete concepts. Their concept maps had more incorrect propositions and inappropriate structure types. This was probably because they were limited in their ability to identify the meanings of concepts, particularly at a more abstract level, and form meaningful relationships between concepts. The differences between high and low score students in their concept mapping sequence corresponds with the viewpoints of Novak and Gowin (1984, p. 98). They suggested that starting from more super-ordinate concepts, then gradually adding more subordinate concepts could lead to a well-organized, hierarchically structured concept map that would attain a high score if measured using Novak and Gowin's scoring scheme. The findings are also consistent with those from Wong (1998) that more knowledgeable students self-reported that they "identified the most inclusive concept or major concept (first)…Next identified the second most inclusive concept" in constructing a concept map. By comparing the concept mapping sequence of high score students, a teacher could determine whether a student is choosing an inappropriate starting point or taking a dissimilar sequence for composing a concept map. This student is very likely to create a dissatisfactory concept map and can be spotted in an earlier stage through the comparison. Whether this student is decisive in choosing concepts or making connections could help to judge whether he/she has a problem, conflicting interpretation, misconception, or complete ignorance about specific concepts or connections. Concept mapping sequences by higher-score students could be referenced to judge what portion (concepts or connections) of a concept map by the lower-score student should be dealt with and what priorities should be taken. The lower-score student might need to have those concepts or connections explicitly stated through didactic exposition and reinforced through practice and feedback. The teacher could use a created map with its construction sequence from higher-score students as an instructional aid when guiding a lower-score student during concept map development. Alternatively, the teacher could set up heterogeneous pairs and require them to strive for consensus regarding their maps' appearance. The difference in their original concept maps and mapping sequences allows students to weigh their own and others' perspectives, and then be able to justify, confirm or modify their concepts and conceptual relationships.

CONCLUSIONS

Understanding student concept mapping sequences is important. This information helps understand student learning performance. If students learn in an appropriate manner, student problems can be detected at an early stage and specific sequences could be made explicit for students. Recurring student sequential patterns might indicate some problem with instruction and thus could suggest directions for instructional improvement. This paper proposes a method for discovering concept mapping sequences. The sequential method is derived by transforming a sequential pattern mining algorithm used in scientific and commercial domains. The proposed method was implemented as a computer program to automatically yield results. Uncovering student concept mapping sequences has traditionally relied upon manual tracing of students' self-reports or concept mapping data logged by computer. Those techniques are labor intensive, not practical for large data sets and subject to individual bias. The sequential method presented in this paper is clearly superior to any method that requires human intervention. Attributable to the automated nature of the program, the proposed method could analyze large data sets in a fraction of the time previously required and moreover yield objective results that are reliable and reproducible. While applying the sequential method to practical student concept mapping data it was found that the mapping sequences produced by higher-score students were similar. These sequences showed a pattern in which most of the constituted propositions were the same and formed progressively from more inclusive to less inclusive. This pattern would become obscure in lower-score students. Low-score students' concept mapping sequences appeared very diverse. The findings substantiate the theoretical expectations (Novak & Gowin, 1984) and correspond to the qualitative research findings based on student self-reports (Wong, 1998). Although real data rather than artificial data was used for the evaluation makes the efficacy of the sequential method more worthy of recognition, this study was carried out using specific and limited participants. This would suggest further evaluation with larger, different and diverse populations. In addition, the real student data was collected in a concept mapping activity with some constraints ("selected terms" concept mapping). It is suggested that this method be also tested on the monitoring and analysis of students engaged in more open-ended concept mapping activities.

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REFERENCES

Agrawal, R., & Srikant, R. (1995). *Mining sequential patterns*. Paper presented at the the Eleventh International Conference on Data Engineering, Taipei, Taiwan.

Biswas, G., & Sulcer, B. (2010). *Visual exploratory data analysis methods to characterize student progress in intelligent learning environments*. Paper presented at the 2010 International Conference on Technology for Education (T4E), IIT Bombay, Mumbai.

Deguchi, A., Yamaguchi, E., Funaoi, H., & Inagaki, S. (2004). *Concept mapping software to reconstruct learning processes: Enhancement based on the teachers' requests and its evaluation from the viewpoint of teachers*. Paper presented at the International Conference on Computers in Education, Melbourne, Australia. Retrieved from http://plum.yuntech.edu.tw/icce2004/Theme4/Ch113_Deguchi.pdf

Dochy, F. J. R. C. (1996). Assessment of domain-specific and domain-transcending prior knowledge: Entry assessment and the use of profile analysis. In M. Birenbaum & F. J. R. C. Dochy (Eds.), *Alternatives in Assessment of Achievements, Learning Process and Prior Knowledge* (pp. 93-129). Boston, MA: Kluwer Academic Publishers.

Dorough, D. K., & Rye, J. A. (1997). Mapping for understanding. *The Science Teacher, 64*(1), 36-41.

Fraser, K., & Edwards, J. (1985). The effects of training in concept mapping on student achievement in traditional classroom tests. *Research in Science Education, 15*(1), 158-165. doi: 10.1007/BF02356538

Gomathi, C., Moorthi, M., & Duraiswamy, K. (2008). Web access pattern algorithms in education domain. *Computer and Information Science, 1*(4), 183-186.

Hay, D. (2007). Using concept maps to measure deep, surface and non-learning outcomes. *Studies in Higher Education, 32*(1), 39-57. doi: 10.1080/03075070601099432

Karvonen, A., Rautama, E., Tarhio, J., & Turkia, J. (2001). *Versatile concept map viewing on the Web*. Paper presented at the the Sixth Annual Conference on Innovation and Technology in Computer Science Education, Canterbury, UK.

Kinchin, I. M., Hay, D. B., & Adams, A. (2000). How a qualitative approach to concept map analysis can be used to aid learning by illustrating patterns of conceptual development. *Educational Research, 42*(1), 43-57.

Markham, K. M., Mintzes, J. J., & Jones, M. G. (1994). The concept map as a research and evaluation tool: Further evidence of validity. *Journal of Research in Science Teaching, 31*(1), 91-101. doi: 10.1002/tea.3660310109

McAleese, R. (1998). The knowledge arena as an extension to the concept map: Reflectionin action. *Interactive Learning Environments, 6*(3), 251. doi: 10.1076/ilee.6.3.251.3602

McClure, J. R., & Bell, P. E. (1990). *Effects of an Environmental Education-Related STS Approach Instruction on Cognitive Structures of Preservice Science Teachers*. Universty Park, PA: Pennsylvania State University. (ERIC Document Reproduction Service No. ED 341582).

Moreira, M. A. (1979). Concept maps as tools for teaching. *Journal of College Science Teaching, 8*(5), 283-286.

Moreira, M. A. (1985). Concept mapping: An alternative strategy for evaluation. *Assessment & Evaluation in Higher Education, 10*(2), 159-168. doi: 10.1080/0260293850100206

Novak, J. D. (1988). Learning science and the science of learning. *Studies in Science Education, 15*(1), 77-101. doi: 10.1080/03057268808559949

Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn*. New York: Cambridge University Press.

Rautama, E., Sutinen, E., & Tarhio, J. (1997). Supporting learning process with concept map scripts. *Journal of Interactive Learning Research, 8*(3), 407-420. doi: 10.1145/268809.268829

Schau, C., Mattern, N., Zeilik, M., Teague, K. W., & Weber, R. J. (2001). Select-and-fill-in concept map scores as a measure of students' connected understanding of science. *Educational and Psychological Measurement, 61*(1), 136-158. doi: 10.1177/00131640121971112

Schmid, R. F., & Telaro, G. (1990). Concept mapping as an instructional strategy for high school biology. *Journal of Educational Research, 84*(2), 78-85.

Shaka, L. F., & Bitner, B. L. (1996). *Construction and validation of a rubric for scoring concept maps*. Paper presented at the the 1996 Annual International Conference of the Association for the Education of Teachers in Science, Seattle, WA. Retrieved from http://www2.ed.psu.edu/CI/journals/96pap43.htm

Tsai, C.-Y., & Shieh, Y.-C. (2009). A change detection method for sequential patterns. *Decision Support Systems, 46*(2), 501-511. doi: 10.1016/j.dss.2008.09.003

Winitzky, N., Kauchak, D., & Kelly, M. (1994). Measuring teachers' structural knowledge. *Teaching and Teacher Education, 10*(2), 125-139. doi: 10.1016/0742-051X(94)90008-6

Wong, M. S.-L. (1998). An investigation into high-achiever and low-achiever knowledge organisation and knowledge processing in concept mapping: A case study. *Research in Science Education, 28*(3), 337-352. doi: 10.1007/bf02461567

Yen, S. J., & Chen, A. L. P. (1996). *An efficient approach to discovering knowledge from large databases*. Paper presented at the the Fourth International Conference on Parallel and Distributed Information Systems.

SERIOUS GAME MOTIVATION IN AN EFL CLASSROOM IN CHINESE PRIMARY SCHOOL

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ABSTRACT
This paper is a report on the findings of a qualitative PhD pilot research study on the integration of Serious Games specifically Mingoville to motivate the Chinese primary students in an EFL classrooms. It was carried out in two primary schools: the students are both from low and high income families respectively in Jiangsu Province, PR, China. Content analyses techniques were used to analyze the transcript of which the researcher systematically works through each transcript assigning codes using numbers to specific characteristics within the text, the categories emerged from data by reading through each transcript as well as from literature reviews. The findings identified the differences on how Mingoville motivated the students in the two schools. It revealed some mitigating factors that affected the student's full motivation when Mingoville was integrated in their English learning classroom. The findings indicate that teachers and parent's attitude are key factors to consider for a successful game based learning. Lastly, this paper explores the question, how can Serious Games be integrated successfully in ESL classrooms in order to motivate the Chinese primary school students?
Keywords: Motivation, Mingoville, Serious Games, Chinese Students, Primary Schools, ESL

1. INTRODUCTION

To perfectly acquire a language, motivation is an essential tool. Considering the importance of motivation and engagement in language learning, one cannot stop thinking of finding better strategies to motivate and engage the digital generation in primary schools in China who are bored with the present method of teaching and for whom English is not their mother tongue. (Ruphina .A,& Liu .M, 2011).The use of games in traditional English language classroom has been in existence for some time now and is a practice that has been regarded as educationally sound despite the limited empirical evidence to validate this contention. Games are often use for motivational or fun purposes. Games have often been included in language teaching to stimulate motivation and authenticity in communicative practices. The sudden transition of games from traditional classroom to game based classroom has attracted a great deal of interest both from educators, researchers, teachers and students. There are many studies showing the benefits of computer games for children and adults in terms of providing motivation, engagement, developing skills and encouraging collaboration .Wood and Stewart(1987) asserted that incorporating digital games into instructional design improves students' skills in practical reasoning, complex problem solving (Hayes,1981) transfer of learning(Crisafulli &Antonietti,1993)making inferences and engaging in inductive reasoning (Mayer &Sims,1994)and using Metaphorical Maps to generate alternative solution paths(Quinn,1996).Other researchers that explored this area includes Prensky (2001),who discussed the potential of educational computer games and listed 12 elements as to why games engage people. Those reasons includes: games motivate players (to achieve goals), gratify the ego (when winning), are fun (through enjoyment and pleasure) and spark the players' creativity (to solve the game problem). The use of interactive games has impacted the mode of learning. (Foreman et al., 2004).Krasilovsky (1996) claimed that young learners tend to 'favor "edutainment" applications-academics-oriented games.' Wood (2001) investigated the use of learning games as a learning tool and concluded that game-like formats could be more effective at capturing learners' attention than traditional media such as textbooks. Looking at all these claims on the potential of game based learning, there is need to reconceptualise our attitude and thinking on how the Chinese digital natives will maximize the potential benefits of computer games to motivate and engage the primary schools students in an ESL classroom. .Also, this research hopes to address the problem of boredom, and lack of interest which pupils always complain when learning English. According to Nguyen and Khuat (2003). For many learners studying English as a foreign language, vocabulary learning is considered boring, as they have to memorize unfamiliar words and spelling and are typically asked to complete lots of exercises. In accordance with the reported statistics, it is estimated that China has the largest number of internet users than any country with at least 457 million people online at the end of 2010 of which two thirds engage in online game play. (China Information Base, 2010). The Chinese parents become worried about the excessive time spent on games and social-networking sites that interferes with their children's schoolwork. Though, this figure does not stipulate the population of primary school students that plays digital game. We realized during our study that most all the students at the target schools played uneducated commercial computer games, though the number of hours played differed. Playing computer games in China is not a new pupil phenomenon, but the issue lies on the kind of games they play, Is it a serious games, what is the content of the game, and can the game motivates them to learn or is it just a waste of time? I guess not. If it's a serious game the parents would not bother much about the time spent playing it. If pupils can sacrifice hours playing uneducated commercial games, then integrating serious games in the school curriculum to supplement traditional teaching would go a long way toward motivating and engaging them to learn English as a second language. It is repeatedly pointed out, for example, that young people of their own volition choose to spend many hours playing complex computer games outside school (Keri F). The desire to harness this motivational power to encourage young people to want to learn is the main drive behind an interest in computer games for learning. As Chinese primary school students devotes their energy ,enthusiasm and concentration when playing commercial computer games, why wouldn't educational computer games be integrated in the English lessons to supplement ,motivate and engage pupils as people naturally gravitate to the things that interest them? The objective of this study, is to find out how well Serious games like Mingoville can motivate and engage the Chinese pupils to learn EFL efficiently and to identify the necessary factors that may hinder the students motivation in learning with computer games as it supplements the traditional teaching.

Mingoville.com

Mingoville is an online interactive English learning program, for children between 5 to 15 years old. A flamingo narrates the Mingoville instructions in English.Mingoville was designed and developed by the Danish e-Learning Center. The Mingoville platform is full of colored pictures, animated objects sound, music and flash movies which attracts the young learners. The platform is built on a narrative concept and contains 10 Missions that take the learners through a variety of themes such as The Family, Colors and Clothes, Numbers and Letters. The Mingoville platform can be described not as a full game in itself, but rather as a web-based learning environment that capitalizes on the mini-games and other entertainment activities that children engage in their spare time outside school.

English in Chinese Primary School

China is a multilingual, multidialectal country. There are 55 minority groups in China with 44 living in the western provinces. While Mandarin is the official language of China, most of the ethnic minorities have their own native language. Cantonese is commonly spoken in southern and western China as well as Hong Kong and the Chinese government has paid much attention to English learning and teaching since 1978(Siemon .A.2010). Prior to 2001, English language had not been a compulsory course in primary schools although, some teaching of English had taken place at this level since the mid 1980s (Wang Q, 2002). This has been on a very modest scale although, on an increasingly larger scale mostly in urban key schools. Nevertheless, the teaching of English at this level had not been standardized, due to its unrecognized position in the school curriculum, limited availability of qualified teachers and lack of appropriate teaching materials. The starting age to learn English varied from age 8 to age 11 and the weekly time allocation ranged from 1 period to 4 periods depending on the availability of the teachers. (Wang, 2002).However, since the start of the new millennium, the Chinese government has become increasingly concerned with the upgrading the level of English language of all Chinese citizens. It was decided in early 2001 that English would be offered at primary level from September of that year, starting in cities and then gradually towns and villages (Ministry of Education Document, April 2001). The Basic Requirement for Primary School English was designed and issued at the same time by the Ministry of Education (MOE). The Basic Requirement makes it clear that the beginning age is grade 3 (age 8) and the time allocation recommended is 4 times a week, with a minimum of 80 minutes, based on the principle of shorter periods and higher frequency. English language teaching and learning is booming in China and it is fast becoming the most popular and dominant foreign language in modern China. Coupled with the establishment of the open door policy, the2008 Beijing 29th Olympics Games, the People's Republic of China's admission to the World Trade Organization and the on going World Expo in Shanghai, the Chinese people's interest in learning English has become more intense. Many English training schools have been set up in different parts of China. English is considered as a means of changing average Chinese person's expectations in the motherland, where upon the language is seen as a tool to better understand the West and the rest of the world to serve the country better. Chinese people regard English as an indispensible tool which can make easier access to modern scientific and technological advances to the countries where English is the major language. Chinese enthusiasm for English learning is amazing, English study is being inspired by not only the desire to study abroad but also by a need to improve skills and find a good job. Thus, the TOEFL and GRE, along with many other English tests, come to be a must for job hunters. Demand for oral and business English is also growing and spreading all over the country. China's quest to master the English language by all means has brought the introduction of different electronic gadgets like computer, VCD,DVD tapes, MP3 and 4 respectively, in learning English language both at school and home.(Ruphina .A&,Liu .M.,2011)

2. PROBLEMS

Though, lots of efforts have been made to boost the teaching and learning of ESL in China, there are still many complaints, ranging from lack of interest and motivation to learn English, lack of a suitable English environment, lack of interactive teaching methodology to attract the digital natives, lack of confidence, lack of interest to master and remember English words as well as bored teaching and learning attitude (Ruphina .A, Liu .M., 2011). Most research indicates that Chinese students' English learning strategies are primarily focused on reading and writing, on grammar and translation, and on memorization of vocabulary (Rao 2002). However, research has indicated that this traditional grammar-translation method "'failed to develop an adequate level of communicative competence (i.e. the ability to use the target language for authentic communication)" (Hu, 2002,). In China, teaching is a typical teacher-oriented mode. The teacher mostly dominates the class leaving no option for students to answer and ask questions not even to exchange ideas with the teachers and asking a question is considered an admission of a lack of knowledge(Siemon .A.2010). Asking teachers in class or in public by spontaneously raising unsolicited questions about the subject may be seen as an admission of a lack of knowledge or as a deliberate, offensive act challenging the teacher's authority and credibility. This predicament has really affected the teaching and learning of English quality in China. Some Chinese students often complain that they have learned English for 20 years but cannot communicate in English. Some primary school English teachers even find it difficult to communicate fluently in English .These challenges have called for quick intervention .The question lies on "if all efforts have been made to salvage teaching English as a second language in China, why do the challenges already mentioned still exists ?.Time has come to address the issues in order to satisfy the hunger and thirst of the digital natives who wish and are determined to master English language like native speakers. Serious games seem to be one answer to solve the present predicaments faced by the pupils in learning EFL in China. They seem to intrinsically and extrinsically motivate the pupils and help to keep the attention of digital natives. Today's students are no longer the people our educational system was designed to teach (Prensky, 2001). The digital natives pay little or no attention to the classroom activities claiming that they are boring and not active. This has repercussions in education, especially in fields related to language and literature, where students are expected to engage in readings of various lengths. According to Gee,(2003)the educational potential of (video) games is associated with the experience of deep expertise – an experience that is often not offered learners in school, as schools are generally focused on testing and competence rather than performance. Interactivity is an underlying theme when the children speak of computer games and chat. The fact that children like to be in control and make decisions is made clear in many interviews and discussions with children in the research project.

3. THE PURPOSE OF THE STUDY

The main aim of this study is to examine how Mingoville an interactive Serious game would motivate, engage and arouse the interest of Chinese primary school students who are struggling to master EFL. The continued complaint of lack of motivation, boredom, and lack of good English learning environment has called for concern on how to integrate educational computer games in teaching and learning EFL to attract the attention and interest of Chinese young learners of English language .These young learners are the digital natives who desire a change in teaching and learning of EFL in their various primary schools.

4. THE RESEARCH QUESTIONS

The central research questions that this study aimed to answer are:

1) How did Serious game motivates Chinese primary school students to learn EFL?
2) What factors affected the Chinese primary school student's motivation and engagement when Mingoville was used in their classroom?

5. RESEARCH METHODOLOGIES

5.1 The Participants

The target groups in this study are two primary schools in Nanjing, Jiangsu province, China with different socio-economic status. School A consisted of students from high socio economic class families while schools B were students from low income families. The occupation of school B's parents are mainly farming and small scale business while the high socio economic class parents tended to be managers,doctors,businessmen, or other professional. The children are within the age range of 8-11years old and both male and female students were involved in the study. The total population of the two students that participated in the study was 229, School A population was a total of 121 while 106 students participated in school B. Classes chosen for the research study were grades 4 and 5, two classes from each grade, 4 classes in each school. The two grades were chosen because Mingoville was meant for children of their age and also because the Mingoville contents fit their English language level. Before the researcher chose the grades level for the experiment the researcher had discussions with the English teachers. They examined the Mingoville content and concluded that the Mingoville content was relevant, though not related with the school English language curricula. The general class size of the school was 25 to 35, though school B seems to have smaller class sizes and both school classes lasted 40 to 45 minutes. In addition, the children of the school were already acquainted with using computers in other activities. Their previous acquaintance with computers helped our research in that the students had played different types of Chinese computer games before at home for recreational purposes and not for learning English language. It is pertinent to mention that the teachers are all university degree holders and had continuously used computers for more than five years. The teachers had the knowledge of computer games though; they had not been applying it in the teaching of EFL. Rather, the teachers applied traditional games

5.2 The Instrument

The two schools are well equipped with about 53 computer in School A and 35 computers in school B, including internet connection and one whiteboard. All the students had a computer to use during the research study, including the teacher controlled computer. The research study took place at the school computer laboratory.

In collecting the research data for the study, several research instruments like Observation, Field notes, interview and literature review was applied.

5.3 The study procedure

The pilot study was done for the trial testing of the research instrument adopted. This was personally done by the researcher, with the help of the research assistant and two trained observers. The whole process started April 2009, with the help of my supervisor; a meeting was organized and was held at the Nanjing primary school experimental centre. The technology teachers and the English teachers of the two schools attended the meeting .The researcher introduced the research plan to the participating teachers. After long discussion and deliberation, the teachers agreed to convey the research plan to their respective school leaders and promised to get in touch in two weeks time. The teachers were asked to go home and study Mingoville.com after the researcher introduced the Mingoville platform. The first week of September, 2009 was used to educate and give the teachers an in-depth training about the use of Mingoville. The teachers also asked questions about the aim, potential and purpose of using an educational games like Mingoville.com.Then on 11th September, the main research started by giving of user names and password to the students of school A. The user name and password was created by the Mingoville office in Denmark. It was the beginning of a new session, so some students did not have a user name and password because they were new students. So the researcher created their usernames and passwords with the instruction of the Mingoville CEO.After the issuing of the usernames and passwords, the researcher introduced Mingoville to the students, they became very excited immediately once they were told about Mingoville. Then, flash software was installed on both teachers' and students' computers in order to open the Mingoville web site. The first day at school A was more of interaction with the students and teachers because the school had problems with their school internet connection which was rectified before the second study took place. At school B, the main study started on 13th of September 2009.The research study lasted for five weeks and classes were held once a week for 45 minutes. The Mingoville topics covered during the research study included family, season, numbers, animals etc. The teachers were given free hand to choose and prepare lessons, there was no restriction on the teaching methods to adopt. Prior to the beginning of the research, a letter of consent was written and signed by the supervisor. The letter informed them about the research study, requesting the teachers and the student's willingness to participate in the study. The teachers also verbally informed the students to pass the message on to their parents, informing them on the importance of Mingoville in learning English.

5.4 Interview

The Pilot study interview was conducted on the last week of the research study, however, after every English lessons the researcher, research assistants and the two observers, would stay for a while to chat with the students to enquire their true perception about game based classroom and Mingovilled content. After this enquiry both the study group will discuss further on our observations and students response. Semi- structured interview was adopted, a pre-set questions was prepared to ask the students but allowed more open ended answer that lasted for 20 to 40 mins. The interview was mostly concerned on the digital games for learning. Altogether, 58 pupils

participated in the interview from the two schools and there was no special criterion in choosing the interviewee. In some occasion, it was the teacher or the research assistant that picked the students, at least in each class 6 to 8 pupils represented their class. The research assistant also translated most of the interview responses.
The method adopted to analyze this research study was content analysis of which was analyzed manually. The researcher systematically pawed through the interview text and assign codes to the text into manageable categories by using themes to specify characteristics within the text.

5.5 Credibility of the study
In analyzing the data, the researcher read the data extensively and coded the data. Then, transferred the raw data to the research assistant without showing the categories that emerged from the researchers coding. The research assistant then coded the raw data after reading through it. Later, categories were compared with the research assistant categories that emerged. The two categories were merged into a combined set. After the interview, the researcher was in contact with the school, enquiring some information in the areas that was not clear. In this way the researcher hoped to avoid possible misunderstandings. Unbiased data is hard to guarantee when you are doing qualitative research. Some answers can be used for several conclusions for instance, by taking quotes out of their context. The researcher hoped to prevent such consequences by letting the interview objects look over the analysis of their interviews. Furthermore, the conference paper which the researcher wrote was lifted from this research study and was rigorous peer reviewed by the different conference committee and certified it credible to be presented at the conference and published.

6. RESEARCH FINDINGS
6.1 Finding for research questions 1: How did serious games motivates Chinese primary school students to learn EFL?
This question was actually raised to gain an understanding of how serious game like Mingoville could motivate and arouse the interest of the Chinese primary school pupils to learn English as a second language. Motivation is seen as a strong desire for learning and acquiring knowledge of English, maybe likened to an engine and steering wheel of an automobile, something that can move students from boredom to interest. Advocates of computer game-based learning argued that computer games have the potential to transform the way in which students learn, motivate engage and arouse the interest and improve active participation of new generation of learners in a way that traditional teaching does not. It is said that Chinese education is more teacher centered but serious games is student -centered. During the course of this study the pupils were interviewed if the Mingoville program had motivated them to learn English. In order to ask this question about motivation three questions related to motivation was created.

A. Do you think that Mingoville motivated you to learn English?
Majority of the students, about 45 students said “Yes” that Mingoville motivated them while 8 said that they don’t think Mingoville has really done much .However, Mingoville is a good method to learn English, and 5 students said that they are not sure, though they would want the teacher to integrate Mingoville or any computer games to teach them. In order, to clarify more on how Mingoville motivated the pupil to Learn EFL, question no 2 answered the question. The students mentioned different sources in which they received motivation from Mingoville program .Many categories emerged based on the interview responses.

B. In what ways did Mingoville motivated you to learn English?
Six categories emerged on how Mingoville motivated the pupils to learn EFL

- Feeling of fun and satisfaction

The mostly cited reasons why Mingoville motivated the pupils was because of the fun and satisfaction derived when Mingoville was introduced in their EFL classroom. We can view fun as excitement and as a vehicle of engagement which might help make it more palatable. According to Bartle (2004) people play games because they are seeking “fun” and Gee (2007) points out that pleasure are inseparable from deep learning and hard work. The findings revealed that Mingoville features like background music, dictionary, recording of voice, replaying of voice, narratives etc created fun, relaxation, satisfaction. Majority of the pupils agreed that they were satisfied because they improved their writing skills, vocabularies, pronounciation and listening.etc. This supports Bisson and Luckner view which states that “enjoyment and Fun as part of learning process that are important when learning new tools since the learner is relaxed, motivated and therefore more willing to learn.
Student’s interview comments: “When I use Mingoville I feel calm, fun and willing to read more”. “I learn fast and fell happy”. “Flamingo is humorous and that helps me to lean happily.” “Mingoville is fun and attractive to play.” “I feel relaxed and happy; the game platform is like a dream world.” “I learn better when I use games; I started playing game since the age of 4.” “Mingoville just like other educational games are stress free and interesting.” “It’s learning by doing, I feel more relaxed” The songs in

Mingoville program motivated and engaged me a lot and I recorded my voice and it's amazing to hear my voice.

- Autonomy, Free from loosing face and scared of teachers

Merriam-Webster Online Dictionary defines autonomous as the quality or state of being self-governing, especially the right of self. The students felt that they have the right to choose their own part and confident in exercising that right. In the findings, majority of the students revealed that they prefer using games because they have to learn on their own and avoid loosing face and scared of teachers. Teaching with Serious games also suggests that there are specific features of game play that could encourage student engagement, such as the opportunity to have autonomous control over a responsive environment, and the ability to use games familiar from home in which they can demonstrate expertise.

Student's comments: "In traditional classroom we are passive, always listening to the teachers all the time, but when Mingoville was introduced I felt happy because I had the chance to control the mouse and I felt am in control of my learning, and that motivated me to be interested in using Mingoville program to learn English". "I think I would want the teachers to change their way of teaching by using games like ,Mingoville which motivates us through being related with the school content". "I am still young, I don't like coming to the class every day to recite English words, I always feel scared in our English class because I don't want to fail the teacher's questions, so any time we have class I feel worried. I wish our teacher will continue to use Mingoville because I feel relax and the flamingo instruct you and inform you on what to do. You can also repeat it as long as you like, nobody will laugh at you and you wouldn't lose your face."

In language teaching ,games have often been used to stimulate motivation and authentic communicative practices, as games have been conceptualized as the "the fun factor" of language learning (Warschauer&Healey,1998).Malone(1980) advocated that schools should try to integrate game elements into curricula so as to arouse students' intrinsic learning motives.

- It improved collaboration and co-operation

The students said that Mingoville game offered them the chances to collaborate, interact and learn from one another. They also had the opportunity to ask the teacher questions about the Mingoville platform when they are confused with the task. Some friends chose to work together to complete games, they contributed their ideas and learn from one another. In the traditional classroom normally, the teachers speak while the students listen. The students are always passive and do not have the courage to ask teachers questions because they don't want to lose face or because they feel shy or even scared of the teachers. In the Mingoville program, if a student is confused at any stage of the platform he or she has to get it right in order to proceed. So, this encouraged the students to collaborate more and even involve their teacher when they are confused. In China, it is always hard for a student to raise hands and ask teacher question because of the cultural ideology of Confucious style. But in the Mingoville program the students have to ask teachers questions or discuss with other students who are progressing if they wish to proceed to the next level. So the challenging aspect of Mingoville motivated the students a lot because it gave them the chances to interact, share ideas and collaborate.

Students commented "Mingoville is two ways while in traditional classroom is one way, only the teacher talking most of the time. Though, flamingo can't hear me, it gave me an instruction to do something and when I do it perfectly he praises me. I feel am communicating with somebody."

- Reward and Encouragement

Reward and encouragement are motivating factors in Mingoville platform that encourages learners to keep their motivation. The learners agreed that they were extrinsically motivated when Mingoville mark good to their work or when Mingoville uses an encouraging word to praise the students when they get the answer correct. According to one of the students "Even if I fail the exercise, flamingo will encourage me to do it again. If it's in the classroom, when you fail an exercise the teacher will scold you, you will become scared, and students don't like to lose face".

- problem solving ability

The reasons for considering using games in the class were for motivation and engagement reasons. As shown in the findings, the interviewee admitted that problem solving features in Mingoville platform motivated them, though some of the problems were challenging, they were motivated to solve the questions. According to Keller (1987) another way of sustaining curiosity may be activated by creating a problem situation that can be resolved only by knowledge seeking behavior. Giving the learner problems to solve primarily facilitates application strategies because solving a problem requires the application of relevant knowledge and skill.

Students commented that "The Mingoville program motivated me because when I followed the flamingo instruction and I did the exercise correctly flamingo always response by praising me like saying 'job well done'. "In Mingoville, the more you repeat the exercise the more you learn it .Also, it builds your confidence, and you don't have to worry more about scolding and loosing face."

Alessi & Trollip, (2001) emphasized that Problem solving also facilitates understanding and awareness of one's own thinking and cognitive processes. "Problem solving is the critical cognitive "engine" that drives a vast array of digital games. In fact, problem solving is one of the defining characteristics of digital games as players interpret rules and determine how to play the game. Subsequently, solving problems within the game is where the real potential for fostering problem solving skills and the complex relationship for learning takes place" (Gee, 2007).In Mingoville ESL classroom, students solved the problems in different ways, like paying close attention to Flamingos instruction and carrying out the instruction effectively. Answering the questions, after each part their will be a questions either to complete a sentence, spellings, record their voice etc. the games provide a set of challenges that children must overcome in order to complete the game successfully and all these problems are expected to be solved in order to proceed to the next level and this helped to engage the students more in the game. Though some students commented that they could not skip to another game if they are not satisfied, thus Mingoville was designed that you have to finish a task before proceeding, you can not just abandon a task. The more they were trying to solve the problems the more they are learning New English skills.

- Good learning environment

In the study we find out that majority of the pupils appreciates Mingoville rich learning environment and this motivated the students to learn with Mingoville. The students commented "What motivated and engage me to use Mingoville to learn English is the vivid and rich colors used to design Mingoville platform which made it to look real".. I like the memory games, the pacman, songs, etc "I also like the pure English environment". "The dictionary part of Mingoville programs motivated me more because when I am using Mingoville, if I do not understand any of the words, I will quickly click the dictionary section which will give me the meaning of the word, and shows the picture of the word even pronounced the word. I can easily check my own pronunciation by recording my voice and replaying it again"." My spelling is very bad; I improved my spellings when I use Mingoville". "I feel like a player and also a learner at the same time". "I feel active in class when Mingoville was used and that made the class to be more active and interactive. The class is more active when using games than in traditional classroom."

Demotivating factors

Few students mentioned that Mingoville did not motivate them, they also mentioned some factors why they think Mingoville did not motivate them to learn English, they are as follows,

- Lack of cultural element on the game design

  "I don't like the teacher to use Mingoville program. The program demotivated my interest to learning English. I don't like the animal flamingo, and they should have used panda or any other beautiful animals that Chinese pupils like. I think flamingo, its ugly". The Flamingo animal seems not to be Chinese primary school students favorite animal. Most of the students suggested that the animals like pandas, cats, dogs or snakes are their favorite. They also think that using their favorite and familiar animal will attract their interest more.
- Boring

  "Mingoville program is boring, besides, I don't enjoy learning with computer game". "I actually prefer traditional teaching than game based teaching". I learn well when the teachers talk to me face to face". Though, most of the students agreed that the use of Mingoville motivated them to learn ESL, some students though, few still felt that the traditional teaching method was their ideal method.
- Preference:

  "I am demotivated when Mingoville game was used in class, it's so boring and the game content is easy. I want games that are challenging. I prefer the Chinese games". The game content is what attracts and arouses the students to use any game. If they think the game is easy for them, they lose their interest. The game developers should pay more attention on the content of the serious games. Also, it is necessary to study the age and level of the students before developing a game for them. The English level of the students that made this comment is higher than that of their classmates. According to these students, they think that they already know the topic, so there was nothing new for them to learn. Though they agreed that he would prefer a game integrated in learning ESL but they made it clear that games should be challenging.

C. Would you prefer your teacher to use serious games to teach or do you prefer traditional teaching method?

The students were asked questions on whether they would prefer their teacher to integrate Mingoville games when teaching English as a second language. Majority of the students preferred Serious games classroom while few students prefer traditional Methods of teaching, some of their responses included:

"I prefer to use Mingoville because I play and learn the same time". "When we perform badly in traditional classroom the teacher gets so angry, he gets red face and I become so scared but using Computer game I feel am in control of my learning". "Using Mingoville or any other English games helps us to learn a lot. Books are boring". "I prefer traditional class because I think it's more truthful and useful to learn with it." "Its more practical, computer games can not help us master the real knowledge" "Students feels happy when they use computer game but they wouldn't remember what they have learned after the class". "Traditional classroom requires a lot which the teacher can't teach us but the computer game can teach us". "In traditional classroom, the teachers just teach, most students don't understand but in games you have to be creative to figure out how to solve the problems.""Mingoville aroused the interest in me to learn English." "In traditional classroom I can't speak out my mind because am afraid the teacher would scold me, so I don't answer questions in class, but in game classroom there is nothing like being afraid."

6.2 Finding for research questions 1: Research question 2: What factors affected the Chinese primary school student's motivation and engagement when Mingoville was used in their classroom?

In order to answer research question 2, two questions where created as follow.

A. What challenges did you encountered that affected your full participation in the Mingoville classroom?

The following are student's comments about the challenges they encountered when Mingoville was introduced in their EFL classroom and this as well hindered their full participation in the EFL lesson.

"At first I do not know how to use the game, I got so lost and confused, and I even forgot what we have learned". "My English words are limited and I do not understand flamingo's narrative very well, flamingo speaks very fast". "Mingoville games forces you to finish one game before you switch to another, it restrict your movement in the game environment and compel you to finish the task before switching to another. "There are many unfamiliar words, though we have option to use dictionary, it takes my time". The game is boring, it's not like the Chinese game and I don't like English" "I don't like when the teacher controls the games". "I would rather prefer more challenging games that will attract people". "Mingoville has lots of activities and they are related, they should try to change the activities". "The computers always freeze and we have to start afresh, it's a waste of time."

B. What do your parents think about the integration of Mingoville game in an EFL classroom?

In order to fully understand the factors that might affect the integration of Serious games in Chinese schools, the researcher extended his questions by asking the students about parent's feelings and perception of Serious games in an EFL classroom .According to Prensky, (2002) many parents and critics express the opinion that computer and video games are "mindless,"i.e. that kids do not learn anything beyond hand-eye coordination from the thousands of hours they spend playing video games. Other critics express the opinion that digital games impart only negative messages and, in the words of one, "teach our kids to kill." Still others assert that while players may learn "about the game" they learn nothing "useful" about "real life." This falls inline with the student's response about their parents' concern on playing computer games.

The majority of the students responded that their parents were strictly against playing of computer games as a waste of time, in fact most parents wants their students to concentrate on what the teacher taught in class in order to pass examinations. While very few students said that their parents played along with them. Further enquiry made us understand that the parents that played with their child (ren) understands English and can say some English words. Some also said that playing computer game is a kind of reward from their parents when they finish their home work or do things that pleases their parents.

School homework: "My parents are not against playing computer games but against playing it when I have not finished my homework or read my books for the day". "Though my parents don't want me to play games, Mingoville was an exception. I told them that it was an educational game, so they allowed me to play, but my mother always monitors what I was doing". "My father don't like computer games, I don't even play Chinese computer games so he wouldn't allow me to play Mingoville game." "I played Mingoville when I got home, since my teacher informed our parents. So there is no problem but I must finish my home work and I played for sometimes before I go to bed. I didn't stay long because I have to go to school the next day. I will play Mingoville this weekend."

Though more and more Chinese parents are worried about their children's game playing, from our interviews and observations we realized that if the parents are aware of the game contents and its specific use for educational purposes their fears wouldn't be much. All that is needed is proper monitoring to make sure that the children do not get addicted.

Observation Findings: The researcher, research assistant and the two trained observers observed the lessons. The lessons were taught by the English Chinese teachers using Mingoville.

Engagement and motivational different at both primary schools: We observed that the students at both school were motivated and engaged differently. It was observed that school B was highly engaged and more motivated than school A when Mingoville was integrated in their EFL classroom. When the teaching was going on the students at school B seems to be more active and organized. Though, at School A, the students were also active but we observed that sometimes they did not follow the teachers' instructions. They even stopped using Mingoville and switched to other Chinese games installed on the computer. Some students from school A were complaining that the games were boring and very easy. Sometimes, they don't pay full attention but in an actual sense we realized that though they might think a topic was easy, they could not recognize all the words and did not know the meanings of the words taught. Their familiarity with the topics taught example, my family, colours, animals' etc.does not mean that they have mastered all the contents. Most of the students at school A had access to a computer and the internet at home, they played computer games often and it was easy for them to make a choice about the type of games they wanted to play. The students at school B had less access to computers and Internet; a few of the students have computers with internet connection at home while very few have both a computer and an Internet connection. Perhaps, because the students at school B do not have full access to computer games, they were more engaged and motivated to use Mingoville in their EFL classroom than the pupils from School A. They followed the instruction of the teachers and carried out all the game exercises more than the School A students. It was also observed that though the English level of students at school B was lower than that of School A, the students of school B were so eager to learn English with Mingoville, that they appeared to be more disciplined than the students of School A. From the observations, it seems the school B students were more intrinsically motivated; they were more engaged in using Mingoville to learn ESL.

Homework: The teachers of the two schools gave the students home work to do in the Mingoville Program. It was observed that the majority of the students did not do the home work. The students that carried out their homework were from School A. Few students from school B completed the home work. The reason could be because most of the students at School B do not have access to home computer. Most of the students said they have lots of school home work to do and do not have time to do the Mingoville program.

Class size: Class size is very important when introducing game-based learning in order to manage and organize the students very well. We observed that it was really difficult for the teacher to control the class because most of the students do not follow the teacher's instructions, rather they will navigate to another game platform installed on the computer which they think it's more interesting. So, when the teacher is teaching, those students do not pay attention and the teacher could not recognize this problem. I suggest that a class of 10 to 15 or less is suitable for a game class if a games- based method should be adopted. Chinese classes are normally large in population between 35-50 students in a class. In order to control and discipline the students in game based classroom, small class size is a unique and important factor to consider.

Teacher's attitude: The teacher's acceptance of the computer game programs can easily motivate and influence the students. If the teachers are reluctant to integrate computer games in classroom, it will definitely affect the students' acceptance of game. The teachers should master the games skills. It is not advisable for the teachers to come to the class and start asking the students to teach them how to operate the game. We observed that due to the busy schedule of the teachers, some teachers did not have time to master the Mingoville program very well. Those teachers were not really sure of what they were doing. They felt scared of making mistakes and that disrupts the class. So it is good for the teachers to master the necessary skills needed.

Being in control

We observed that the students wanted to be in full control of their learning when Mingoville was integrated in their English class. They wanted to control their learning; whenever the teacher controlled the computer to teach them they appeared sad. Though some of the students were confused when they were controlling the mouse, they always tried to figure out what to do by asking their classmates or even calling for the attention of the teacher. Throughout the game-playing process, learners have to experience and tackle the problems within predefined learning contexts. According to Gee (2005), leaving learners to float amidst rich experiences but without teachers' guidance in the process of game-based learning does not work.

However, I will suggest that the teacher should control the computer when teaching. If time permits the teacher can give the students a short time to be autonomous by giving them an exercise to complete. Another method which was effective when Mingoville was integrated in one of the primary school was asking one of the students to come in front of the class to control the mouse, carrying out the task while other students watched. Alternatively the teacher should divide the class into two, group A and group B, or boys and girls. The teacher controls the mouse, asking them questions and the side that gets the best score is the one the teacher gives marks. This method aroused the interest of the students a lot. The class was active and struggled to win the game. This method combines both traditional and games based learning.

6.3 Problems Observed

Few of the problems observed when Mingoville Program was integrated were mostly technical problems. Some of the problems were resolved by the computer teachers, while some problems that had to do with Mingoville program were not resolved:

- It takes time to load the game and sometimes the teachers and students feel frustrated.
- Few of the Mingoville words are not in the Mingoville dictionary.
- Sometimes a page freezes and the flamingo stops giving instruction.
- Most of the students always forget their usernames and passwords, and that delays them from signing in.
- Some students cannot follow the flamingo's instruction and pronunciation
- Lack of time for teachers to prepare what to teach.
- Some teachers think Mingoville is not part of their curriculum, so they do not pay much attention to the Mingoville study since they have a lot of school works to do.
- The class time was very short.

7. SUGGESTIONS AND CONCLUSION

In this study we concluded that Mingoville or any Serious games, if properly integrated in learning EFL in primary schools in China, will highly motivates, engage and arouse the interest of Chinese digital natives to learn English. In China, teachers must finish teaching the text books assigned for the term. Therefore, no teacher would be expected to use serious games in class unless they are part of the curriculum. From the study, it is clear that even those few students who do not like Mingoville they would still prefer learning EFL with computer games. It's was observed in this study that the integration of Mingoville or any other computer games to supplement traditional teaching of ESL was a better strategy to reach digital natives in China. Research evidence (e.g., Bisson & Lunckner, 1996; Cordova & Lepper, 1996) has shown that fun and enjoyment are important in the process of learning as learners can be more relaxed, motivated and willing to learn. Based on a series of surveys, observations and interviews with game-players, Malone (1980) gave his intrinsic motivation theory, which asserts that challenge, fantasy, control, curiosity, cooperation, recognition and competition are the most significant elements that make game-playing fun and engaging and sustain players' continual motives.

Games are an important part of childhood development and learning often takes place through a child's game-play. Therefore, integrating Mingoville games to supplement traditional learning improved the Chinese students' classroom atmosphere, lowered students' anxiety, motivated and sustained their interest in learning ESL and helped them learn and retain the language with new words, pronunciation, writing and listening, all in a fun way. All that is needed is to properly organize and try to rectify all the necessary impediments listed in the research study. Rieber, (1996) argues that Play, especially during early childhood, performs an important role in psychological, social and intellectual development; it is a voluntary activity that is intrinsically motivating, involves some level of activity and often possesses make-believe qualities. Such attributes are similar to those espoused in modern educational theories where learning should be a self-motivated and rewarding activity.

REFERENCES

Ang, C.S & Zaphiris , P. (2006,) Developing enjoyable second Language learning software tools: A computer game paradigm. In zaphiris, P. (ED) User-Centered computer Aided Language Learning, Science Publishing. (.pp 1-21).

Alessi, S.M., & Trollip, S.R. (2001).Multimedia for learning. Boston: Allyn and Bacon.

Bisson, C., & Lunckner, J. (1996). Fun in learning: The pedagogical role of fun in adventure education. Journal of Experimental Education, 9(2), (pp109-110).

China Information Base: retrieved online from http://www.chinatoday.com/data/data.htm#Int.

Cordova, D., & Lepper, M. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. Journal of Educational Psychology, 88, (pp 715-730).

Crisafulli, L &Antonietti, A. (1993).videogames and transfer: An experiment on anological problem solving) Ricerche di Psicologia, 17(pp, 51-63).

Foreman, J., Gee, J. P., Herz, J. C., Hinrichs, R., Prensky, M. & Sawyer, B. (2004) Game-based learning: how to delight and instruct in the 21st century, EDUCAUSE Review, 39(5),(pp 50–66).

Gee, J. (2003) what video games have to teach us about learning and literacy. New York, NY: Palgrave Macmillan.

Gee, J. (2005). What would be a state of the art instructional video game look like? Retrieved from http://www.innovateonline.info/index.php?view=article&id=80.

Hayes J R, (1981). The complete problem solver, Philadelphia: Franklin institute.

Hu, G. (2002), Potential Cultural Resistance to Pedagogical Imports: The Case of Communicative Language Teaching in China. Language, Culture and Curriculum 15(2), (pp93-105).

Kerri Facer(ED), Computer games and Learning: Why do we think its worth talking about computer games and learning in the same Breath. Future Lab. Retrieved from http://www2.futurelab.org.uk.

Keller, J. (1983). "Motivational design of instruction. In C. Riegeluth (ED.) Instructional Design Theories and Models." Hillsdale, N.J.: Lawrence Erlbaum.

Krasilovsky, P. (1996) A child's garden of virtual reality, American Demographics, 1996(September), (pp20–22.)

Mayer, R.E &Sims, V.K, (1994).For whom is a picture worth a thousand words? : Extensions of dual -coding theory of multimedia learning. Journal of Educational Psychology, 86 (3), 389-401.

Malone, T. (1980). What makes things fun to learn? A study of intrinsically motivating computer games. Palo Alto, CA: Xerox.

Sørensen, B.H. and Meyer, B. (2007) Serious Games in language learning and teaching: a theoretical perspective. Conference Proceedings, DiGRA, Tokyo, September.

Siemon .A. (2010) Learning English in China: is communicative language teaching a reality. Retrieved from http://findarticles.com/p/articles/mi_6953/.

Ministry of Education Document: On promoting English Language Teaching in Primary Schools. April, 2001.

Nguyen, T. T. H. & Khuat, T. T. N. (2003) the effectiveness of learning vocabulary through games, Asian EFL Journal Quarterly, 5(4).

Prensky, M. (2001). Digital game-based learning. New York, NY: McGraw Hill.

Prensky, M. (2002) Why Games Engage Us? in Digital Game-Based Learning, op.cit. and online at www.marcprensky.com/writing/default.asp.

Rao, Z.(2002). A close look at the Chinese cultural influence on students' learning styles and strategies. *Asian English's*. 5 / 1, (pp40-63)

Reiber, L.P. (1996). Seriously considering play : Designing interactive learning environments based on the blending of micro worlds, simulations and games. Education Technology Research & Development, 44(2), 43-58.

Ruphina, A. & Liu, M. (2011). Digital games: Potential Integration of Mingoville games in Learning English as a Foreign Language. Chesapeake, VA: USA AACE. /SITE (pp.2216-2222).

Quinn, N. (1996).Designing an instructional game: Reflections on Quest for independence. "Education and Information Technologies, 1(pp 251-269).

Wang Q, (2002). Primary School English Teaching in China: New Developments. ELTED Vol. 7 winters 2002.

Wood.L.W & Stewart .W (1987).Improvement of practical reasoning skills with computer skills. Journal of Computer Based Instruction, 14(2), (pp 49-53).

Wood, J. (2001) Can software support children's vocabulary development? Language Learning & Technology, 5(1), (pp166–201).

THE DEVELOPMENT OF A WEB-BASED SELF-REFLECTIVE LEARNING SYSTEM FOR TECHNOLOGICAL EDUCATION

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ABSTRACT
One obstacle to industrial technology education is that the difficulties or problems students encounter during experiments are not easy to detect. Students are often unaware of their flaws, and some will not notify the teacher of these flaws even if they are aware of them. Consequently, many opportunities to rectify these flaws and improve teaching methods are lost, and students who are falling behind are deprived of instant guidance and cannot catch up. Therefore, this paper aims to develop a web-based self-reflective learning system to enhance students' learning of industrial technology.

This study applied sensor network technology to develop a web-based self-reflective learning system based on a self-reflective learning approach. The system was integrated into a micro-fabrication technology course for empirical study. Subsequently, the influence of the web-based self-reflective learning system on students' learning performance and technical skills was investigated. Analysis of the data obtained from learning cognition, skill assessment, and learning satisfaction following education indicated that the web-based self-reflective learning system could effectively improve the learning performance of students falling behind, thereby allowing these students to catch up in their cognitive and skill achievements by the end of the semester.

INTRODUCTION
Dewey (1933) was the first scholar to propose the concept of reflection, which he defined as the behavior of repeated thinking and searching upon encountering problems; combined with observations of the surrounding environment, understanding of the causal relationship stimulates deeper thinking. Kemmis (1985) believed that reflection was a process of internal and external dialectics. Through reflection, individuals are able to increase comprehension of their own thinking process. Reflection is a psychological activity that extracts and forms meaning from experience, which contributes to reorganizing and restructuring perceptions. This further enables gained knowledge to become refined and differentiated gradually. Consequently, this study considers reflection distinctive from thinking. Reflection is the process of integrating experience or past perception with newly received perspectives before further internalization into personal knowledge. Therefore, reflection is thinking with the additional components of reflection and action. Paris and Ayres (1994) pointed out that reflective thinking motivates students to learn; applying strategies to accomplish specific objectives is very useful. Reflection may occur before or after the action, which indicates that personal knowledge is progressively formulated during actual working action. Regarding the relationship between personal action and reflection, Elliott (1991) stated that reflection originates from action, which suggests that reflection is generated from collected information during personal action. From a teaching perspective, Schon (1983) divided reflection into two major frameworks: reflection-on-action and reflection-in-action. Reflection-on-action indicates that reflection occurs in the interval after teaching and before planning and thinking. Reflection-in-action is an attempt to adjust personal teaching and deal with responses during the process of teaching. Carver and Scheier (1998) identified self-reflection as individualistic survey, evaluation, and comprehension of personal thoughts, feelings, behavior, and self-awareness. Davis (2000) requested learners to perform self-reflection during the process of learning; the action of reflection allowed the learners to re-survey, test, and modify existing thoughts and knowledge, which further achieved improved and more structured comprehension. Costa and Kallick (2000) believed that students who could conduct self-reflection were more able to gain cognitive structure among teachers and classmates as they had a clearer understanding of their own steps in reasoning.

Paris and Ayres (1994) suggested that applying learning portfolios and authentic assessment could effectively induce reflective learning. The creation of learning portfolios is a continuous process from the beginning to the end of the learning activity. Prior portfolios can provide learners with a reference for reflection, allowing the learners to focus their reflection on the learning objectives. This approach is more effective and directional. E-portfolios are primarily a development of traditional portfolios, and only secondarily result from the process of digitizing; data that are collected, stored, and managed digitally before being placed on the Internet are called web-based portfolios. The main functions of the web-based student portfolio system developed by Younes (2004) was to provide storage, display, and reflection of students' learning processes from admission to graduation. In the structured web-based portfolio assessment system established by Chang (2008), one of the functions was composition and assessment of reflection. This system provided students with a reflection outline for them to compose their reflections; the teacher assessed the compositions and responded with feedback. Students could assess their own reflections as well as assess and give feedback on the reflections of their peers. E-portfolios assist students in evaluating their own learning processes and performing reflections (Liu, E. Z. F., 2010, and Chang, C. S., et al., 2011). Through observing and emulating each other, the students'mutual understanding among peers is increased along with the opportunity for competitive learning processes; teachers are thereby aided in observing the learning circumstances of the students and can assess accordingly. However, how to combine modern technology and construct a web-based learning system based on a self-reflective learning approach to enhance learning performance is an issue requiring further examination.

With recent advances being developed in the fields of micro-electro-mechanical systems (MEMS) and wireless communication technologies, wireless sensor networks have emerged from being utilized in laboratories to being ubiquitous, potentially changing our lives on a daily basis. Wireless sensor networks are more attractive and useful than traditional wired sensing systems because of their ad-hoc and easy means of deployment. This new technology expands our sensing capabilities by connecting the physical world to the communication networks and making a broad range of applications possible (Akyildiz, Su, Sankarasubramaniam, and Cayirci, 2002). Sensor networks are the integration of sensor techniques, distributed computation, and wireless communication techniques. They are embedded in our physical environment and are used for sensing, collecting data, processing information of monitored objects, and finally, transferring the processed information to users. The sensor node's hardware consists of five components: sensing hardware, processor, memory, power supply, and transceiver (Tubaishat and Madria, 2003). For numerous applications, a sensor network operates in three phases. In the first phase, the sensors take measurements that form a snapshot of the signal field at a particular time, and these measurements are stored locally. The second phase is the information retrieval, during which data are collected from individual sensors. The last phase is information processing, during which data from sensors are processed centrally with a specific performance metric (Dong, et. al, 2007, and Shyr, 2011). Such a network is composed of numerous tiny low-power nodes, each consisting of actuators, sensing devices, and a wireless transceiver. These sensor nodes are deployed in significant numbers in a region of interest to gather and process environmental information.

WEB-BASED SELF-REFLECTIVE LEARNING SYSTEM

The new technology of a wireless sensor network expands sensing capabilities by connecting the physical world to the communication networks. To support learning in micro-fabrication technology, numerous sensor devices must be deployed in the laboratory to collect real-time information of students' motions and machine operation conditions. This study used the Zigbee modules to build a wireless sensor network. The proposed architecture of the sensor network system is shown in Figure 1. The overall system architecture is comprised of a Web camera, a Zigbee dongle (base node), a server, and wireless sensor nodes. The wireless sensor nodes consist of two key parts referred to as the static and the mobile nodes. The static sensor nodes are scattered in the laboratory, forming a multi-hop mesh networking topology. A couple of the defining roles of the static node is to transfer all the data packets from the mobile node to the dongle, while the other role is to provide sufficient anchor points for the localization. Each sensor nodes is capable of collecting data and routing data peer-to-peer to the Zigbee dongle, which is then used to bridge the sensor network to the Internet to provide a serial interface and wireless connection for node programming and data transferring. The server is connected to the Internet to enable remote users to access the laboratory monitoring system. The mobile node, comprised of an accelerometer, is worn by the students and it monitors student motions and positions in an indoor environment.

Since students need to rotate handles manually, operate machines, and adjust machining parameters simultaneously, and while some of the machines also require students to have the machining parameters adjusted by stepping on pedals during experiments and practice, this study has intended to incorporate ultra-thin force sensing units (0.127mm) into the Zigbee node. To ensure that the students are able to use the tools correctly, training during experiments and practice is necessary; hence the connection between the Zigbee node and the PIR325 infrared sensing unit to make a wireless infrared sensor that will then be installed in the toolbox. In this study, a Zigbee node is connected to a three-axis micro electro-mechanical system (MEMS)-based accelerometer to make a wireless accelerometer, which is a device that measures acceleration and detects the acceleration magnitude and direction as a vector quantity. The sensor is worn by the students, and it not only detects and records the students' position inside the laboratory but also senses their movements.

A graphical user interface (GUI) enabled remote users to carry out the operations desired, such as sending commands and parameters to activate the sensor nodes, as well as having the measurement results visualized. This thesis used ASP.NET and Microsoft Visual C# to write an internet program that enabled swift and convenient processing of information. Figure 2 displays the Web GUI of a user monitors the laboratory environment at the remote client side. By clicking on the mouse, a remote user is able to adjust the camera's viewing angle to acquire video data. This interface accepts remote client-side to acquire information on which node to monitor though clicking the buttons and checkboxes on the panels. Upon clicking the sensor installed on the node, the sensors' signal can be observed, and then the data from the selected sensors are collected and sent to the Web GUI at the specific time intervals. In Figure 3, the top-left corner displays the information measured by the force sensor at various intervals, while the bottom-left corner displays the force sensor's instant information. Additionally, the top-right corner displays information measured by the IR sensor at various intervals, while the bottom-left corner shows the student's current position in the laboratory.

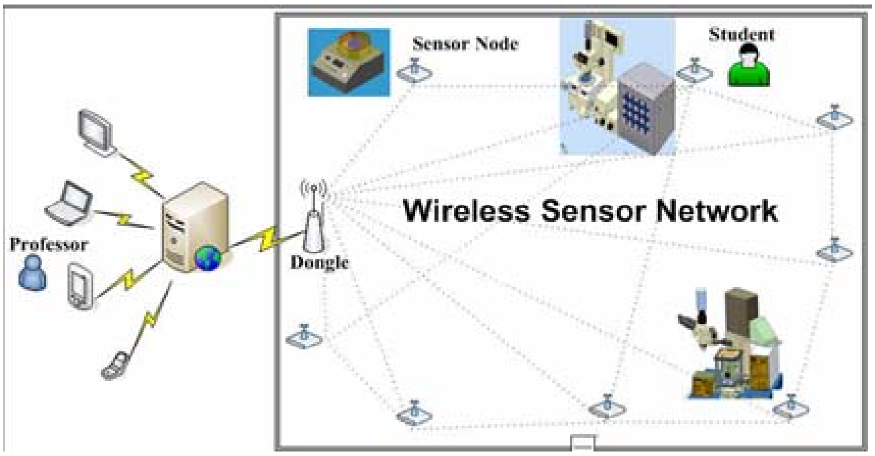

Figure 1. Architecture of the wireless sensor network system

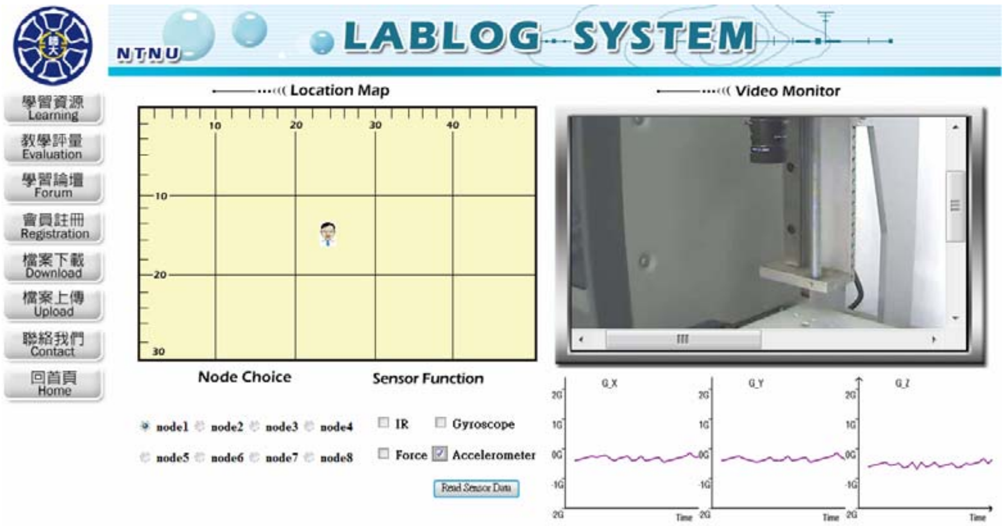

Figure 2. GUI of the wireless sensor network system at the remote client side

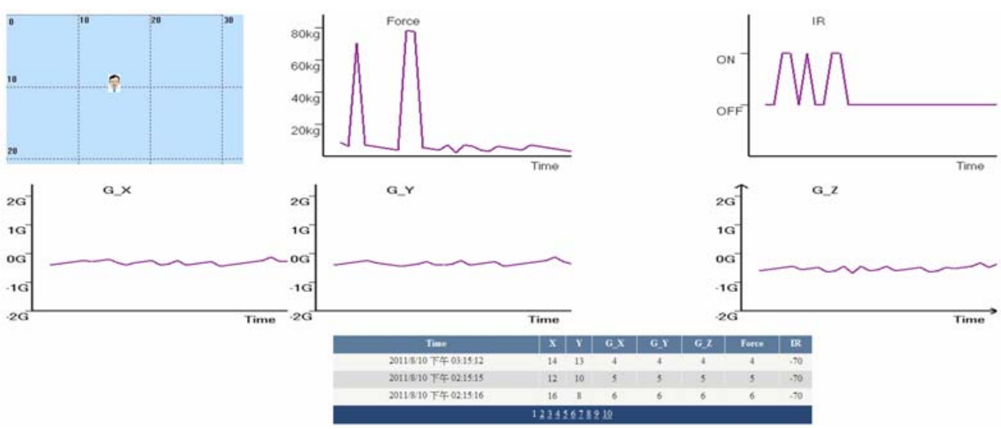

Figure 3. Real time monitoring of force and IR sensors at the remote client side

RESEARCH PURPOSE

The objectives of this study are as follows:

1. Investigating the influence of a web-based self-reflective learning system on student learning performance and technical micro-fabrication Technology skills.
2. Investigating the influence of a web-based self-reflective learning system on student satisfaction of micro-fabrication technology learning activities.

Based on the preceding research motives and research purposes, this study formulated the following hypotheses:

Research Hypothesis 1-1: Students' micro-fabrication Technology cognitive aptitude test scores before and after experiencing the web-based self-reflective learning system demonstrate no significant differences.

Research Hypothesis 1-2: The micro-fabrication Technology technical skills test scores from different raters after implementation of the web-based self-reflective learning system show no significant differences.

Research Methods and Instruments

The study population is comprised of students taking courses in micro-fabrication technology; the sample size was 54 students. The curriculum contains a series of formal lectures and laboratory sessions. Besides the scientific fundamentals and the technical subjects presented in the classroom, the students were required to complete practical work that is basing on problem-based learning (PBL) approaches, and assignments as such aim to increase the theoretical understanding of the subjects presented and the development of practical micro-fabrication and micro-packaging skills.

The experimental tools used during this study include a Cognitive Aptitude Test, a Learning Satisfaction Survey, and a Technical Skills Indicator. Following revision and correction, the Cognitive Aptitude Test had 50 multiple-choice questions. The passing mean and discrimination percentage were 0.58 and 0.35, respectively, demonstrating it to be a reasonable test with a good passing and discrimination percentage. According to the reliability analysis of the study, the Cronbach's alpha value of internal consistency was 0.786. Furthermore, the criterion validity was based on a significantly positive correlation between the semiconductor assembly and the packaging test scores of several comprehensive and technological universities. As a result, the cognitive aptitude test had good reliability and validity.

In addition, the satisfaction survey for this study was based upon a Likert-type five-measurement scale. By administering a pre-test satisfaction survey, this study had participants answer questions regarding observations and thoughts, and then analyzed each question's effectiveness and reliability according to the received result. Following evaluation of the survey's effectiveness and reliability, the questions were carefully revised and edited to produce the final and official questionnaire.

To better understand the technical skills of students, this research developed a technical skills indicator based on E. J. Simpson's Seven Levels of Taxonomy, and to avoid subjective judgment, the teaching assistants joined the researchers in monitoring and evaluating the testing groups during the examinations. Upon reviewing the results using Spearman's Rho rank order correlation, the correlation coefficient was 0.889, indicating that the researchers' and the teaching assistants' evaluations were consistent.

DATA COLLECTION AND DISCUSSION

The data collected in this study include the scores from the two cognitive aptitude tests, the learning satisfaction questionnaires of technical activities, and the technical skills tests. The adopted methods for statistical analysis were mean, standard deviation, and a t-test, conducted using SPSS12.0.

This study examined the relations between pre-course cognition, post-course cognition, satisfaction, and the technical skills test. Pearson's correlation coefficient was applied to investigate the correlation and strength among the variables. As shown in Table 1, significant linear correlation exists between pre-course cognition and post-course cognition ($r = 0.812$), between post-course cognition and the technical skills test ($r = 0.320$), between satisfaction and pre-course cognition ($r = 0.657$), and between satisfaction and post-course cognition ($r = 0.604$). The correlations are all positive, indicating that: 1) pre-course cognition is proportionate to post-course cognition; 2) higher scores in the technical skills test represent greater post-course cognition; and 3) satisfaction is greater in students with higher pre-course cognition or post-course cognition.

Table 1: Summary of correlation analysis

Item	Pre-course Cognition	Post-course Cognition	Technical Skills Test
Pre-course Cognition			
Post-course Cognition	.812**		
Technical Skills Test	.137	.320*	
Satisfaction	-0.061	-0.151	-0.031

**p*<.05; **p<.01

This study adopted an independent t-test to determine whether significant differences exist between students with higher and lower learning achievement. Students scoring in the top 27 % in pre-course cognition were in the high achievement group, while the bottom 27 % comprised the low achievement group, and the statistics from these two groups were compared. As indicated in Table 2, a t-test presented significant difference (p<.05) between the high and the low achievement groups in the pre-course cognition test, indicating a difference between the two groups in pre-course cognition. In post-course cognition, a t-test also showed a significant difference (p<.05) between the two groups. In terms of progress, the difference between the two groups was also significant (p<.05); the margin of progress was greater in the low achievement group than in the high achievement group. The above results indicate that receiving web-based self-reflective learning causes the learning cognition of students to differ.

Table 2: Comparison of t-test results for course cognition of high and low achievement groups

Group	Low Achievement Group (n = 16)		High Achievement Group (n = 18)		*p*	t
	Mean	SD	Mean	SD		
Pre-course Cognition	44.50	11.74	68.00	3.43	.000**	-7.72
Post-course Cognition	54.38	12.48	71.78	5.69	.000**	-5.12
Improvement Score	9.88	6.55	3.78	5.04	.004**	3.06

**p*<.05; **<.01

Table 3 presents the t-test results for technical skills in the two groups of students. Excluding the perception and set constructs, the t-tests produced statistically significant results (p<.05), indicating that considerable differences exist in the technical skills test of both groups. The total score of the technical skills test was derived by summing up the mean number of times in the achieved items of each construct, and that sum was then converted to a percentage. Analysis revealed that the majority of the constructs reached significance (p<.05), indicating considerable differences being in existence in the technical skills of students in the high and low achievement groups upon receiving web-based self-reflective learning.

Table 3: U test results for the technical skills test scores of high and low achievement groups

Group	Low Achievement Group (n = 16)		High Achievement Group (n = 18)		*p*	*U*
	Mean	SD	Mean	SD		
Perception	2.00	0.00	2.00	0.00	1.000	352.0
Set	5.88	0.34	5.83	0.38	.081	291.0
Guided Response	7.25	2.08	8.06	1.63	.001**	175.0
Mechanism	12.94	3.21	13.67	3.36	.000**	149.5
Complex Overt Response	8.19	2.61	8.72	2.89	.022*	226.0
Adaptation	2.50	0.73	2.72	0.75	.000**	122.0
Origination	2.06	1.06	2.28	1.41	.049*	244.5
Total Score	62.19	11.71	64.86	12.73	.002**	174.5

**p*<.05; **<.01

According to the data analysis shown in Table 3, a radar chart was created for the percentages converted from the sums of the mean number of times in the achieved items of each construct. Figure 4 exhibits the overall learning performance of both groups of students for each technical skill. Using weighted calculation, the mean comprehensive ability values were derived; these were 1.53 and 1.43 for the high and low achievement groups, respectively. As indicated by the values, the mean comprehensive abilities of both groups of students differ significantly after employing the web-based self-reflection learning system. This result corresponds with that of Table 3. The web-based self-reflection learning system effectively improves the learning performance of students falling behind, enabling the students that are struggling to catch up. Regarding satisfaction, a t-test revealed no significant differences (p>.05) in both groups as shown in Table 4.

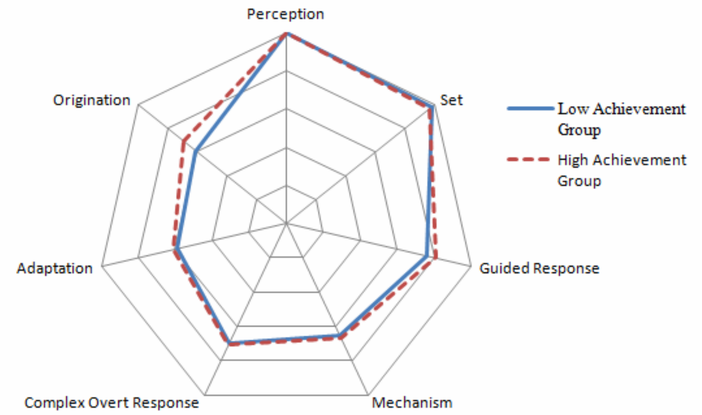

Figure 4. Comparison of Radar Charts for the Technical Skills of Students in the High and Low Achievement Groups

Table 4: T-test results for satisfaction of high and low achievement groups

Group	Low Achievement Group (n = 16)		High Achievement Group (n = 18)		*p*	t
	Mean	SD	Mean	SD		
Satisfaction	4.14	0.59	4.24	0.57	0.623	-.497

**p*<.05

STUDY LIMITATIONS

The sensors developed in this study were experimental. One study limitation was that the large sensor size reduced the wearabilty for students. However, this issue will be resolved with future progress in electronics designed to be flexible; sensors may become soft and small like a piece of cloth, which students will barely notice when using. Another limitation of this study was that the precision of the sensor network system's indoor positioning was approximately one meter. Though this affected the positioning of students within the test room, it did not affect the sensing and measurement of data while students operated equipment.

CONCLUSIONS

Practical training is an important teaching strategy to improve students' industrial technology competence. To overcome the obstacles of traditional experiments and practical training courses, and to enhance current e-learning system functions, this study used sensor network technology as the foundation for developing a self-reflective learning system. The system presents with the teachers the students' operational results immediately, thereby enabling appropriate guidance when the students encounter problems during experiments and practical training. Moreover, because this system can record the students' learning processes during experiments and practical training -- where the data can be used to identify the students' learning difficulties -- the teachers are aware of the problems encountered by students during the practice process and can guide students to avoid repeating mistakes, even when practicing in a clean factory room. According to related data, a web-based self-reflective learning system may effectively improve the learning performance of those students who are falling behind, enabling them to catch up by the end of the semester.

ACKNOWLEDGMENT

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REFERENCES

Akyildiz, I.F., Su, W., Sankarasubramaniam, Y., and Cayirci, E., (2002). A survey on sensor networks. *IEEE Communications Magazine*, 40(8), 102-114.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. Cambridge, UK: Cambridge University Press.

Chang, C.-C. (2008). Enhancing self-perceived effects using Web-based portfolio assessment. *Computers in Human Behavior*, 24(3), 1753-1771.

Chang, C. S., Liu, E. Z. F., Lee, C. Y., Chen, N. S., Hu, D. C., & Lin, C. H. (2011). Developing and validating a media literacy self-evaluation scale (MLSS) for elementary school students. *Turkish Online Journal of Educational Technology*, 10(2), 63-71.

Costa, A. L., & Kallick, B. (2000). *Assessing and reporting on habits of mind*. Alexandria, VA: Association for Supervision and Curriculum Development.

Davis, E. A. (2000). Scaffolding students knowledge integration: Prompts for reflection in KIE. *International Journal of Science Education*, 22(8), 819-837.

Dewey, J. (1933). How we think: A restatement of the relations of reflective thinking to the educative process (2nd rev. ed.). Boston, MA: D. C. Heath.

Dong, M., Tong, L., and Sadler, B.M., (2007). Information Retrieval and Processing in Sensor Networks: Deterministic Scheduling Versus Random Access. *IEEE Transactions on Signal Processing*, 55(12), 5806-5820.

Elliott, J. (1991). *Action Research for Education Change*. Philadelphia: Open University Press.

Kemmis, S. (1985). *Action research and the politics of reflection*. In D. Bound, R. Keough, and D. Walker (Eds.). Reflection: Turning experience into learning. London: Kogan Page.

Liu, E. Z. F., & Lin, C. H. (2010). The survey study of mathematics motivated strategies for learning questionnaire (MMSLQ) for grade 10–12 Taiwanese students. *Turkish Online Journal of Educational Technology*, 9(2), 221-233.

Paris,S.G. & Ayres,L.R. (1994) . *Becoming Reflective Students and Teaching*. American Psychological Association.

Schon, D. (1983) . *The reflective practitioner*. NY: Basic Book.

Shyr, W.J. (2011). Development and Evaluation of Mechatronics Learning System in a Web-based Environment. *Turkish Online Journal of Educational Technology*, 10(1), 89-96.

Tubaishat, M. and Madria, S., (2003). Sensor networks: An overview. *IEEE Potentials*, 22(2), 20-23.

Younes, M. (2004). Web-based student portfolio system at AAWC. Paper presented at the 2004 HCT Annual Conference Workshops, Arabian, Dubai.

THE DYNAMICS OF MOTIVATION AND LEARNING STRATEGY IN A CREATIVITY-SUPPORTING LEARNING ENVIRONMENT IN HIGHER EDUCATION

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ABSTRACT
The purpose of the study was to model the processes involved in the development of creativity and discuss how motivation and teaching strategies figure into a creativity-supportive learning environment. The subjects included 28 college students enrolled in an Introduction to Instructional Media course. A questionnaire and interviews were used for the collection of data. Over the course of the semester, the students were tasked with making a "creative multimedia video website". The results of the study reveal that the motivation of students in areas such as task value and self-efficacy were enhanced by this exercise. Moreover, this study developed effective strategies for the promotion of creativity and the enhancement of high-level meta-cognitive processes.
Keywords: creativity, creativity learning strategy, high-level meta-cognitive process, creative multimedia video, MSLQ

INTRODUCTION
Many researchers have reached the theoretical conclusion that intrinsic motivation is positively related to creativity (Sternberg & Lubart, 1991; Woodman & Schoenfeldt, 1990), and empirical studies have supported this contention (Torrance, 1987). While engaged in the creative process, students become the centre of learning in which an understanding of the goal of innovative thinking and the prerequisites for creativity are essential. Students must also learn how to use a variety of learning strategies and resources in order to conceive of innovative notions or implement them in an innovative manner. Various technologies have been employed in the field of education to enhance learning (Chang & Lee, 2010; Chen, Liu, Shih, Wu, & Yuan, 2011; Feng, Lin, & Liu, 2011; Hassan, Ismail, & Mustapha, 2010; Jou, Chuang, & Wu, 2010; Liu, 2010; Liu, 2011; Liu & Chang, 2010; Liu & Lin, 2009; Liu, Lin, & Chang, 2010; Miller & Robertson, 2010; Nuutinen, Sutinen, Botha, & Kommers, 2010; Tsai, Chen, & Chen, 2010; Wang, Shen, Novak, & Pan, 2009), and it is now common for students to express their creativity through various media, indicating the inherent creative potential of all students (Lin, Liu, Kou, Virnes, Sutinen, et al., 2009).

CREATIVE PROCESS
From the perspective of the creative process, many researchers have emphasised that engagement in creative activities is meaningful, and regardless of whether the resulting products are innovative, useful, or creative, the entire process influences outcomes and improves individual performance (Drazin, Glynn, & Kazanijan, 1999). Many researchers have investigated human creativity from the cognitive psychological perspective. Kaufman and Baer (2002) used self-report and case study methods to investigate creativity, concluding that cognitive

mechanisms related to creativity are domain specific. Some researchers have investigated how one's mindset influences creative performance. For instance, Kray, Galinsky, and Wong (2006) found that a counterfactual mindset can impair the generation of novel ideas but can be beneficial to the performance of creative association tasks (Kray, Galinsky, & Wong, 2006). In addition, Miller (2007) and Necka (1999) indicated that a number of personal characteristics, such as field independence or a problem-solving style, are important dimensions influencing creative performance. Necka (1999) studied the relationship between attention and creativity and found evidence to support a link between creativity and a defective attentional filter. Scott, Lonergan, and Mumford (2005) investigated the influence of analogical and case-based approaches on the generation of new combinations. Researchers have also discussed creativity as it pertains to various dimensions of cognitive psychology (Hennessey & Amabile, 2009).

Creative behaviour has been seen as the performance of the creative process. The period of creative behaviour is believed to begin with the arousal of motivation and end with the finished product (Lubart, 2001). In other words, creative behaviour includes all of an individual's intrinsic and outwardly directed behaviours performed during the process of creative thinking.

MOTIVATION AND LEARNING STRATEGIES IN THE CREATIVE PROCESS

Amabile (1996) stressed that intrinsic motivation is essential for creative performance and has the power to propel a person in the pursuit of unachieved goals throughout the creative process. The period of creative behaviour is believed to begin with the arousal of motivation and end with the finished product (Campbell, 2007; Harris, 1998; Lubart, 2001). In other words, creative behaviour includes all of an individual's intrinsic and outwardly directed behaviours performed during the process of creative thinking. Torrance (1988) concluded that problems confirming and formulating hypotheses, discussions with others, and contradicting what is normally expected were stressed during the creative process. Joy (2004) discussed creative behaviour within the framework of social learning theory, in which human creative behaviour is believed to be influenced by expectancy and need value. Ford (1996) considered motivation, including expectations and emotion, to be an important factor influencing the creative actions of individuals. Moreover, domain-related skills were seen as the basis of creative performance, related to the domain-specific characteristics of given tasks.

LEARNING ENVIRONMENT FOR CREATIVITY LEARNING

A number of studies have indicated that interacting with the learning environment influences creative behaviour (Csikzentmihalyi, 1999; Sternberg, 2006). The decision to undertake tasks is based on the presence or absence of salient constraints in the social environment, which decreases individual intrinsic motivation, and in so doing detracts from creativity (Joy, 2004). Individual expectancy and need value influence creative performance (Joy, 2004; Zimmerman, 1989), and reinforcement from the environment encourages individuals to seek alternative strategies to overcome difficulties (Rotter, 1975). The model proposed in this study was designed to facilitate an examination of the effects of a creative environment on learner motivation and learning strategies. Our model enabled us to examine how learner motivation and learning strategies varied within the creative learning environment developed for this study.

RESEARCH QUESTIONS

Several studies in Taiwan have employed experimental designs using single data collection methods to investigate issues related to creativity (Tsai, Ting, & Kao, 1989; Wang & Horng, 2002). Although an increasing number of recent studies have used non-experimental methods to investigate learner creativity, the relationship between motivation and learning strategies remains unclear. Most studies have investigated changes in learning motivation and strategy within a creativity-supporting learning context and collected data at multiple points in time.

The four research questions addressed in this study are listed below.

1. In the creative process, what are the patterns of change in learner motivation and creative learning strategies?
2. Which factors related to learner motivation and creative learning strategies changed between the beginning of the semester and the middle of the semester?
3. Which factors related to learner motivation and creative learning strategies changed between the middle of the semester and the end of the semester?
4. Which factors related to learner motivation and creative learning strategies changed between the beginning of the semester and the end of the semester?

METHODS

Participants

A total of 28 students enrolled in the Introduction and Application of Instructional Media course at a university in northern Taiwan participated in the study. Of these, 11 were graduate students (39%) and 17 were undergraduate students (61%). Among the 28 students, 12 were male (43%), and 16 were female (57%). In addition, 15 students were from the college of science (54%), and 13 students were from the college of liberal arts (46%). When grouped according to technical ability, 5 students (17%) had course-related experience in the use of video editing software, whereas 23 students (83%) had no such experience. Similarly, 6 students (21%) were familiar with web page building, while 22 students (79%) were not familiar with the technology. Although a number of the students were familiar with video editing software (such as PowerDirector, VCD Cutter, and Windows Movie Maker) and web page building software (such as FrontPage and Dreamweaver), none of the students had any experience with the software taught in the course (web page building software: Namo Web Editor 5.5; video editing software: VideoStudio). The researchers performed participative observation, and at the end of semester, randomly interviewed 20 students to collect information related to creative learning.

Instrument

The aim of this study was to investigate how student motivation and learning strategies change throughout the creative process. The Motivated Strategies for Learning Questionnaire (MSLQ), developed by Pintrich, Smith, Garcia, and McKeachie (1991), has been applied in many disciplines (Liu & Lin, 2010). In this study the MSLQ was adapted to examine learner motivation and creative learning strategies in a creative learning environment in which learners were assigned creative tasks to complete. The MSLQ comprised 35 items in total, which were rated on a six-point Likert scale with 1 = strongly disagree to 6 = strongly agree. In the motivation subscale, three factors were included: intrinsic motivation (3 items), task value (6 items), and self-efficacy (7 items). In the learning strategies subscale, five factors were included: rehearsal (2 items), elaboration (5 items), organization (2 items), critical thinking (4 items), and self-regulation (6 items). The results of reliability analysis indicate that the values of the Cronbach’s Alpha for all factors were higher than .70, demonstrating the good reliability of the questionnaire (Table 1).

Table 1. Reliability Analysis of Motivated Strategies for Creative Learning Questionnaire

	Factor	Items	Alpha
Motivation subscale	Intrinsic goal orientation	3	0.83
	Task value	6	0.76
	Self-efficacy	7	0.91
Strategy subscale	Rehearsal	2	0.77
	Elaboration	5	0.85
	Organization	2	0.70
	Critical thinking	4	0.77
	Self-regulation	6	0.84

Course design

The objective of the course, Introduction and Application of Instructional Media, was to provide students with experience in the creation of an impressive multimedia video while collaborating with others. The most important element of instruction is to promote the learning process (Hou, 2010; Isman, 2011; Shieh, Chang, & Liu, 2011). Therefore, the course-related tasks required that students describe the creative process they follow when they present their mid-term reports, and to post their thoughts on a discussion forum. Prior to the course, the syllabus was thoroughly reviewed by one instructor and one teaching assistant. During the semester, the instructor was responsible for instruction, while the teaching assistant helped to monitor learning. During the course, documents and information, such as personal reflection journals, records of group discussions, and multimedia videos, were recorded in the discussion forum as student learning portfolios. The instructor and the teaching assistant monitored the discussions of different groups and provided suggestions.

Cole, Sugioka, and Yamagata-Lynch (1999) studied supportive environments for creativity in higher education with a focus on the role of the instructor. They found that strategies, such as remembering every student’s name and calling the students by their names would make students more comfortable with the instructor and more willing to share their thoughts and innovative ideas within the enjoyable atmosphere. Therefore, the strategy the instructor and the teaching assistant employed in this course was to remember all of the students’ names. Moreover, the instructor and the teaching assistant interacted with students in the discussion forum outside of class time. It was hoped that these strategies would give the students greater confidence in developing their own innovative ideas and products, and that this confidence would be less contingent on the comments of others regarding their work.

The tasks designed in this course provided students with the opportunity to express their creativity. The creative tasks had two characteristics: fuzzy structure and open-endedness. The theme and direction of the tasks were not limited; students were permitted to select any topic for their midterm video, incorporate related resources, and edit their video as they saw fit. For the final assignment, the students were required to make a website with an instructional video, but the students were free to select a topic that they were interested in.

RESULTS

In the creative process, how did learning motivation and creative learning strategies change over time?

From the beginning to the middle of the semester, the mean scores on the two factors constituting creative motivation: Task value (t=2.71, p<.05) and self-efficacy (t=2.18, p<.05), improved significantly. This demonstrates that during that period, student expectations concerning task value and self-efficacy in producing a multimedia video were enhanced, and that students believed themselves capable of producing creative works (Table 2). The effect size of the factors of task value and belief in self-efficacy were moderate. Although the factor of intrinsic goal orientation did not show a significant change over time, the effect size of the factor was small, indicating that students' intrinsic goal orientation changed only slightly. In the dimension of learning strategies, the factor of elaboration did not change significantly over time and the effect size was only trivial or small.

Table 2. Comparisons between Pre-Test and Middle-Test

Factors	Pre-test		Middle-test		df	t	Effect size[a]
	M1	SD1	M2	SD2			
Intrinsic goal orientation	4.37	0.76	4.56	0.69	27	1.23	0.37
Task value	4.51	0.48	4.78	0.50	27	2.71*	0.78
Self-efficacy	3.91	0.63	4.16	0.51	27	2.18*	0.62
Rehearsal	4.27	0.65	4.19	0.68	27	-0.46	-0.17
Elaboration	4.30	0.58	4.42	0.55	27	1.31	0.30
Organisation	4.31	0.57	4.35	0.76	27	0.24	0.08
Critical thinking	4.44	0.63	4.45	0.59	27	0.08	0.02
Self-regulation	4.35	0.52	4.42	0.53	27	0.67	0.19

Note: *p<.05[a] (M2-M1)/(sqrt(SD_1^2+ SD_2^2)/2)

The mid-term task was to edit multimedia videos. During this process, the students considered how the task was important to them. The characteristics of motivation influenced the process, and the students appreciated being able to select a topic of personal interest. In this stage, students identified the value of the assignment and, after confirming the meaning of the task for themselves, engaged in the creative activity with greater commitment, became more interested in the task, and valued their work more highly:

> *I felt good because I felt that I was a director, and I could express my ideas freely. For example, I put my mid-term work on the website of a baseball team, and some viewers felt touched, and some felt amused, and some even said they awaited my follow-up work. I felt fulfilled. Because I spent lots of time and energy to complete the work, I also wrote many pages for the reflection journal. (Stu_C)*

> *I edited a video to record my memories in Australia. It was an unforgettable experience and I will treasure the work. (Stu_G)*

The improvement in self-efficacy was associated mainly with the skills involved in the use of video-editing software and with the students' belief in their own ability to complete the work. Students also indicated an awareness of the defects in their work, how to make improvements, and a willingness to do so. Thus, in the first half of the semester, the self-efficacy of the students showed improvement.

> *Actually, I believed that I was equipped with high-level skills; however, because of the limitation of the resources, the final product was different from the idea I generated at the beginning. The resolution of the video received my highest appraisal because I cared about the quality of the frames, and I thought I would revise it continually. (Stu_A)*

> *It was important to build an environment and push us to do something we did not know or something we thought we could not accomplish. When we accomplished the task for the final, we suddenly realised that we could actually do it. (Stu_J)*

How did motivational factors and creative learning strategies change between the middle and the end of the semester?

During the period from the middle to the end of the semester, the groups produced creative multimedia videos. Group discussions were incorporated into the curriculum, and the groups filmed videos. Changes in learning motivation and learning strategies are shown in Table 3. No statistically significant change was evident between the middle- and post-tests. Factors such as intrinsic goal orientation ($t=.85$, $p>.05$), task value ($t=1.00$, $p<.05$), belief in self-efficacy ($t=1.70$, $p<.05$), organization ($t=1.08$, $p>.05$), and critical thinking ($t=1.69$, $p>.05$) showed small effect size (Table 3). In the dimension of learning strategies, the effect size of the factor of self-regulation ($t=1.62$, $p>.05$) was moderate, indicating that the students' learning strategies had perhaps changed. The results indicate that creative motivation and learning strategies did not change dramatically between the middle and the end of the semester, but self-regulation perhaps changed by a statistically insignificant degree.

Table 3. Comparisons of Middle-test and Post-test Results

Factors	Middle-test		Post-test		df	t	Effect Size
	M1	SD1	M2	SD2			
Intrinsic goal orientation	4.56	0.69	4.69	0.65	27	0.85	0.27
Task value	4.78	0.50	4.89	0.59	27	1.00	0.28
Self-efficacy	4.16	0.51	4.30	0.50	27	1.70	0.39
Rehearsal	4.19	0.68	4.27	0.67	27	0.51	0.17
Elaboration	4.51	0.65	4.50	0.61	27	-0.67	-0.02
Organisation	4.35	0.76	4.56	0.83	27	1.08	0.37
Critical thinking	4.45	0.59	4.64	0.55	27	1.69	0.47
Self-regulation	4.42	0.53	4.63	0.60	27	1.62	0.52

During the interviews, the students described how the process of producing videos led to many discussions and negotiations with group members. Students even adjusted their creative ideas based on the information received from others. Furthermore, during the discussion, each group had to provide feedback to other groups, which led to the generation of more ideas and the development of high order meta-cognitive strategies.

> *After receiving feedback from others, I would accept the feedback and try to make some adjustments; therefore, I looked forward to receiving more feedback. Reviewers should explain the reasons why they feel my work was good or bad. Just saying "good" would not make me feel happy. (Stu_J)*

> *The discussion activity was helpful for us to generate creative ideas. Through the discussion, it became possible for us to see the defects in our work, and see where it could be improved. The suggestions from other groups helped us to examine our ideas. (Stu_H)*

How did motivational factors and creative learning strategies change between the beginning and the end of the semester?

Comparing the results of the pre-test and the post-test revealed that motivation and task value ($t=2.66$, $p<.05$) changed significantly, as did self-efficacy ($t=2.93$, $p<.01$). In the dimension of learning strategies, the factor of self-regulation changed significantly (Table 4). The result was that throughout the creative process, the students gradually used more high order meta-cognitive strategies. Analysis of effect size shows that the factors of intrinsic goal orientation and self-regulation had moderate effect sizes, and the factors of task value and self-efficacy had large effect sizes (Table 4).

Table 4. Comparisons between Pre-test and Post-test

Factors	Pre-test		Post-test		df	t	Effect Size
	M	SD	M	SD			
Intrinsic goal orientation	4.37	0.76	4.69	0.65	27	1.92	0.64
Task value	4.51	0.48	4.89	0.59	27	2.66*	1.00
Self-efficacy	3.91	0.63	4.30	0.50	27	2.93**	0.97
Rehearsal	4.27	0.65	4.27	0.67	27	0.00	0.00
Elaboration	4.30	0.58	4.50	0.61	27	1.39	0.48
Organisation	4.31	0.57	4.56	0.83	27	1.26	0.50
Critical thinking	4.44	0.63	4.64	0.55	27	1.35	0.48
Self-regulation	4.35	0.52	4.63	0.60	27	2.07*	0.71

p<.05*; *p*<.01**

Figure 1 illustrates that in a creativity-supporting learning environment, self-efficacy and task value were enhanced, and students employed higher order learning strategies. From the beginning to the middle of the semester, self-efficacy and student perceptions toward the value of the tasks they were asked to perform significantly improved. From the beginning to the end of the semester, self-efficacy and task value also improved, and students tended to employ more self-regulated learning strategies.

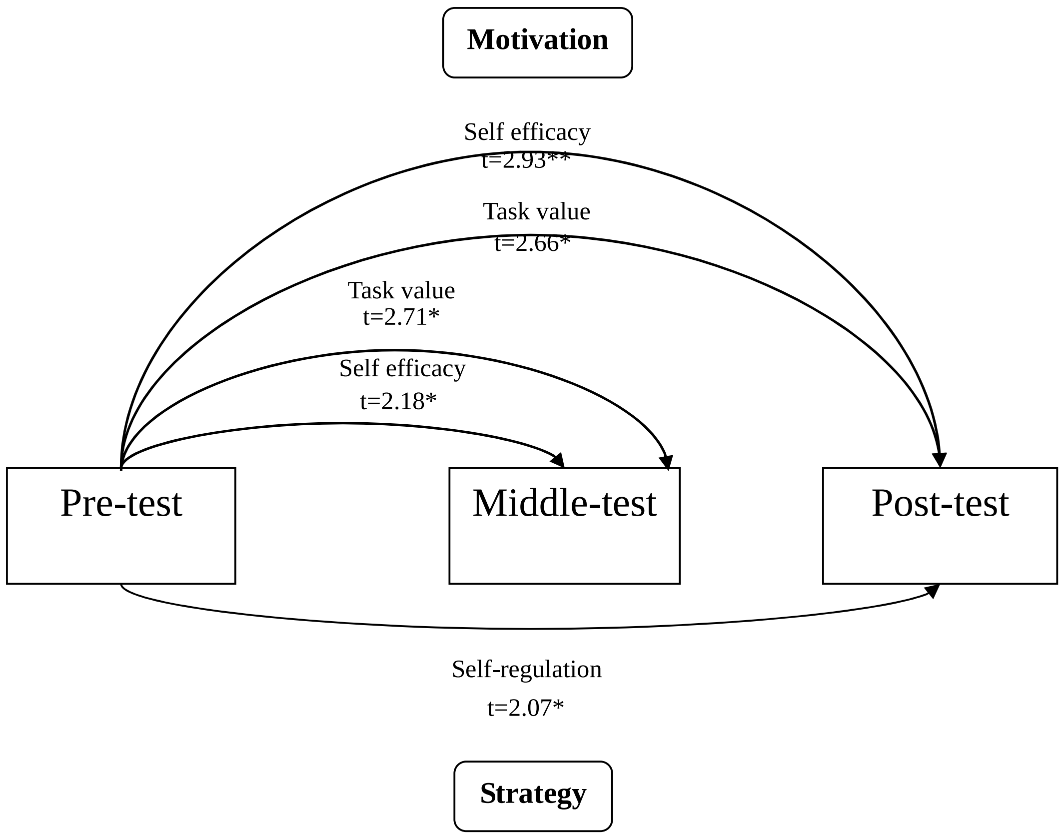

Fig. 1. Changes in Learning Motivation and Creative Learning Strategies

In the interviews, the students expressed how they sensed changes during the execution of creative tasks and how the course affected them:

> *I believe that the course influenced my creativity by helping me to implement my ideas through editing videos or building a website. The course enabled me to produce my own work and I really felt fulfilled. I got a lot from the course, and many different ideas were stirred within me. Generally, it would be impossible to discuss things with so many people in other courses. (Stu_B)*

> *I believe that this course is the most interesting course I have ever taken. Group discussion was interesting, and I felt that I could produce many creative things by being able to express my ideas freely. I was impressed by the work of others, and many different ideas were generated during the process. (Stu_J)*

CONCLUSION AND DISCUSSION

The purpose of the study was to design a suitable environment for the development of creativity and examine changes in learning motivation and learning strategies. Both qualitative and quantitative data indicate that students improved significantly with regard to task value and self-efficacy over the period of the semester. The characteristics of these changes influenced the willingness of students to engage in the creative process. During creative activities, the students continually adjusted their evaluative processes, confirmed the value of the task, saw an improvement in their self-efficacy, and adjusted the strategies they used to overcome problems. All of these changes enhanced their willingness to engage in the creative process. These finding are consistent with social learning theory (Joy, 2004), which predicts that creative behaviour is influenced by expectancy and need value.

However, in the dimension of intrinsic goal orientation, no significant change was observed over the course of the semester. The mean scores on both the pre-test and post-test were very high, indicating little variance. The high mean scores may have been due to the characteristics of tasks used to inspire the creative process. The students were strongly engaged in the tasks and enjoyed overcoming difficulties during the process of learning; thus, they showed high intrinsic goal orientation from the beginning to the end of the semester. The willingness of students to engage in the creative task and the confirmation of task value were important for maintaining student motivation to engage in the creative process.

Basic learning strategies, such as rehearsal, did not change significant between the pre-test and post-test, for which the scores were both very high. Such learning strategies are very basic; however, they are highly valuable and students commonly employ them to bolster their performance. In this study, students employed these learning strategies consistently throughout the study period; however, self-regulation strategies showed significant improvement between the pre-test and post-test. The improvement in self-efficacy was the other key element fostering changes throughout this process. The creative learning process is a dynamic cycle, and a number of studies have found that creators continually evaluate the possibility of achieving their goals, forming a cycle between problem confirmation and the achievement of goals (Amabile, 1996; Necka, 2003). If instructors paid more attention to the changes occurring in the creative process and provided timely support, students would be more willing to engage in creative activities.

For this reason, instructors should evaluate students' final products and also try to adjust students' perception of creativity as well as helping students to understand the value of the assignments and bolstering their self-efficacy. Because students tend to underestimate their creative potential, it is crucial to help students improve their self-efficacy, understand the value of the task, break through fixed thinking in a supportive environment, and reassure them that they too can be creative. An optimum course design should focus on creative tasks and provide chances for students to experience the creative learning process in which they begin with nothing and end up creating something of value, while remaining cognizant of the changes they go through during the process. Creative instruction is not only the evaluation of creative products, but also a process of self-realisation.

Learning motivation is an essential issue when designing a course (Cheng & Yeh, 2009; Liu, Kou, Lin, Cheng & Chen, 2008; Liu & Lin, 2009). This study provides some principles for designing a course that supports creative learning to enhance learning motivation and learning strategies. First, it is important to develop an enjoyable atmosphere for students, which enhances the relationship between teacher and students (Cole, Sugioka, & Yamagata-Lynch, 1999). It could also encourage students to share creative ideas. One of the strategies we used was to learn all of the students' names to ensure that students become more comfortable with their partners and instructor, which is beneficial for students in the development of confidence and in the sharing of ideas.

Second, learning activities and creative tasks should include two characteristics: a fuzzy structure and open-endedness. The task should also allow students to employ various strategies to achieve the goal. The instructor could also provide students the opportunity to select the kind of task that they would like to complete. During the selection process, students would have to evaluate their own abilities and expectations and select strategies suitable for completion of the task. These meta-cognitive processes would enhance self-regulated learning. Furthermore, providing students the opportunity to choose their task could improve their recognition of task value and encourage them to engage more in the task.

Third, it is important for students to confirm and improve their basic creative skills (Amabile, 1996). These skills influence the generation of creative ideas as well as the discussion of creative ideas. Before assigning the task, the instructor should provide some training and help to develop and evaluate the students' basic skills in creativity. When students are equipped suitable skills, they generally demonstrate more confidence in their ability to complete the task and are more willing to share their ideas with others.

In this study, we developed a creative learning environment, examined the changes in learning motivation and learning strategies, and provided principles for developing a creative learning environment. Future studies could examine the relationship between learning motivation and learning strategies under a creative learning environment.

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REFERENCES
Amabile, T. M. (1996). *Creativity in the context*. NY: Springer-Verlag.
Campbell, M. M. (2007). Motivational systems theory and the academic performance of college students. *Journal of College Teaching & Learning, 4*(7), 11-24.
Chang, C. Y., & Lee, G. (2010). A major e-learning project to renovate science leaning environment in Taiwan. *Turkish Online Journal of Educational Technology, 9*(1), 7-12.
Chen, Y. L., Liu, E. Z. F., Shih, R. C., Wu, C. T., & Yuan, S. M. (2011). Use of peer feedback to enhance elementary students' writing through blogging. *British Journal of Educational Technology, 42*(1), E1-E4.
Cole, D. G., Sugioka, H. L., & Yamagata-Lynch, L. C. (1999). Supportive classroom environments for creativity in higher education. *Journal of Creative Behavior, 33*(4), 277-293.
Csikszentmihalyi, M. (1999). Implications of a systems perspective. In R. J. Sternberg (Ed.), *The handbook of creativity* (pp. 297-312). NY: Cambridge University Press.
Drazin, R., Glynn, M. A., & Kazanjian, R. K. (1999). Multilevel theorizing about creativity in organizations: A sense making perspective. *Academy of Management, 24*, 286 -307.
Feng, H. C., Lin, C. H., & Liu, E. Z. F. (2011). Parents' perceptions of educational programmable bricks for kids. *British Journal of Educational Technology, 42*(2), E30-E33.
Ford, C. M. (1996). A theory of individual creative action in multiple social domains. *The Academy of Management Review, 21*(4), 1112-1142.
Harris, R. (1998). *Introduction to creative thinking*. Retrieved January 31, 2010, from, http://www.virtualsalt.com/crebook1.htm.
Hassan, I. S., Ismail, M. A., & Mustapha, R. (2010). The effects of integrating mobile and CAD technology in teaching design process for Malaysian polytechnic architecture student in producing creative product. *Turkish Online Journal of Educational Technology, 9*(4), 162-172.
Hennessey, B. A., & Amabile, T. M. (2010). Creativity. *Annual Review of Psychology, 61*, 569-598.
Hou, H. T. (2010). Exploring the behavioural patterns in project-based learning with online discussion: quantitative content analysis and progressive sequential analysis. *Turkish Online Journal of Educational Technology*, 9(3), 52-60.
Isman, A. (2011). Instructional design in education: New model. *Turkish Online Journal of Educational Technology, 10*(1), 136-142.
Jou, M., Chuang, C. P., & Wu, Y. S. (2010). Creating interactive web-based environments to scaffold creative reasoning and meaningful learning: From physics to products. *Turkish Online Journal of Educational Technology, 9*(4), 49-57.
Joy, S. (2004). Innovation motivation: The need to be different. *Creative Research Journal, 16*(2), 313-330.
Kaufman, J. C., & Baer, J. (2002). Could Steven Spielberg manage the Yankee? Creative thinking in different domains. *Korean Journal of Problem Solving, 12*, 5-14.
Kray, L. J., Galinsky, A. D., & Wong, E. M. (2006). Thinking within the box: The relational processing style elicited by counterfactual mind-sets. *Journal of Personal Social Psychology, 91*, 33-48.
Lin, C. H., Liu, E. Z. F., Kou, C. H., Virnes, M., Sutinen, E., & Cheng, S. S. (2009). A case analysis of creative spiral instruction model and students' creative problem solving performance in a LEGO robotics course. *Lecture Notes in Computer Science, 5670*, 501-505.
Liu, E. Z. F. (2010). Early adolescents' perceptions of educational robots and learning of robotics. *British Journal of Educational Technology, 41*(3), E44-E47.
Liu, E. Z. F. (2011). Avoiding internet addiction when integrating digital games into teaching. *Social Behavior and Personality, 39*(10), 1325-1336.
Liu, E. Z. F., & Chang, Y. F. (2010). Gender differences in usage, satisfaction, self-efficacy, and performance of blogging. *British Journal of Educational Technology, 41*(3), E39-E43.
Liu, E. Z. F., & Lin, C. H. (2009). Developing evaluative indicators for educational computer games. *British Journal of Educational Technology, 40*(1), 174-178.
Liu, E. Z. F., & Lin, C. H. (2010). The survey study of mathematics motivated strategies for learning questionnaire (MMSLQ) for grade 10–12 Taiwanese students. *Turkish Online Journal of Educational Technology, 9*(2), 221-233.
Liu, E. Z. F., Lin, C. H., & Chang, C. S. (2010). Student satisfaction and self-efficacy in a cooperative robotics course. *Social Behavior and Personality, 38*(8), 1135-1146.
Lubart, T. I. (2001). Models of the creative process: Past, present and future. *Creativity Research Journal, 13*(3), 295-308.
Miller, A. L. (2007). Creativity and cognitive style: The relationship between field-dependence-independence,

expected evaluation, and creative performance. *Psychology of Aesthetics, Creativity, and the Arts, 1*(4), 243-246.

Miller, D. J., & Robertson, D. P. (2010). Using a games console in the primary classroom: Effects of 'brain training' programme on computation and self-esteem. *British Journal of Educational Technology, 41*(2), 242-255.

Necka, E. (1999). Creativity and attention. *Polish Psychological Bulletin, 30*(2), 85-97.

Necka, E. (2003).Creative interaction: A conceptual schema for the process of producing ideas and judging he outcomes. In M. A. Runco (Ed.), *Critical creative processes* (pp.115-127). New Jersey: Hampton press

Nuutinen, J., Sutinen, E., Botha, A., & Kommers, P. (2010). From mindtools to social mindtools: Collaborative writing with woven stories. *British Journal of Educational Technology, 41*(5), 753-775.

Pintrich, P. R., Smith, D .A. F., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the motivated strategies for learning questionnaire (MSLQ)*. National center for research to improve postsecondary teaching and learning, University of Michigan, Ann Arbor, MI.

Rotter, J. B. (1975). Some problems and misconceptions related to the construct of internal vs. external control of reinforcement. *Journal of Consulting and Clinical Psychology, 43*, 56-67.

Scott, G. M., Longergan, D. C., & Mumford, M. D. (2005). Conceptual combination: Alternative knowledge structures, alternative heuristics. *Creativity Research Journal, 17*(1), 79-98.

Shieh, R. S., Chang, S. L., & Liu, E. Z. F. (2011). A case study of low-status women's attitudes towards computers. *Educational Studies, 37*(2), 233-243.

Sternberg, R. J. (2006). The nature of creativity. *Creativity Research Journal*, *18*(1), 87-98.

Sternberg, R. J., & Lubart, T. I. (1991). An investment of creativity and its development. *Human Development, 34*, 1-31.

Torrance, E. P. (1987). Future career image as a predictor of creative achievement in the 22-year longitudinal study. *Psychological Reports, 60*, 574.

Torrance, E. P. (1988). The nature of creativity as manifest in its testing. In R. J. Sternberg (Ed.), *The nature of creativity* (pp.43-75). NY: Cambridge University.

Tsai, C. C., Chen, N. S., & Chen, G. D. (2010). The current status and future of e-learning in Taiwan. *Innovations in Education and Teaching International*, 47, 5-7.

Tsai, C. T., Ting, S. S., & Kao, C. F. (1989). Need for cognition, brainstorming and individual creativity. *Chinese Journal of Psychology, 31*(2), 107-117.

Wang, C. W., & Horng, R. Y. (2002). The effects of creative problem solving training on creativity, cognitive type and R & D performance. *R & D Management, 32*(1), 35-45.

Wang, M., Shen, R., Novak, D., & Pan, X. (2009). The impact of mobile learning on students' learning behaviours and performance: Report from a large blended classroom. *British Journal of Educational Technology, 40*(4), 673-695.

Woodman, R. W., & Schoenfeldt, L. F. (1990). An interactionist model of creative behavior. *Journal of Creative Behavior, 24*, 279-290.

THE EFFECTS OF USING LEARNING OBJECTS IN TWO DIFFERENT SETTINGS

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ABSTRACT
The study compared the effects of Learning Objects (LOs) within different applications; in classroom and in extracurricular activities. So in this study, firstly a Learning Object Repository (LOR) has been designed in parallel with 9th grade school mathematics curriculum. One of the two treatment groups was named as "classroom group" (n=24) used LOs with the guidance of the teacher during lessons in a computer lab, another group named as "project group" (n=26) used LOs at home with the aim of preparing projects and assignments. Students in both groups used LOs during 11 weeks. A pre-test and post-test quasi-experimental design was used. Test results are compared in different learning domains (sets, numbers, relations and functions). In addition the interviews with the teacher and the observations inside the class were taken into account for revealing the reasons about the change on academic achievements. The results of the study about students' academic achievements showed that; LOs use in classroom activities were more effective than LOs use in extracurricular activities if sets, numbers, relations, functions and operations domains are considered together. Nevertheless this study supported the idea of "LOs can be used in both in classroom activities and in extracurricular activities".
Keywords: Learning objects, High school mathematics, Mathematics curriculum, Web based learning

INTRODUCTION
Web services facilitate transmission of the information through internet. This transmission supported learning environments to be developed rapidly. The last few years, worldwide interest about web based learning has been tended to LOs. As indicated in the term; instead of the word "material", "object" is used to impress on the real potential of this approach. Although LOs have not had a long history, the researchers have made many different definitions about LOs. For instance, LOs are defined as discrete chunks of reusable materials or activities that can be come together with other LOs to construct learning contents (Koppi et al., 2005). Despite the fact that there has been no definition universally agreed on yet, some common opinions have been put forward about LOs like; "LOs can be united in order to be used in different areas, can be reused, and can be arranged easily". So, LOs can be designed to support exploration, investigation, constructing solution by manipulating content or parameters. Student with different learning needs may also benefit from LOs like doing homework, reviewing subjects or making projects.

It is possible to organize reusable learning environments by using LOs on web. Longmire (2000) has stated that it is necessary for the object to be arranged as a part of a learning content (topic or lesson) which is greater than itself or to be used as meaningful learning source on its own in order for the learning contents prepared on web to be reused. This makes traditional instruction methods to be re-designed with the aim of being used on web environment for the web based courses (Hamel & Ryan, 2002). Within this idea, Wagner (2002) clarified that; it is necessary to construct content design models for re-united LOs according to the basis of dividing content into segments for special learning targets. Thus, instead of static and wide contents on web environments the dynamic course contents can be designed by the union of LOs.

Recently, the research studies related to LOs have tended to the sub-fields such as the relationship between LOs and instructional designs, the classification of LOs, principals for interactive LO design and the evaluation process of LOs. But the research studies including LO based long-term applications are rather insufficient. The studies including the applications such as presenting LOs designed for university level different courses via distance learning have been considered (Farha, 2007; Stamey et al., 2005). Some research studies have expressed the ideas that LOs can be used as learning tools at classroom settings on guidance of a teacher or when used individually (Bradley & Boyle, 2004; Churchill, 2007; Haughey & Muirhead, 2005; Kay & Knaack, 2007; Kenny et al., 1999). Even if LOR have started to be prepared for primary and secondary education recently, the number of LOs directly related with the outcomes from curriculums is limited (Ally et al., 2006; Gronn et al., 2006). In this study, we have especially focused on the student outcomes in parallel with LO design. Therefore LOs in this study are surrounded with metadata structure and designed so as to prioritize student-computer interaction, to be able to set different problem cases including exercises, trial and special tutoring activities, animations, and also to teach different concepts in detail. The designed LOR can be extended and a great part of the outcomes in accordance with Turkish 9th grade mathematics curriculum has been transferred to object repository as being modeled in the form of LOs. In this study a specific instructional design model consisting Analysis, Design, Development, Implementation, and Evaluation phases (ADDIE) is used to create LOs. The objects have been produced with java and action script codes.

Thus, the goal of this study is to investigate effect of the use of LOs in high school mathematics courses. This impact has been revealed by defining the differences, according to academic achievement, appearing among the students using LOs at an authentic classroom environment and with the extracurricular activities.

RELATED STUDIES

A less number of experimental studies have completed about LOs that some of them were case studies planned especially for high school students in order to define fundamental principals of LO use. It has been suggested so often that real potential of LOs can appear with the long-term experimental studies but this has been made rarely (Kay & Knaack, 2007; Sedig & Liang, 2006). Some examples from case studies and experimental studies about the usage of LOs have been presented below.

A case study including difficult mathematics concepts are taught by using LOs and a positive increase has been seen on academic achievement of students who are learning by using the objects (Sedig & Liang, 2006). Another study has indicated that 400 students from Department of Computer Sciences using LOs at mathematics courses had a high performance during the courses (Chalk et al., 2003). However, study results have shown that this achievement has not only been the result of the LOs, but also both the usage of LO and the level of readiness for the course have a high correlation in the issue of the achievement of the student. The study carried out at Indiana State University has tried to explain the learning outcomes of the students from two different classes by using LOs and course books during the course in these different classes. The findings at the end of the courses have pointed out that the academic achievements of the groups who used LOs are higher than the ones having used the course books (Farha, 2007). There are also qualitative studies indicating that LOs have been developing the learning performance of the students (Kenny et al., 1999; Lim et al., 2006; Windschitl & Andre, 1998). Besides, two research studies bring up their findings via descriptive analysis that LOs have enhanced learning. One of these studies addressed some changes at the assignments of many students (Bradley & Boyle, 2004), and in another study the ratio of the achievement at exams has increased from 12% to 23% (MacDonald et al., 2005). Rieber et al. (2004), has pointed out that the achievement of the students benefiting from LOs is higher than the ones depriving of this support. At Windschitl and Andre's (1998) studies it has been concluded that the students who have studied with the LOs in two subjects out of six are more successful than the ones who have not studied with LOs. On the other hand, Kay and Knaack (2007) have expressed that the studies related to LOs have not been at adequate level, there should be done actual experimental studies, and studies about content design models constructed by using LOs.

As stated above, the effects of LOs which are used in classrooms are generally compared to traditional methods used in the classrooms. Even if there are some suggestions about extracurricular use of LOs (Ally et al., 2006; Kay & Knaack, 2007), but limited number of studies have been done yet. Thus; in this study, the in classroom and extracurricular use of LOs are dealed together and the academic achievements of students have been examined in this process.

DESIGN AND PROCESS

Within the study, firstly the Turkish 9th grade mathematics curriculum has been examined and the scenarios have been provided for LOs in order to be conformable to the level of students. We focused on LOs that the interaction levels should be high and different problem cases should be formed by LOs in LOR. The LOs have been located at LOR as integrated with object management system. In this study, widely accepted the Institute of Electrical and Electronics Engineers Learning Object Metadata (IEEE LOM) standards have been used for the developed LOR. Object repository consisting of LOs which are mostly convenient for 9th grade mathematics program has been published on the website “www.ogrenmenesneleri.org”.

Study was conducted during spring term at a high school. The LOs in the program include; drill and practice, problem solving, decision making, conceptual learning activities including sets, numbers, relation and functions learning domains. The course schedule is presented in Table 1.

Table 1: Course schedule

LEARNING DOMAIN	Sub Learning Domain	Schedule	Duration	Number of Related questions in post test
NUMBERS	**1.** Natural Numbers	1st week	5 weeks	2
	2. Whole Numbers			1
	3. Real Numbers	2nd week		1
	4. Rational Numbers			1
	5. Modular Arithmetic			1
	6. Absolute Value	3rd week		2
	7. Exponential Numbers			1
	8. Squared Numbers			1
	9. Problems	4th- 5thweek		4
SETS	**10.** Basic Concepts in Sets	6th-7th week	2 weeks	1
	11. Set Operations			3
RELATION, FUNCTION AND OPERATION	**12.** Relation	8th week	4 weeks	2
	13. Operation	9th week		2
	14. Function	10th week		1
	15. Operations in Functions	11th week		2

This kind of LOs support has enabled LOs to be used as supporting tools for learning. Vygostky (1986), defines the support for the student as the main locomotive of learning and defines this role as scaffolding. The mentioned role, “scaffolding”, was tried to be gained from learning environment formed with LOs and guided by the teacher. The learning environment is aimed to fill the information gap between the student’s readiness and zone of proximal development cases.

First, the teacher and the students in a pilot study are informed about the use of LOs and the LOR. At the pilot study, the deficiencies in LOs evaluated by students in two different classes (n_1=20 and n_2=24) and also by their mathematics teachers, then the LOR is updated through the comments of students and teachers.

METHODOLOGY

Since the study has been planned as quasi-experimental, two 9th grade classes taught by the same teacher have been randomly selected classes as two groups used LOs in different ways. The teacher’s guidance in both groups was only designing learning environments for students. During eleven weeks period the students from classroom and project groups have studied by using 38 objects from LOR. In both two groups, we did not intervene the teacher’s usage ways of LOs, so she used LOs completely towards her planning in both groups. Before the study, the interview with the teacher showed that; the teacher has tried to benefit from computer and internet in so far as it’s possible. The teacher has used internet for annual plans, course presentations, and sometimes for downloading different exam questions. She has pointed out that she encouraged students use internet for researching, but since some of the students do not own computers or some of the parents limits their children in the issue of using internet, some difficulties can appear while benefiting from internet. The data indicating the students’ properties of computer usage is listed in Table 2.

Table 2: Computer usage of groups

Group	Number of Student(n)	Gender		Average Age	The average age that students begin to use computer
		M	F		
Classroom Group (A)	24	9	15	15.66	10
Project Group (B)	26	11	15	16.1	11

Students of Group A have had their courses at a PC lab which includes at least one PC to one student. Students of Group B have used the PC lab when it is free from Group A and could have prepared their assignments and projects here in the laboratory. In addition, most of the students have prepared their assignments and projects out of the school, when they find PC to prepare them at their home or in different places.

Group A: In this group the teacher has prepared lessons by using LOs towards course objectives and planned the course related to the objects. The teacher introduced LOs to students with brief notices. She sometimes let students use LOs individually. She sometimes solved instance problems on LOs and she used tutorials as demonstration. Students were not directly pushed to reach intended learning outcomes and no special effort was spent to support students who had difficulty to understand by using LOs. So, in our case the practice of teacher's using LOs and trying to make students use them in the classroom happened only as preparing the learning environment for only scaffolding students by LOs. This can be interpreted as the teacher did not directly affect development in cognitive learning domain of the students

Group B: In this group, students used the objects out of the class. The teacher has assigned students certain number of projects about to the objectives of related learning domains. While the projects are being carried out, similarly in Group A the teacher explained to the students in this group how to use LOs in projects and how to keep records of details and solutions of the questions in projects. Additionally, she briefly explained how to use LOs as she did for group A. She asked students to explain how they used LOs while they were dealing with the project. She directly covered activities on LOs with different questions, as well as she sometimes engaged in activities that require different investigations on LOs. During project process, teacher only provided clues to explain project questions but she did not give information about which solution algorithm to be used. In this setting the teacher also tried to create a learning environment but she did not put any encouragement or pressure on students to make them attain the goals. So, again it is possible to comment that the practice of the teacher on this group did not affect the development in cognitive learning domain of the students. These groups can be defined in Table 3.

Table 3: The use of LOs in different settings

Group A	Group B
LOs have been used during classroom setting	**LOs have been used outside of the classroom setting**
• Using objects at some part of the course • Using LOs as scaffolding • Teaching lesson by using objects completely • Using objects one by one or by developing content	• Teacher Suggestion, Orientation • Assignment, Project • Research • Exercise - Practice • Game

So the teacher tried to avoid directly affecting the development in cognitive learning domain of the students in both groups. "Students' different usage of the instructional tools in different learning environments" can be accepted as the factor whose effect cannot be controlled and the matter of concern for this study with experimental design.

INSTRUMENTS

In order to reveal the effects of LOs, the qualitative data is also used together with quantitative data. The quantitative data collection instruments were two achievement tests. The interviews and observations in classroom were other instruments. The two achievement tests were pre-test and post-test. Pre-test were administrated at the beginning of the study with the aim of determining students' levels at previous mathematics courses. The post-test composed of 25 multiple choice questions prepared by taking into account the opinions of the teachers and field experts. The pre-test items were selected from the 7th and 8th grade mathematics topics and the post-test has been prepared related with the outcomes from 9th grade mathematics. Both of the pre-test and post-test have been conducted to 70 students before the study, and the alpha reliability coefficients have been in turn determined as R(pre-test)=0.79 and R(post-test)=0.78. Cronbach and Richard (2004) noticed that $0.8>R>0.7$ is acceptable for reliability of tests. Item analysis is conducted by computing the results for discrimination index and difficulty index on 33 questions for pre-test and on 34 questions for post-test. There were a few questions having low difficult index value which means too difficult and low discrimination index which means too easy. After eliminations in item analysis, the pre-test is reduced to 26 items and post-test is reduced to 25 items in order to derive reliability. After item analysis computations 4,17,19,20,23,25, and 28th questions are removed from the pre-test. Also 2,8,10,14,21,22,25,27 and 34th questions are removed from post-test for determining the reliability as 0.78 because of their discrimination indexes were less than 0.19.

The content of the items included the learning outcomes which were about numbers, sets, relations, functions and operations learning domains. As Anastasi and Urbina (1997) suggested the test has content validity of tests were built into it by careful selection of which items to include. Items are chosen so that they comply with the test specification which is drawn up through a thorough test of the subject domain. The numbers of the items were determined according to the learning outcomes by illustrating the outcomes on table of specifications. The number of items of post-test and the related learning field is seen in Table1. Bailey (2004) noted that by using a panel of experts to review the test specifications and the selection of items the content validity of a test can be improved. So two experts in mathematics education and a mathematics teacher of 9th grades reviewed the items and commented on whether they are appropriate for 9th grade mathematics curriculum outcomes and cover a representative sample of the behavior domain. Then they discussed each other until they come to exact agreement on each item. It can be concluded that they shared a common understanding of the items, distractors and the correct answers.

In addition to pre-test and post tests; teachers' opinions about the students 'academic achievements acquired with the students' usage of LOs by the semi-structured interviews with teacher have also been obtained. The teacher is interviewed generally related to the "learning" and "engagement" effects of LOs. The interviews are constructed via semi-structured items which are designed by contribution of "Learning object evaluation scale for teachers" which Kay and Knaack (2008) developed it for teachers to evaluate the effect of LOs. The items on this scale which include motivation, feelings, interaction, learning easy, understanding dimensions is reconsidered through the treatments in two groups. Also, an instrument which has 14 criteria for "learning" and "value" dimensions for evaluating learning environment designed by using LOs developed by Haughey and Murihead, (2007) is also taken into account. Besides, the achievement tests, the interviews also, the courses carried out by the teacher during the study have been observed and interpreted with the quantitative data.

DATA ANALYSIS

The highest grade has been 100 while evaluating the pre-test conducted for determining students' general mathematics adequacies before the study and the post-test applied with the aim of determining their achievements in related with the topics they dealt with during the study. The pre-test and post-test results for both groups have been analyzed statistically. The data acquired from pre-test and post-test provide the conditions of parametric tests. So, independent sample t-test is carried out to define if there is a significant difference among the grades of pre-test and post test. Similarly, according to the results of post-test; independent sample t-test is applied if there is a significant difference among two groups. The opinions of teacher have been presented as research problems in accordance with direct quotation. While the change of students' academic achievements in different classes is being interpreted, observation data is also used.

FINDINGS

The average of grades taken from pre-test and post-test have been presented in Figure 1.

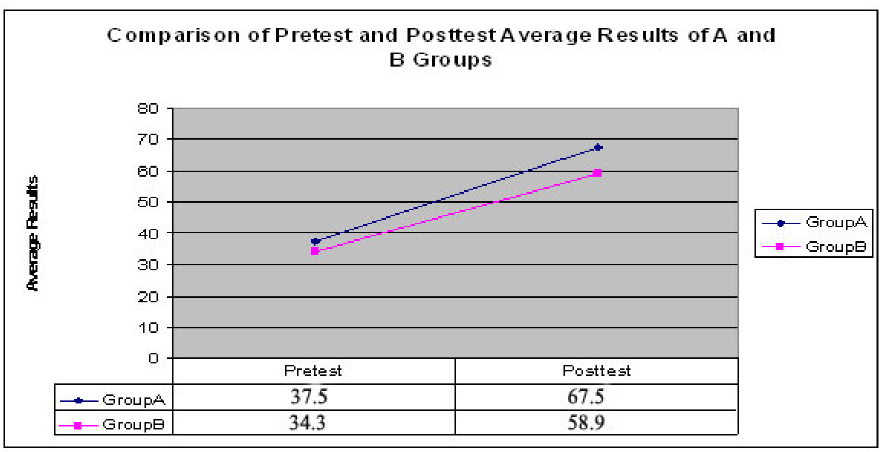

Figure 1. Pre-test and post-test averages of groups

The results of t-test carried out with the aim of defining statistically if there appeared significant differences among the pre-tests of the groups at the beginning of the study have been presented in Table 6 and in Table 7. In order to use independent t-test the data must verify the assumptions of t-test. The assumptions for independent t-tests are;

- *The dependent variable is normally distributed.*

When testing for normality, we are mainly interested in the tests of normality table. In this table Shapiro-Wilk Test is more appropriate for small sample sizes (< 50 samples). If the value of the Shapiro-Wilk Test is greater the 0.05 then the data is normal. For this reason, we used the Shapiro-Wilk test as our numerical means of assessing normality shown in Table 4.

Table 4: Test of normality results for pre-test and post-test

		Shapiro-Wilk		
Tests	Groups	Statistic	df	Sig.
Pre-test	A	0.909	24	0.134
	B	0.954	26	0.286
Post-test (Section1)	A	0.945	24	0.208
	B	0.952	26	0.255
Post-test (Section2)	A	0.862	24	0.104
	B	0.884	26	0.107
Post-test (Section3)	A	0.931	24	0.104
	B	0.952	26	0.252
Post-test	A	0.953	24	0.309
	B	0.947	26	0.192

We can see from Table 4 that for the Group A and Group B, both Pre-test, Post-test (Section1), Post-test (Section2), Post-test (Section3) and Post-test (Total) was normally distributed.

- *The two groups have approximately equal variance on the dependent variable.*

It can be checked by looking at the Levene's Test. The Levene's Test for pre-test and post-test is seen on Table 5.

Table 5: Levene's Test for pre-test and post-test

	Levene's Test for Equality of Variances	
Tests	F	Sig.
Pre-test	1.227	0.274
Post-test (Section1)	0.107	0.705
Post-test (Section2)	1.601	0.212
Post-test (Section3)	0.230	0.634
Post-test(Total)	0.351	0.556

As the significance for Levene's test is 0.05 or upper for each tests the variances are assumed equal.

- *The two groups are independent of one another.*

The groups are naturally occurring groups which are assigned to the students in two different classrooms.

The results of verifying tests showed that both samples come from normally distributed populations with equal standard deviations, so the independent samples t-test may be used for determining the significance difference among two groups' achievement test results.

Table 6: The descriptive statistics of students' pre-test scores

Groups	N	Mean	SD
Group A	24	37.5	13.490
Group B	26	34.3	11.491

Table 7: Independent samples t- test scores within groups before treatment

Groups	N	df	t	P
Group A	24	48	0.903	0.371
Group B	26			

According to pre-test results owing to the data, t(48) = 0.903 and p>0.05 there was no significant difference among the mathematical knowledge of the groups. On the Figure 1 it is seen that the pre-test averages of the groups A and B are close to each other (37.5, 34.3). The highest and the lowest grades of two groups are also close to each other (A:16–64, B:12–52). At the end of the study, in order to define if the post-test grades of the groups have caused a significant difference; independent sample t-test applied for bringing up the significant difference among groups is shown in Table 8.

Table 8: Independent sample t-test results of A and B groups within post-tests

Measure	Group	N	Mean	SD	df	t	p
Section1 (48)	A	24	33.17	10.51	48	0.404	0.688
	B	26	32.00	9.92			
Section2 (20)	A	24	15.66	3.31	48	1.196	0.237
	B	26	14.46	3.76			
Section3 (32)	A	24	18.66	6.84	48	3.330	0.002
	B	26	12.46	6.33			
Total (100)	A	24	67.5	13.77	48	2.147	0.037
	B	26	58.92	14.42			

This evaluation shows that as a result of the treatments, there was a significance difference in the students' total academical achievements. The total test results $t(48) = 2.147$, ($p<0.05$). This result reveals that the different use of LOs has different effects on academical achievements. This result was observed with respect to the test results taken as a whole. In addition, when the ($\eta^2 = .1415$) assessment has been taken into consideration, it illustrates that teaching ways in different classes have a large influence on students' achievements. In fact, in classifications (for the sample) impact size indexes indicate how much of the variance at test grades is resulted from the independent variable (Cohen & Manion, 1988). That the values are .01, .06 and .14 define the impact size by order of small, medium and large.

No significant differences were observed between the answers of the two groups of students for the 1st and 2nd sections in the final tests (p section1: .688, p section2: .237). So, we can say that there is no significant difference between the academic achievement scores of the students for "Numbers" and "Sets" units. For the 3rd section, however, there is a significant difference for "Relations and Functions" unit favoring Group A (p section3< .05).

A semi-structured interview was administered three times periodically in order to obtain the qualitative data of the study. We captured data from teacher's opinions about the use of LOs in authentic classroom environment and in extracurricular activities during the process of using the tools in Group A and during the process of using the course pages prepared by the assigned projects by Group B. At the end of the analysis, the codes determined for each question, themes assembled by the codes and the frequencies of the codes were presented in Table 9. The interview questions were generally about learning and engagement effects of LO based learning environment. Appendix-1 illustrates some examples from the interviews.

Table 9: Teacher's opinions about the effect of learning environment

Theme	**About Group A**			**About Group B**		
	Numbers	Sets	Functions	Numbers	Sets	**Functions**
Not getting bored	2	1	1	1	1	**1**
Learning Easily	1	2	1	2	-	**2**
Interest	3	1	2	2	2	**1**
Motivation	2	1	2	1	1	**1**
Being active	2	2	4	2	1	**1**
Learning individually	1	1	1	3	2	**1**

The teacher used more positive expressions about establishing and sustaining motivation of the student in Group A (5 times) than the expressions about sustaining project motivation in Group B (3 times). The teacher noted that the students in both groups were active while they were working with tools and this was one of the most frequently repeated statements. Particularly, the teacher more frequently mentioned that the students were even active for 'functions' unit, which they have not faced previously. It is interesting that the teacher commented Group B students as active although they did not use the tools in the lesson. Besides, the teacher used expressions like "they are more independent from teacher" and "they can learn by themselves" more frequently for Group B than Group A. The frequencies of the positive codes mentioned by the teacher in each group were the same. This can be taken as the indicator of that the teacher gave similar opinions for both groups with regard to the effects of the tools on students. That the teacher more frequently mentioned that the students using LOs were active in “functions unit” than she mentioned for Group B students, can be interpreted as using LOs in classroom render students more active.

RESULTS AND DISCUSSIONS

At the end of the study an increase at a little deal at all two groups A and B has been seen (Figure 1). For all two groups when it is looked for the average grades taken at the beginning and at the end of the study, it has been noted as A: 37.5–67.5 and B: 34.3–58.9. As evaluated in percentage, the increase of the achievement for Group A it is 80%, for Group B 71%. Even if the pre-test measures general mathematics achievement and the post-test measures the achievement related to the subjects studied during study, it is seen that while there is no significant difference between the groups’ achievements at pre-test but significant difference is recognised according to the post test results of Group A and B.

After the interviews with teacher it has been designated that the visual and interactive features of LOs increased the motivation and the achievement of A and B groups and this motivation influenced students’ achievement in positive way. It is known that learning environments based on LOs especially with high interaction enables positive impact on students’ academic achievement (Lim et al., 2006; Sedig & Liang, 2006). It has been pointed out by focusing on the interview with the teacher carrying out the study that the teacher has no negative opinions about using internet for teaching. Also she has no experiences on designing course or planning web-based teaching on internet, but has the ability to use computer at an adequate level. In addition, there are some research studies available indicating that the negative opinions of teachers about using internet based instruction have a negative impact on academic achievement (Becker & Ravitz, 1999; Ertmer et al., 1999). Thus, the positive ideas of teachers about using internet in instruction have contribution to the success of application at class. Besides, it can be stated that at this treatment the minority of technical faults occuring frequently at web-based teaching applications like the study of Karaman (2005) have had positive contribution to achievement. However, against some researchers having the idea that the impact of LOs on learning can only occur with the teacher’s help (Buzza et al., 2005). The findings of the study are seen to be opposite of these researchers as the application in Group B.

The study indicates that one of the reasons of the increase in the achievement of A and B groups can be the student-centered activities in learning environment and the success of the teacher with perfect guidance helping the students while using these activities. It has been considered that the impact can also be seen the average grade results of Group A on post-test. So, the parallel can be seen between the findings of this study and some of the studies in which using computer-based instruction materials in classroom environment can have positive impact on students’ achievements (Bradley & Boyle, 2004; Jimoyiannis & Komis, 2001).

Even if students from Group B have had courses with traditional methods, they studied with LOs on projects. The students observing LOs and studying in order to perform the projects have indicated that they studied on the projects seriously and delivered their works to their teachers by completing them. Group B has not reached the same increase in achievement as Group A, but LOs had also great impacts on Group B students’ achievements. This point out that usage of LOs at extracurricular activities may perform positive results. The findings of the study concerning Group B supports the idea at Kay and Knaack’s (2008) studies that when LOs arrange the student control at a convenient level, the appropriate content is prepared and also when LOs involve motivation items, LOs can also be used out of the class. So based on this idea, we can say that LOs can also support the students not only inside classes but also out of the classes. Thereby, it can be mentioned that the support called “scaffolding” by Vygotsky (1986) is possible to be enabled from LOs. Jonassen et al. (1993) defined scaffolding as any help intentionally given to students so that they could fulfill a task. From this point of view, the help that the students in group B got from LOs to complete their projects can be referred as scaffolding. Surely, one of the preconditions of this aspect is to prepare the project contents in quality. However, while preparing projects the students have often used objects for different aims such as learning concepts, drill and practice or solving problems. In addition, group studies have also positive impact on the increase of students’ achievement at a percentage of 70% during the preparation of the projects.

In the study when the students whose academic achievements have increased are observed one by one, it is seen that some of the students who had low grades at pre-tests have increased their achievements at post tests. At this point the result such as the level of students’ readiness for the course should be high, the research of Chalk et al. (2003) has not been confirmed with this study in order to be successful with LOs at the studies.

The students who gave right answers to the questions related to “numbers” and “sets” in the pretest could also give right answers in the post-test. Moreover, most of the Group A and B students who had lower averages in the pre-test, managed to have good scores in the “numbers” and “sets” units in the post-test. However for the answers given for the questions about "relations and functions unit", which the students faced for the first time, using LOs in the classroom had greater impact on academic achievements comparing to using LOs in extracurricular activities. This may be showing that; LOs can be more effective on the performance in classroom for the subjects that students have not faced before. Besides, it was observed that some difficulties were experienced while students were preparing projects with LOs for the subjects they have not encountered before. The reason for this was the projects prepared by the teachers focused on consolidating concept knowledge and solving problems rather than conceptual learning.

CONCLUSIONS AND RECOMMENDATIONS

The findings reveal that a proper planning is needed in order to increase academic achievement depending on the systems with LOs, and for the students to perform the expectations, for the teachers to adopt their roles in the application of the system and to carry out them well. So both the design features of the LOR and teachers', students' views include the items which can effect to the academic achievement.

In addition it has been concluded that there has been significant difference between Group A and Group B according to the result of post-test. The increase of achievement as a result of applying LOs in class environment depends on the items given below.

- Teacher's positive ideas about the success of the study,
- Enable students to work independently in a classroom by providing them motivation,
- Not meeting with technical problems so much,
- The quality of LOs,
- The interests of students.

Group B used LOs for preparing projects and the results obtained from the treatment at Group B as follows;

- LOs prepared properly for the curriculum has enabled to prepare a project which is proper for the level of students,
- When the projects have been prepared, the LO based projects are also effective on academic achievements,
- The process of preparing projects from LOs is not simple and the usage of the system of designing course prepared by this aim is very influential within this process,
- The projects based on LOs can also be carried out in a successful way of collaboration,
- The usage of the systems purified from technical problems by teachers who are going to assign projects and the teachers' beliefs in the benefit of such kind of systems,
- The need for LOs at a sufficient number to be selected by the teacher for preparing projects.

By this study it is concluded that LOs can be used as supportive means (scaffolding) for learning via projects and assignments, and they can also be used to enhance learning in classroom activities using LOs with different instructional methods together. It has also been deducted that it is possible to prepare learning environments which are appropriate for students' levels by planning proper LOs and in addition, and these learning environments may have positive impact on learning. Being used of these kinds of systems at pilot schools to be selected by volunteer teachers, internet use in instruction should become widespread in order to remove the deficiencies at this point. In addition, it is needed to exhibit presentations to use it both for the courses out of the school by students.

This study addresses that; if the LOs used for the subjects which the students have not faced before; in classroom activities would be better for this case. Considering this case; LOs for new concepts should be designed and especially when the new concepts are taught, the in classroom activities should be planned to be conducted. Besides, when the LOs are planned to be used in projects, it would be better to use them in the subjects which the students are encountered before and have some knowledge about them.

When LOs are arranged to be studied with learning management systems, they can be considered as tools to be used in instruction. The design process of LOR takes a long period and it is needed to cooperate with experts for proper LO designs for the study. In future applications with students in low number should be preferred and it should be noticed for the laboratory to include all technical equipments. Considering the economic dimension of LOs, learning outcomes should be determined to be presented in the form of LOs concerning many courses and the LOs to be prepared with this idea should rapidly take place within the education system.

REFERENCES

Ally, M., Cleveleand-Innes, M., Boskic, N., & Larwill, S. (2006). Learners' use of learning objects. *Journal of Distance Education, 21*(2), 44–57.

Anastasi, A., & Urbina S. (1997). *Psychological testing (7th ed) (pp. 40-45)*. New York: McMillian.

Bailey, D. B. (2004). Tests and test development assessing infants and preschoolers with special needs (3rd ed., pp. 22-44). Upper Saddle River, NJ: Pearson.

Becker, H. J., & Ravitz, J. (1999). The influence of computer and internet use on teachers' pedagogical practices and perceptions. *Journal of Research on Computing in Education, 31*(4), 356–384.

Bradley, C., & Boyle, T. (2004). The design, development and use of multimedia learning objects. *Journal of Educational Multimedia and Hypermedia, Special Edition on Learning Objects, 13*(4), 371–389.

Buzza, D., Schoner, V., & Harrigan, K. (2005). Learning objects in use: Lite' assessment for field studies. *The MERLOT Journal of Online Learning and Teaching (JOLT), 1*(1), 1–18.

Chalk, P., Bradley, C., & Pickard, P. (2003). Designing and evaluating learning objects for introductory programming education. *Proceedings of ACM ITICSE.03*, Thessaloniki, Greece.

Churchill, D. (2007). Towards a useful classification of learning objects. *Education Technology Research and Development, 55*(5), 479–497.

Cohen, L., & Manion, L.(1998). *Research methods in education (4th ed.)(pp. 40-45)*. London and New York: Routledge.

Cronbach, L.J., & Richard J. S. (2004). My current thoughts on coefficient alpha and successor procedures. *Educational and Psychological Measurement,* 64, 3 (1), 391-418.

Ertmer, P.A., Addison, P., Lane, M., Ross, E., & Woods, D.(1999). Examining teachers' beliefs about the role of technology in the elementary classroom. *Journal of Research on Computing in Educati*on, 32(1–2), 54–72.

Farha, N. (2007). *An exploratory study into the efficacy of learning objects*. Unpublished doctoral dissertation, Indiana State University, USA.

Gronn, D., Clarke, O., & Lewis, G. (2006). Using the learning federation's learning objects in the classroom. *Australian Primary Mathematics Classroom, 2*(11), 4-7.

Hamel, C., & Ryan, D. (2002). Designing instruction with learning objects. *International Journal of Educational Technology*, 3(1), 18-26.

Haughey, M., & Muirhead, B. (2005). The pedagogical and multimedia designs of learning objects for schools. *Australasian Journal of Educational Technology, 21*(4), 470-490.

Jonassen, D. H., Mayes, T. Y. & McAleese, R. (1993). A manifesto for a constructivist approach to technology in higher education. In T. Duffy, J. Lowyck, & D. Jonassen (Eds.), Design Environments for Constructivist Learning, New York: NY: Springer-Verlag.

Jimoyiannis, A., & Komis, V. (2001). Computer simulations in physics teaching and learning: A Case study on students' understanding of trajectory motion. *Computer & Education*, *36*, 183-204.

Karaman, S. (2005). *Developing a learning object based content development system and determining the object based content desing profiles of pre-service teachers.* Unpublished doctoral dissertation, Atatürk University, Turkey.

Kay, R., & Knaack, L. (2007). Evaluating the use of learning objects for secondary school science. *Journal of Computers in Mathematics and Science Teaching,* 26(4), 261–289.

Kay, R., & Knaack, L. (2008). An examination of the impact of learning objects in secondary school. *Journal of Computer Assisted Learning, 24*(6), 447-461.

Kenny, R.F., Andrews, B.W., Vignola M.V., Schilz M.A., & Covert J. (1999). Towards guidelines for the design of interactive multimedia instruction: Fostering the reflective decision-making of preservice teachers. *Journal of Technology and Teacher Education*, *7(1)*, 13–31.

Koppi, T, Bogle, L., & Bogle, M. (2005). Learning objects, repositories, sharing and reusability. *Open Learning, 20*(1), 83–91.

Lim, P.C., Lee, L.S., & Richards C. (2006). Developing interactive objects for a computing module. *International Journal on Elearning, 5*(2) , 215- 221.

Longmire, W. (2000). A primer on learning objects, learning circuits. http://www.learningcircuits.org/mar2000/primer.html. Accessed 11.09.2007

MacDonald, C.J., Stodel E., Thompson T.L., Muirhead B., Hinton C., Carson B., & Banit E. (2005). Addressing the elearning contradiction: a collaborative approach for developing a conceptual framework learning object. *Interdisciplinary Journal of E-Learning and Learning Obje*cts, 1, 79–98.

Rieber, L.P., Tzeng, S., & Tribble, K. (2004). Discovery learning, representation, and explanation within a computer-based simulation: Finding the right mix. *Learning and Instruction, 14 (3)*, 307–323.

Sedig, K., & Liang, H. (2006). Interactivity of visual mathematical representations: Factors affecting learning and cognitive processes. *Journal of Interactive Learning Research*, *17*(2), 179–212.

Stamey, J. W., Saunders, B.T., & Deluca, W. V. (2005). Design of intelligent learning Objects. *Proceedings of the 5th Annual IEEE International Conference on Advanced Learning Technologies, ICALT 2005*, Kaohsiung, Taiwan.

Vygostky, L. (1986). *Thought and language (pp. 108-109)*, Cambridge: MIT Press.

Wagner, E. (2002). The new frontier of learning object design. *Elearning Developers Journal*, *2* (4), 1–11.

Windschitl, M., & Andre, T. (1998). Using computer simulations to enhance conceptual change: The roles of constructivist ınstruction and student epistemological beliefs. *Journal of Research in Science Teaching, 35(2)*, 145–160.

Appendix-1. Examples from interview questions

- Did you observe differences among groups about students' interests to the subjects?
- Was the motivation of students different according to the previous courses?
- Could they learn from LOs in the classroom?
- Did students' conceptual understandings and problem solving develop?
- Did you see change in students' behavior for both classes studying with LOs?
- Did you feel tightness in groups?
- How were students' engagements in projects?
- Did you note changes on interactions among students and interactions with you?
- How do you evaluate students' strategies for homework or projects?

TURKISH AND ENGLISH LANGUAGE TEACHER CANDIDATES' PERCEIVED COMPUTER SELF-EFFICACY AND ATTITUDES TOWARD COMPUTER

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ABSTRACT
The aim of this study is to reveal the relation between the Turkish and English language teacher candidates' social demographic characteristics and their perceived computer self-efficacy and attitudes toward computer. The population of the study consists of the teacher candidates in the Turkish and English language departments at the universities in Cyprus. The sample consists of 136 teacher candidates who were selected according to convenience sampling in Faculty of Education at Cyprus International University. In this study, the "Perceived Computer Self-Efficacy" scale developed by Aşkar and Umay and the "Attitude Toward Computer" scale developed by Aşkar and Orçan were used for collecting data. Considering the purposes of the study percentage documentation average, t-test, ANOVA, Mann-Whitney U, Kruskal Wallis, Scheffe and Pearson Product-Moment Correlation test were used in data analysis. The statistical significance level was accepted as .05 in the study. The result of this study shows that there is a significant difference in teacher candidates' department, age, English proficiency level and socioeconomic level according to the perceived computer self-efficacy whilst according to the attitudes toward computer there is only a significant difference in the English proficiency level. Also, it was determined that there is a medium level positive statistical difference between perceived computer self-efficacy and attitudes toward computer.
Keywords: Perceived computer self-efficacy, attitudes toward computer, self-efficacy, attitudes, Turkish teacher candidates, English teacher candidates,

INTRODUCTION
Motivation, incentives, sense organs, intelligence, age, attention, preparedness, lack of motivation, physical conditions, psychological medium and perceived self-efficacy are among the factors affecting learning. Perceived self-efficacy is a concept in the scope of social learning theory. According to the social learning theory, the most basic motivating structure behind the behaviors of the individuals is perceived self-efficacy. The societies of nowadays require individuals who possess life-long learning talents; in other words, individuals who can continuously renew their knowledge, comply with transformation, follow developments and can produce conscious knowledge. The basic outcome expected from the education institutes is to train self-learning individuals equipped with knowledge and talents, who can manipulate technology (Akkoyunlu & Orhan, 2003).

Perceived self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves and behave. Such beliefs produce these diverse effects through four major processes. These include cognitive, motivational, affective and selection processes. A strong sense of efficacy enhances human accomplishment and personal well-being in many ways. People with high confidence in their capabilities approach difficult tasks as challenges to overcome rather than as threats to avoid. Such an efficacious outlook fosters intrinsic motivation and deep engagement in activities. They set themselves challenging goals and maintain strong commitment to them. They heighten and sustain their efforts in the face of failure. They quickly recover their sense of efficacy after failures or setbacks. They attribute failure to insufficient effort or deficient knowledge and skills which are to be developed. They approach threatening situations with confidence that they can exercise control over them. Such an efficacious outlook produces personal accomplishments, reduces stress and lowers vulnerability to depression (Bandura, 1994).

Perceived self-efficacy plays a significant role in displaying the students' behaviours and in keeping their motivation high. In perceived self-efficacy success is defined as follows: it is dependent on the interactions between behaviours, personal factors and surrounding conditions. Perceived self-efficacy affects the individual's task selection, effort, patience and success (Schunk, 1984).

In contrast, people who doubt about their capabilities avoid difficult tasks which they view as personal threats. They have low aspirations and weak commitment to the goals they choose to pursue. When faced with difficult tasks, they dwell on their personal deficiencies, on the obstacles they will encounter, and all kinds of adverse outcomes rather than concentrate on how to perform successfully. They slacken their efforts and give up quickly in the face of difficulties. They are slow to recover their sense of efficacy following failure or setbacks. Because they view insufficient performance as deficient aptitude it does not require much failure for them to lose faith in their capabilities. They fall easy victims to stress and depression (Bandura, 1994).

Perceived computer self-efficacy is defined as “self-judgement of individual regarding computer literacy”. The relevant studies on this topic clearly show that those individuals with high rates of perceived computer self-efficacy are more motivated for participating in computer-related activities in addition to the high level of their expectations from such events. Also, these individuals can much more easily cope with the difficulties they encounter regarding computers (Akkoyunlu & Orhan, 2003).

Within the scope of relevant scientific studies, it is mentioned that perceived computer self-efficacy is a significant parameter in using computers (Aşkar, 2001; Işıksal, 2003; Işman & Çelikli, 2009) and various scales were used to measure perceived computer self-efficacy (Harrison & Kelly,1992; Torkzadeh & Koufteros 1994; Akkoyunlu, Orhan & Umay, 2005).

Another important variable affecting computer usage is the attitudes toward the computer itself. Attitude, on the other hand, together with its formation, transformation, causing transformation or their measurement, is a topic relevant to social psychology. In general, attitudes can be defined as a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object. (Fishbein & Ajzen, 1975). They are relatively less stable than personality traits and can be changed both across time and across situations in virtue of individual’s interaction with the environment (Robinson, Simpson & Huefner, 1991). From years of prior research in the psychological sciences we know that both positive and negative reactions are reflected in attitudes, which are a key component in predicting behavior (Ajzen, 2001). Thus, to more fully understand computer usage, reactions to computers, and the psychological outcomes associated with computer use it is necessary to assess computer attitudes (Morris, Gullekson, Brendan &. Popovich, 2009). The learner attitude towards computer measures his capabilities in effective learning. Computer attitude has been defined as a person’s general evaluation or feeling of antipathy towards computer technology and specific computer related activities (Smith, Caputi & Rawstone, 2000).

Equipping teacher candidates with adequate computer literacy is a significant variable in enhancing the quality of education. Many researchers stated that the attitudes of teacher candidates toward computer are closely related to the effectiveness and efficiency of the education process (Altun, 2003). Within the scope of the studies executed, it was found out that a positive attitude is formed toward computer usage with increased computer literacy (Deniz, 2000), whereas a negative attitude is formed toward computer usage in case of lack of computer literacy (Hashim & Mustapha, 2004). The utilization of computer as a tool of education ought to be an inevitable characteristic of teachers in the current contemporary education approaches. Çavuş and Gökdaş (2006) have also stressed the importance of basic computer skills and education related to the use of internet by the teachers and especially the teacher candidates from the viewpoint of their success in their professions and has as well claimed that this will also lead to effective utilization of computer and Internet.

Within the scope of relevant scientific studies, it is mentioned that attitudes toward computer is another significant parameter to predict behavioral intentions regarding computer use, computer use behaviors (Gerçek & Soran, 2006; Serin, 2011; Kutluca & Ekici, 2010) and various scales were used to measure attitudes toward computer (Aşkar & Orçan, 1987; Morris, A. S., Gullekson, Brendan &. Popovich, 2009).

The aim of this study is to reveal the relation between the Turkish and English language teacher candidates’ social demographic characteristics and their perceived computer self-efficacy and attitudes toward computer.

Problem Statements of the Study

The main problem statement of the study is stated as follows: “Is there a relation between the Turkish and English language teacher candidates’ social demographic characteristics and their perceived computer self-efficacy and attitudes toward computer?”

Sub Problems

The study aims to answer the following sub problem questions.

1. Is there any statistical difference Turkish and English language teacher candidates’ “Perceived Computer Self-Efficacy” and their “Attitudes Toward Computer”?

a) according to the department?
b) according to the gender?
c) according to the age?

d) according to the English proficiency level (self-perception)?
e) according to the level of socio-economic parameters (SEP)?

2. Is there a statistically significant relation between Turkish and English language teacher candidates' "Perceived Computer Self-Efficacy" and their "Attitudes toward Computer"?

RESEARCH METHODOLOGY

Research Design

The descriptive type of research was carried out via the descriptive type and is in accordance with the associational research model. This type of research aims to evaluate the degree and the variation between two or more variables (Karasar, 1998).

The Universe and Sample of the Study

The universe of the study consists of the teacher candidates at the universities in North Cyprus. The sample consists of 136 [57.40% (n=78) female, and 42.60% (n=58) male] Turkish and English teacher candidates' who were selected according to convenience sampling in Faculty of Education at Cyprus International University. This number comprises 64 % of the entire students registered to the programs. The information regarding the distribution of the demographic characteristics of the teacher candidates' participating at the research is presented in Table 1.

Research Instruments

Demographic Information Form

This 5-item form is prepared by the researcher to collect data about teacher candidates' department, gender, age, English proficiency level and their socio-economic level.

Perceived Computer Self-Efficacy Scale

The scale for Perceived Computer Self Efficacy was a 18-item and 5-point Likert scale developed by Aşkar and Umay (2001) to define participants' perceived computer self-efficacy. The participants were asked to rate each item on a scale ranging from 1 to 5. The maximum score which could be received from the scale was 90. The Cronbach's alpha reliability coefficient of the scale was calculated to be .71

Attitude Toward Computer Scale

The scale for Attitude Toward Computer Scale was a 24-item and 5-point Likert scale developed by Aşkar and Orçan (1987) to define participants' attitudes toward computer. The minimum and the maximum score which could be received from the scale was 24 and 120 respectively. High scores indicate a positive attitude toward computers. The Cronbach's alpha reliability coefficient of the scale was calculated to be .87.

Table 1. Teacher Candidates' Demographic Characteristics

Independent Variables		n	%
Department	English	54	39.7
	Turkish	82	60.3
	Total	136	100
Gender	Female	78	57.4
	Male	58	42.6
	Total	136	100
Age	18	7	5.1
	19	10	7.4
	20	32	23.5
	21+	87	64.0
	Total	136	100
English proficiency level	Very Bad	4	2.9
	Bad	42	30.9
	Average	33	24.3
	Good	33	24.3
	Very Good	24	17.6
	Total	136	100.0
Socio-economic level	Less than 1000 TL	20	14.7
	1000-1500 TL	37	27.2
	1501-2000 TL	34	25.0
	2001-2500 TL	18	13.2

	More than 2501 TL	27	19.9
	Total	136	100.0

Data Analysis
In the statistical evaluation of the research all analyses are performed by using SPSS 15.0 for windows. When the number of individuals included within the scope of the research exceeds 50, it is recommended that Kolmogorov-Smirnov test be utilized for testing whether or not the data obtained from the attitude scales display a normal distribution (Coakes & Steed, 1997; Tabachnick & Fidell, 2000). In the Kolmogorov-Smirnov test, since the statistical null hypothesis states that "the distribution of the grades does not display a meaningful difference from the normal distribution", the fact that the calculated "p" value exceeds .05 has led to the evaluation that the grades do not display a significant difference from the normal distribution (Büyüköztürk, 2006).

When the Kolmogorov-Smirnov test results are considered, t test and uni-directional variance analysis (ANOVA) tests were applied for the data with a normal distribution; while for the data without a normal distribution, the non-parametric tests Mann-Whitney U test and Kruskal Wallis test were applied. The relation between the dependent variables was calculated by utilizing Pearson moments multiplication correlation coefficient. The significance level was taken as .05 in this study.

FINDINGS
The data obtained from the research were studied and interpreted in accordance with the sub problems.

Comparing the scores obtained from the dependent variables "Perceived Computer Self-Efficacy" and "Attitudes toward Computer", Kolmogorov-Smirnov test was used to check the convenience of the variables with respect to normal distribution. The results of the analysis are presented in Table 2.

Table 2. Analysis Result Regarding Normal Distribution Test of Dependent Variables

Dependent Variables	Kolmogorov-Smirnov		
	Statistic	df	p
Perceived Computer Self-Efficacy	.075	136	.060
Attitude Toward Computer	.105	136	.001*

* p<0.05 (Non-parametric)

The result of the analysis was found to be Kolmogorov-Smirnov$_{\text{Perceived Computer Self Efficacy}}$ =.075 df=136 p=.060; Kolmogorov-Smirnov$_{\text{Attitude Toward Computer}}$ =.105 df=136 p=.001. The data regarding perceived computer self-efficacy indicated a normal distribution, whereas the data regarding attitude toward computers did not indicate a normal distribution.

Findings of the First sub-question of the Research
The first sub-question of the research was expressed as "Is there any statistical difference teacher candidates' Attitudes Toward Computer and Perceived Computer Self-Efficacy according to the department, gender, age, English proficiency level and their socioeconomic level?"

As can be observed in Table 3, t-test has been applied to the data with the aim to determine whether or not there is a significant difference between the mean scores of the dependent variables according to department and gender. As a result of the analysis, it was observed that there is a significant difference between the mean scores for the perceived computer self-efficacy of the teacher candidates' according to their departments and whereas there is no significant difference according to gender. As can be observed in Table 3, the perceived computer self-efficacy of the English Department teacher candidates' is better than those of the Turkish Department teacher candidates. When the means regarding gender are evaluated, although it has been found out that the perceived computer self-efficacy of the male teacher candidates was better than those of the female teacher candidates, this difference is not statistically significant.

Table 3. t-Test Results of the Teacher Candidates' Perceived Computer Self-Efficacy According to the Department and Gender.

Independent Variables		n	Mean	Std.Dev.	t	p	Meaningful Difference
Department	English	54	64.037	11.386	2.112	.037	p<.05
	Turkish	82	59.914	10.973			
Gender	Female	78	60.448	9.952	1.278	.204	p>.05
	Male	58	63.034	12.793			

To determine whether or not there is a significant difference between the perceived computer self-efficacy scores of the teacher candidates' with respect to age, English proficiency and socio-economic level; one directional variance analysis (ANOVA) was applied to the data. As a result of the variance analysis, it was found out that perceived computer self-efficacy was indeed affected by the independent variables age, English proficiency level and their socio-economic level and therefore findings were indeed has significant difference. The descriptive statistics and the ANOVA results related to age, English proficiency and socio-economic level are presented in Tables 4 and 5.

To determine the source groups of significant difference with respect to the variables gender, English proficiency level and socio-economic level, LSD test is applied to the data. As can also be seen in Table 5, the significant difference at the age of 20, 21 and above from the student groups has resulted. This difference is in favor of the ages 21 and above. It was observed that the difference with respect to English proficiency level stemmed from the groups a-b*, a-c*, a-d*, a-e*. On the other hand, it is seen that the difference occurs less than 1000 TL and between 2001-2500 TL groups with respect to socio-economic level.

Table 4. Descriptive Statistics of Perceived Computer Self-Efficacy of the Teacher Candidates' according to Age, English Proficiency Level and Socio-Economic Level

Independent Variables		n	Mean	Std.Dev	SE
Age	18 (a)	7	56.857	10.761	4.067
	19 (b)	10	63.900	9.480	2.997
	20 (c)	32	57.250	9.672	1.709
	21 and 21+ (d)	87	63.241	11.676	1.251
	Total	136	61.551	11.280	.967
English proficiency level	Very Bad (a)	4	49.000	6.377	3.189
	Bad (b)	42	60.238	9.307	1.436
	Average (c)	33	59.576	11.393	1.983
	Good (d)	33	63.515	11.311	1.969
	Very Good (e)	24	65.958	12.909	2.635
	Total	136	61.552	11.281	.967
Socio-economic level	Less than 1000 TL (a)	20	56.550	8.134	1.819
	1000-1500 TL (b)	37	61.703	10.556	1.735
	1501-2000 TL (c)	34	59.000	10.759	1.845
	2001-2500 TL (d)	18	68.778	10.669	2.515
	More than 2501 TL (e)	27	63.444	13.004	2.503
	Total	136	61.552	11.281	.967

Table 5. ANOVA Test Result of Perceived Computer Self-Efficacy of the Teacher Candidates with respect to Age, English Proficiency Level and Socio-Economic Level

Independent Variable	Source of Variance	Sum of Squares	df	Mean Square	f	p	Meaningful Difference
Age	Between Groups	1049.952	3	349.984	2.864	.039	p<0.05 c-d*
	Within Groups	16129.688	132	122.195			
	Total	17179.640	135				
English proficiency level	Between Groups	1424.759	4	356.190	2.962	.022	p<0.05 a-d* a-e* b-e* c-e* d-e*
	Within Groups	15754.880	131	120.266			
	Total	17179.640	135				
Socio-economic level	Between Groups	1759.182	4	439.796	3.736	.007	p<.05 a-d*
	Within Groups	15420.458	131	117.713			
	Total	17179.640	135				

* Indicates that the difference is in favor of the group.

As can be seen in Table 6, whether or not there was a significant difference between the attitudes toward computer scores with respect to departments were controlled by Mann Whitney U test and it was observed that there is no significant difference between the attitude scores of the two groups (Mann-Whitney U=1951.000 WilcoxonW=5354.000 z=-1.170 p>.05).

Table 6. U-Test Result of Attitudes toward Computer Scores According to Department and Gender

Independent Variable		n	Mean Rank	Sum of Ranks	U	p	Meaningful Difference
Department	English	54	73.37	3962.00	1951.000	.242	p>.05
	Turkish	82	65.29	5354.00			
Gender	Female	78	64.47	5028.50	1947.500	.166	p>.05
	Male	58	73.92	4287.50			

To evaluate whether or not there was a significant difference between attitudes toward computer scores with respect to gender were again controlled by Mann Whitney U test. As a result of the analysis, it was observed that there was no significant difference among the attitude scores of the teacher candidates with respect to gender. (Mann-Whitney U=1947.500 WilcoxonW=5028.500 z=-1.385 p>0.05).

Table 7. Kruskal Wallis Test Result of Attitudes toward Computer of the Teacher Candidates with respect to Age, English Proficiency Level and Socio-Economic Level

Independent Variables		n	Mean Rank	df	X^2	p	Meaningful Difference
Age	18	7	73.36	3	1.325	.723	p>.05
	19	10	81.35				
	20	32	67.75				
	21 and 21+	87	66.91				
English proficiency level	Very bad (a)	4	18.50	4	9.771	.044	p<.05 a-b* a-c* a-d* a-e*
	Bad (b)	42	63.12				
	Average (c)	33	70.32				
	Good (d)	33	70.58				
	Very good (e)	24	80.90				

Socio-economic level	Less than1000 TL (a)	20	51.60				
	1000-1500 TL (b)	37	70.54				
	1501-2000 TL (c)	34	61.81	4	9.042	.060	p>.05
	2001-2500 TL (d)	18	85.97				
	More than 2501 T'L (e)	27	75.00				

* Indicates that the difference is in favor of the group.

To determine whether or not there is a significant difference between teacher candidates' attitudes toward computer scores with respect to age and socio-economic level, Kruskal Wallis test was applied to the data. As a result of the analysis, it was observed that there was no statistically meaningful difference between the attitudes scores (X^2_{age}=1.325 p>0.05; X^2_{SEP}=9.042 p>0.05).

To determine whether or not there is a significant difference between teacher candidates' attitudes toward computer scores with respect to English proficiency level is meaningful Kruskal Wallis test was applied to the data. As a result of the analysis, it was observed that there was a significant difference with respect to English proficiency level ($X^2_{\text{English proficiency level}}$=9.771 p<0.05). To determine the source groups of significant difference with respect to the English proficiency level; Mann-Whitney U test is applied to data. As a result of the Mann-Whitney U test, it was observed that the significant difference stemmed from the a-b*, a-c*, a-d*, a-e* groups. This difference was against the teacher candidates' perceiving English proficiency level as very bad.

Findings of the Second sub-question of the Research

The second sub-problem of the research is stated as "Is there a statistically significant relation between Turkish and English language teacher candidates' "Perceived Computer Self-Efficacy" and their "Attitudes Toward Computer?"

The relation between the dependent variables of the research "Perceived Computer Self-Efficacy" and "Attitudes toward Computer" is calculated by the Pearson Product-Moment Correlation test.

Table 8. Pearson Product-Moment Correlation between Perceived Computer Self-Efficacy and Attitudes toward Computer

		Attitudes Toward Computer
Perceived Computer Self-Efficacy	r	0.535(**)
	p	0.000
	n	136

**p<.001

As is seen in table 8, there is a medium level positive statistically significant difference between perceived computer self-efficacy and attitudes toward computer. With this result, it can be concluded that when the attitudes toward computer or the perceived computer self-efficacy scores of the Turkish Department teacher candidates decrease/increase, a parallel decrease/increase will also be observed in the same scores of the English Department teacher candidates.

DISCUSSION

The aim of this study is to reveal the relation between the Turkish and English language teacher candidates' social demographic characteristics and their perceived computer self-efficacy and attitudes toward computer. The observed findings are discussed comprehensively.

It is seen that there is a significant difference between the perceived computer self-efficacy of the teacher candidates with respect to department, age, English proficiency level and socio-economic level, whereas there exist no meaningful differentiation with respect to gender.

When the perceived computer self-efficacy of the teacher candidates is evaluated according to their departments, it is seen that the perceived computer self-efficacy of the English department teacher candidates' is better than those of the Turkish department teacher candidates. This can be explained by the fact that the majority of the computer commands and information technologies are in English language and also the publishers of the books that are used in English departments provide a lot of additional computer resources whereas this is not true in

Turkish departments. These lead to the self-confidence and motivation of English department teacher candidates.

When perceived computer self-efficacy is examined with respect to age, it is seen that the perceived computer self-efficacy of the teacher candidates' shows an increase with increasing age. This can be attributed by the fact that the experiences of the teacher candidates' increase as they get older. However, since self-efficacy is a variable representing a psychological structure, the result obtained cannot be generalized as it is. For this reason, in case the variables other than the perceived computer self-efficacy which develop with age (experience, improved technological structuring, etc.) are included within the research model and a new study is carried out, different results can be obtained (Akkoyunlu & Orhan, 2003).

On the other hand, when perceived computer self-efficacy is evaluated with respect to gender, it is seen that there is no statistically significant difference. The result is also supported by the findings in the studies conducted by both Gerçek and Soran (2006) and Akkoyunlu and Orhan (2003).

It was observed that there is a significant difference in the teacher candidates' perceived computer self-efficacy with respect to their English proficiency level. This can be attributed by the fact that the teacher candidates with high English proficiency levels feel confident regarding information technologies and terminology and this must have affected their perceived computer self-efficacy.

It is observed that is a significant difference in the teacher candidates' perceived computer self-efficacy with respect to their socio-economic level. The research study of Çetin (2008) related to the perceived computer self-efficacy of Marmara University teacher candidates supports the findings of this study. The high socio-economic level of the individual increases the chance to possess or access the computer. This situation prepares the grounds for the teacher candidates' to increase the perceived computer self-efficacy via increasing the computer literacy.

It is seen that there is a significant difference the teacher candidates' attitudes toward computers according to English proficiency level, whereas there is no a significant difference regarding the attitudes toward computers with respect to department, age, gender and socio-economic level.

It is seen that the teacher candidates' attitudes toward computers do not display a significant difference according to department. When Table 6 is examined, it can be found out that the English Department teacher candidates' attitudes toward computers are comparatively higher than those of the Turkish Department teacher candidates' attitudes toward computers. However, this difference is not statistically significant. The significant difference according to department stems from the teacher candidates' perceived computer self-efficacy, not from their attitudes toward computers.

It is seen that the teacher candidates' attitudes toward computers do not indicate a significant difference according to gender. The previous research studies support the fact that the attitudes toward computers do not display a significant difference according to gender (Güler & Sağlam, 2002; Deniz, 2000; Hunt & Bohlin, 1993).

It is observed that there is no significant difference in the teacher candidates' attitudes toward computers according to their age. The result is also supported by the findings in the study conducted by Gerçek (2006).

It is seen that there is a significant difference in the teacher candidates' attitudes toward computers with respect to English proficiency level. This can be attributed to the same reason related to perceived computer self-efficacy.

It is observed that there is no significant difference in the teacher candidates' attitudes toward computers with respect to their socio-economic levels. The result is also supported by the findings in the study conducted by Atay (2008).

It has been found out that there is a medium level positive statistically significant difference between the perceived computer self-efficacy and the attitudes toward the computer. Busch (1995)'s study examining the relation between the perceived computer self-efficacy and attitudes of university students toward computers also supports this finding. It is necessary to take this relation into consideration while organizing the education facilities. Since cause and effect relation cannot be established in the correlation studies, it is not possible to discriminate whether attitudes increase self-efficacy or self-efficacy increases attitudes. In order to render this possibility, detailed causative comparisons and experimental studies should be carried out.

CONCLUSION AND RECOMMENDATION

It is observed that there is a significant difference in the perceived computer self-efficacy of the teacher candidates with respect to department, age, English proficiency level and socio-economic level, whereas there is no significant difference with respect to gender.

It is seen that there is a significant difference in the teacher candidates' attitudes toward computer with respect to English proficiency level, whereas there is no a significant difference with respect to department, gender, age, and socio-economic level.

It has been found out that that there is a medium level positive statistical difference between perceived computer self-efficacy and attitudes toward computer.

For the purpose of disseminating the use of computers as a tool of education by the teachers, it is necessary for the teachers, to whichever branch they belong to, to improve their skills related to information technology and computer literacy as well as learning software developed for computer aided language education and to utilize them in various courses.

REFERENCES

Ajzen, I. (2001). Nature and operations of attitudes. *Annual Review of Psychology*, (52), 27–58.

Akkoyunlu, B. & Orhan, F. (2003). Bilgisayar ve öğretim teknolojileri eğitimi (BÖTE) bölümü öğrencilerinin bilgisayar kullanma öz yeterlik inancı ile demografik özellikleri arasındaki ilişki. *The Turkish Online Journal of Educational Technology,* 2(3). Retrieved June 14, 2010 from http://www.tojet.net

Akkoyunlu, B., Orhan, F. & Umay, A. (2005). Bilgisayar öğretmenleri için bilgisayar öğretmenliği öz-yeterlik ölçeği geliştirme çalışması. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi,* (29), 1-8.

Altun, A. (2003). Öğretmen adaylarının bilişsel stilleri ile bilgisayara yönelik tutumları arasındaki ilişkinin incelenmesi. *The Turkish Online Journal of Educational Technology,* 2(1). Retrieved June 14, 2010 from http://www.tojet.net

Aşkar, P., Orçan, H. (1987). The development of an attitude scale toward computers. *Journal of Human Sciences,*6 (2), 19-23.

Aşkar, P. &Umay, A. (2001). İlköğretim matematik öğretmenliği öğrencilerinin bilgisayarla ilgili öz-yeterlik algısı. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi,* (21),1-8.

Atay, M. (2008). Mühendislik ve eğitim fakülteleri öğrencilerinin bilgisayar kullamına yönelik tutumlarının karşılaştırılması. *8th International Educational Technology Conference*. Anadolu University: Turkey.

Bandura, A. (1994). *Self-efficacy, In V.S. Ramachaudran (Ed.), Encyclopedia of Human Behavior.* New York: Academic Press.

Busch, T. (1995). Gender differences in self efficacy and attitudes toward computers. *Journal of Educational Computing Research,* (12), 147-158.

Büyüköztürk, Ş. (2006). *Experimental designs pretest-posttest control group design and data analysis.* Ankara: Pegem Publishing.

Coakes, S. J. & Steed, L. G. (1997). *SPSS, analysis without anguish*. John Wiley & Sons Publication.

Çavuş, H. & Gökdaş, İ. (2006). Eğitim fakültesi'nde öğrenim gören öğrencilerin internetten yararlanma nedenleri ve kazanımları. *Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi,* 3 (2), 56-78.

Çelik H. C. & Bindak R. (2005). İlköğretim okullarında görev yapan öğretmenlerin bilgisayara yönelik tutumlarının çeşitli değişkenlere göre incelenmesi. *İnönü Üniversitesi Eğitim Fakültesi Dergisi,* 6 (10), 27-38.

Çetin B. (2008). Marmara üniversitesi sınıf öğretmeni adaylarının bilgisayarla ilgili öz-yeterlik algılarının incelenmesi. *D.Ü. Ziya Gökalp Eğitim Fakültesi Dergisi,* (11), 101-114.

Deniz, L. (2000). Öğretmen adaylarının bilgisayar yaşantıları ve bilgisayar tutumları. *M.Ü. Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi,* (12), 135-166.

Fishbein, M. & Ajzen, I. (1975). Belief, attitude, intention and behavior: An introduction to theory and research. Reading, MA; Addison Wesley, Publishing.

Gerçek C. & Soran H. (2006). Öğretmen adaylarının bilgisayar kullanımına yönelik tutumlarının çeşitli değişkenler açısından incelenmesi. *H.Ü. Eğitim Fakültesi Dergisi,* (30), 130-139.

Güler, M. H. & Sağlam, N. (2002). Biyoloji öğretiminde bilgisayar destekli öğretimin ve çalışma yapraklarının öğrencilerin başarısı ve bilgisayara yönelik tutumlarına etkileri. *H.Ü. Eğitim Fakültesi Dergisi,* (23), 117-123.

Harrison, A. W., Kelly Rainer, R. JR. (1992). An examination of the factor structures and concurrent validities for the computer attitude scale, the computer anxiety rating scale, and the computer self-efficacy scale. *Educational and Psychological Measurement,* 52(3), 735-745.

Hashim, H. R. & Mustapha, W. N. (2004). Attitudes toward learning about and working with computers of student at uitm. *The Turkish Online Journal of Educational Technology,* 3(2), Retrieved June 20, 2010 from http://www.tojet.net

Hunt, N. P. & Bohlin, R. M. (1993). Teacher education students' attitudes toward using computers. *Journal of Research on Computing in Education,* 25(4), 487-497.

Işıksal, M., Aşkar, P. (2003). İlköğretim öğrencileri için matematik ve bilgisayar öz-yeterlik algısı ölçekleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi,* (25), 1-8.

Işman, A. & Çelikli, G.. (2009). How does student ability and self-efficacy affect the usage of computer technology? *The Turkish Online Journal of Educational Technology,* 8(1). Retrieved January 20, 2010 from http://www.tojet.net

Karasar, N. (1998). *Bilimsel araştırma yöntemi.* Ankara: Nobel Yayın Dağıtım.

Kutluca, T. & Ekici. G. (2010). Examining teacher candidates' attitudes and self-efficacy perceptions towards the computer assisted education, *H. U. Journal of Education,* (38), 177-188.

Morris, A. S., Gullekson, L. N., Brendan J. M. &. Popovich M. P. (2009). Updating the attitudes toward computer usage scale using american undergraduate students. *Journal of Computers in Human Behavior*, 25(2009), 535-543.

Robinson, P.B., Simpson, D. V., Huefner, J. C. & Hunt, H. K. (1991). An attitude approach to the prediction of entrepreneurship: Entrepreneurship. Theory & Practice, Summer, 13-31.

Schunk, D. H. (1984). Enhancing self-efficacy and achievement through rewards and goals: Motivational and informational effects. *Educational Research*, (78), 29-34.

Serin, O. (2011). The effects of the computer-based instruction on the achievement and problem solving skills of the science and technology students. *The Turkish Online Journal of Educational Technology,* 10(1). Retrieved February 14, 2011 from http://www.tojet.net

Smith, B. & Caputi, P. (2000). Differentiating computer experience and attitude towards computers: An empirical investigation. *Computers in Human Behavior*, 16, 59-81.

Tabachnick, B. G. & Fidell, L. S. (2000). *Using multivariate statistics.* Boston: Allyn and Bacon.

Torkzadeh, G. & Koufteros, X. (1994). Factorial validity of a computer self-efficacy scale and the impact of computer training. *Education and Psychological Measurment, 54*(3), 813-821.

WHEN A CLASSROOM IS NOT JUST A CLASSROOM: BUILDING DIGITAL PLAYGROUNDS IN THE CLASSROOM

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ABSTRACT
In the context of classroom, it is possible to create a playground with digital technology beneficial for learning in spite of rising enthusiasm in incorporating educational games in classroom. This paper is an essay to describe a learning playground called Digital Learning Playground (DLP). It is essentially an application of digital technology to build a Mixed Reality environment with game-based-learning-like ingredient for classroom context. A learning theory that could be used to describe the learning process is that of experiential learning by Kolb. Meanwhile, Total Scenario Response (TSR) can be used for its learning design. Although the experiment was applied in the context of learning English, it may open a possibility to extend for the purpose of learning other subjects, such as Math.
Keywords: Digital Learning Playground (DLP), Total Scenario Response (TSR), experiential learning theory, game-based learning.

INTRODUCTION
Recently, there has been growing interest in the application of new digital technology to improve playing, learning and education. For example, Seitinger, Sylvan, Zuckerman, Popovic, and Zuckerman (2006) reported a design and testing experience of their prototype work on interactive pathway for kid outdoor playground. As another example, Intelligent Playgrounds (Sturm, Bekker, Groenendaal, Wesselink, & Eggen, 2008) were proposed to enhance playground experience with advanced technologies as an effort to overcome the impact of computer games and televisions on reduced social interaction due to children’s time spent in gaming and television viewing, and children’s health because of reduced physical movement. An example in e-learning is the use of animated pedagogical agent as an emphatic avatar to emotionally encourage students to keep on their learning (Chen, Lee, et al., 2011). In the context of classroom, it is possible to create a playground with digital technology beneficial for learning in spite of rising enthusiasm in incorporating educational games in classroom. Educational games in classroom may be classified based on the use of devices into three types as follows:

1. Without using any IT devices: This type uses a minimum of teaching aids, and the aids sometimes are the lightest and cheapest. This method has been widely adopted by classroom teachers, and most classmates can be involved in the game at the same time. Or some are playing while others are learning through observation and imitation. However, these simplest teaching aids constrain the complexity and variety of games; consequently affect students’ deep of learning and chances of practicing their learned knowledge.
2. Using vertical screen as TV games or computer games: In classroom, the screen can be big enough for every student watching it while using a project. However, only few students can play the game with or without teacher’s instructions. Rest of the classmates can only observe aside. Teachers could not allow more students to be involved in the playing at the same time. Involvement and learning effect on those observers might be deficient.
3. Using horizontal table as board games: Using a horizontal table as a playground is the common feature of

these games. More students can sit around the table and compete excitingly. Compared to the first type (without using any IT devices), the plot and some game aids on the table could offer higher complexity and extensibility of learning results. Compared to the second type (using vertical screen), the horizontal table can gather students around and involves them in game playing.

Vertical screen and horizontal table however have different strengths. If providing avatars to communicate with students, using vertical screen is recommended. If requiring group discussion or movement of something concrete on the game plot, a horizontal table should be adopted. Similarly, if we want to create an experiential learning (Kolb, 1984) environment, a vertical screen synchronized with a horizontal table might be of great help to students involvement in situation and learning.

Compared to conventional game-based learning for classroom use, DLP can provide an alternative way. Although game-based learning is believed as capable of making an engaging learning environment (Garris, Ahlers, & Driskell, 2002), it is not always convenient to use in classrooms where teachers oftentimes need to directly guide their students during learning process. Thus this paper offers a design that can make game-based learning be put into classrooms, i.e., how to make classrooms become learning playgrounds. Total Scenario Response (TSR) is devised to design learning activities in the digital playground where all of its game scripts proceed by using the learning materials. When the learners apply the knowledge required in the scripts, they can experience its effect. As a learning place, DLP can involve teachers and students in the learning playground activities while the teachers can act as learning guides and the learners can experience the effect of the knowledge in the playground.

The structure of the paper is as follows. Next section describes the improvements of classrooms followed by a section on theoretical principle behind DLP, the experiential learning. Finally, before discussion and conclusion section, the connection between DLP and Total Scenario Response is explained.

IMPROVEMENTS OF CLASSROOMS WITH DLP

Classrooms are almost always the major learning environments for students. However, in the past, learning in classroom does not change too much. Even so many technologies have been introduced into classroom (Westera, 2010), such as whiteboards, overhead projects, and instructional television, most students still sit in line and learn from teachers' lectures. Recently, the design-based research approach (Wang & Hannafin, 2005) and rapid development of technology make the revolutionary change of the learning in classrooms become possible.

Traditionally, when students were prepared for industrial labors, classroom learning was instructionism. Later finding from cognitive sciences, deep learning has gradually been applied in classrooms (Sawyer, 2006, pp. 1–16). Deep learning requires not merely transfer of knowledge from the teacher to students, but it is dynamic interaction and transaction among the teacher, knowledge and the students. Change also happen in computer and technology use and innovation for learning, from the role of expert to deliver knowledge into a facilitator to give experience to enable deep learning. And according to Kolb in Zull (2004), deep learning can be attained through an integration and progression of experiential learning cycle: experiencing, reflecting, abstracting (thinking), and active testing (acting). A classroom moves from static to more dynamic nature.

Recent technological support for dynamic interaction can be found in touch technologies, for example, tablet PC, touch screen monitors, and interactive whiteboards. A notion of engagement emerges due to touching activities by a teacher or students made possible from this innovation. With the tablet PC, students can dynamically interact with the digital learning content, and then participate by touching the screen for hands-on practice. In digital board game learning design based on the DLP, SMART board for easy objects manipulation by touching was also used (Chen, Wu, & Chen, 2011).

Another tool to enhance classroom learning is simulation, especially computer simulation. An example in engineering education is a network growth simulator program (SONG) that was shown to increase understanding of the subject matter and improve higher-order thinking skills of the students (Chen & Levinson, 2006). When real experiment cannot be done in real physical settings due to its size that is too small or too big, its dangerous nature, or its being invisible, or its being too expensive, oftentimes simulations can help (Steinberg, 2000). With simulation as an experiential knowledge generator (Ören, 2011), learners can learn by experiencing, through doing, interacting, and thus engaging their motivation to learn (Chen & Levinson, 2006).
While a simulation is usually done with a computer with standard I/O facilities, such as a keyboard, a mouse, and an LCD Monitor, there are also other growing interests in extending simulation effect and capabilities by using other ways to improve learning effect. The choice of 2-D or 3-D visualization for simulation interface may

facilitate students to create meaning, to interpret, and to express that influence their learning. Limniou, Roberts, and Papadopoulos (2008), for example, visualized chemical phenomena designed for CAVE^{TM} that could increase student's learning interest and motivation. Moreover, when Mixed Reality (MR) technology is applied to education and used in a classroom, an idea to create near authentic learning environment may be realized (Chang, Lee, Wang, & Chen, 2010). Knowledge construction is accommodated by this MR-based learning environment because the environment may support constructivism and experiential learning, social/collaborative learning, presence, immersion, and interactivity (Liu, Cheok, Mei-Ling, & Theng, 2007). The enhancement becomes a kind of a simulation with extra benefits; and a term *simulation++* may be coined to this, which is an MR technology to simulate an authentic learning environment to produce (near) authentic learning effects. In another case of MR use is a work by Schaf, Müller, Pereira, and Bruns (2008) where MR is designed for learning environment of remote labs and distributed workspaces. In this setting, collaborative learning is achieved with reduced cost because no duplication in real hardware.

When robot technology is also included, some possibilities occur, for example, collaborative learning can be realized using robots. Experiments or demonstration in physics, such as lesson in motion, can be done with robots specifically designed for this. Collaboration might be facilitated due to the tangible nature of robots, in which a shared space for collaborative transaction can be designed. (Marshall, 2007). Moreover, direct interaction by seeing each other's gaze is possible, thus speeds up the understanding of meaning communication. In this case, collaboration, as opposed to independent learning, is indeed one characteristic in meaningful learning (Jonassen, Howland, Marra, & Crismond, 2007).

While robots become increasingly more accessible, they have also been incorporated into the design of DLP. As in Chang, Lee, Chao, Wang, and Chen (2010), robots can be used to play some roles in the classroom, and it was analyzed that some characteristics of robots match with some instructional goals. These robot characteristics include repeatability, flexibility, shareability and preservability, existence with human-like, body movement, interaction, and suspension humanity; each or some of these can be mapped into one or some instructional goals, such as to gain attention, to recall prerequisites, to present objectives, to present new content, to support visual examples, to elicit student response, to provide feedback, to enhance retention and transfer, or to assess performance. It was also identified that robots plays three roles in instruction: learning/teaching tools, teacher's assistant, and learning companions/pets (Chang, Lee, Chao, et al., 2010). In DLP, these robots can also be used as partner/delegation of a team. The benefits of robot as physical and tangible interface were explored. Authentic learning is more supported with robots than virtual characters due to learners' preference in interacting with robots (Chang, Lee, Wang, et al., 2010).

Advances in new digital technology indeed help in realizing authentic learning environment because more complex interactions and thus learning experiences can now be designed (Reiser, 2001). However, as can be seen in Jurassic Park movie, learning experientially a dinosaur in a Jurassic Park can be dangerous because a real complex adaptive system like a dinosaur may behave unpredictably (Katerndahl, 2009). In this case, to save students from any possibility of unwanted risks, a simulated environment may be needed. An effort to do this is by creating a Digital Learning Playground (DLP). Besides as a simulated environment, DLP has been designed to investigate the possibility of creating an authentic learning environment in the classroom (Wang et al., 2010). In a DLP, a "dinosaur" (everything not possible to learn directly and experientially) may be safely brought into a classroom and learned. While meeting the experiential learning requirements, the DLP can be a safe place for a teacher to teach and students to learn. DLP is a kind of enhancement or transformation for a classroom. It integrates and merges various components to provide an experiential near authentic learning environment.

The DLP has somehow been capable of moving Jurassic park into a classroom with the "dinosaurs" are readily provided to learn simultaneously by the teachers and students, in which case the dinosaurs represent real world that oftentimes complex, dangerous, or impossible to learn experientially and in situated manner. The DLP provides *simulation++* learning environment by using target knowledge in context, with a mission to be completed by students, and a set of learning events to facilitate performing actions that are required by target knowledge.

In DLP, the perspective is different from the one used in game-based learning, in that DLP starts from fun learning first point of view. The point is to have fun while learning instead of to learn while having fun such as in game based learning, and this is possible due to digital technologies. In DLP, digital technologies are used to build a near authentic learning environment in the classroom. Digital technologies, as predicted by Moore's Law ("Moore's law - Wikipedia, the free encyclopedia," n.d.), continue to grow, improve, and become increasingly more available to everyone, including for every classroom. E-books, Kinect, voice and video recognition, pervasive computing, mixed reality, augmented reality, virtual reality, etc., will become available in classrooms soon. As an illustration, a similar program, called One Laptop Per Child (OLPC), has been in operation since 2007 (http://one.laptop.org/). It is envisioned that game-based learning will become digital playground based learning played in classrooms.

In DLP, the word "learning" means putting learning content into the environment in which the playground is set to convey the context for knowledge while activities/tasks are designed to use target knowledge as the commands (Chang, Lee, Wang, et al., 2010). The word "play" requires that the learning activities should be fun and engaging. Finally, "ground" indicates that the environment is created to let the students be involved in or stood on it.

While in game based learning, learning effect is tried to be obtained by students' playing game. Thus game-based learning is a kind of "a medicine pill coated with sugar", whereas DLP by design may represent "delicious and nutritious food beneficial for health and curing illnesses" prepared from the beginning. However, as in Kiili (2005), DLP shares the characteristics of the experiential gaming model where there are three components that need to be available: immediate feedback, obvious goals and suitable challenges. These are what play or game characteristics in order to be fun, including also fantasy, competition (no user elimination), challenge, control/command (immediate response), curiosity, randomness (surprise), recognition, and users' involvement and engagement (Malone, 1980).

To conclude the section, advances in technology from time to time has influence on teaching and learning activities in classrooms. As another application of current technology, the DLP is designed to become a platform for classrooms. Required equipments for the DLP have already been available in classrooms. Thus the technology is affordable and it may provide a near authentic learning environment and experiences to conventional classrooms. Moreover, as suggested by Jonassen et al. (2007, pp. 2–5), learning with technology in order to become meaningful learning, required 4 characteristics – active, constructive, cooperative, authentic, and intentional – may be fulfilled in DLP.

THE DESIGN METHOD OF DLP

In following sections, the method for designing and developing DLT is addressed and several DLP implementations that are designed according to this method are introduced.

Total Scenario Response (TSR) design method

When Confucius (ca 450 BC) says "Tell me and I will forget; show me and I may remember; involve me and I will understand," this now coincides with the essence of experiential learning theory (Kolb, 1984) which is based on the constructivism philosophy. The definition of learning in experiential learning theory is "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). Thus an efficient and long-lasting form of learning is to involve the learners by creating a meaningful learning experience. Learning is the process whereby knowledge is created by the transformation of experience.

Figure 1 is a review of the four stage process model of experiential learning cycle by Kolb (1984). The learners go through a circular process from Concrete Experience: act, reflect, conceptualize, apply, and go back to act. The learners act by starting with concrete experience, followed by reflection, followed by abstraction or generalization, and lead to application to more concrete experiences. And this cycle goes repeatedly. Vertical line as perception continuum represents experience grasping mode – Concrete Experience (CE) and Abstract Conceptualization (AC), whereas horizontal line as processing continuum represents experience transforming mode – Reflective Observation (RO) and Active Experimentation (AE). The learning process in the model happens in clock-wise direction.

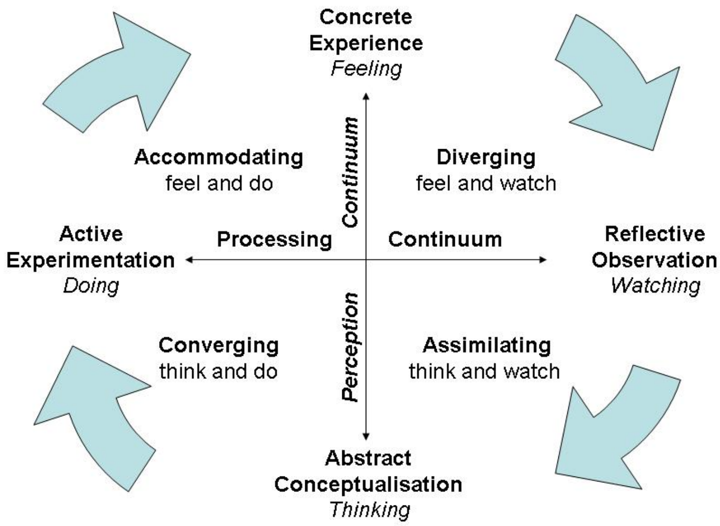

Figure 1: Four-stage of Kolb Experiential Learning Cycle (Kolb, 1984)

In terms of design of learning activities, the DLP can use this model of four-stage learning cycle where learners' direct experiences and reflections on learning are considered as important. Each learning activity is derived into three components: act, respond, and reflect, as follows: (1) Act – Learning contents are converted into robot commands by which students can communicate with the robot and the stage; (2) Respond – every command accepted by the system from the student is immediately responded in multimedia display; (3) Reflect – by experiencing the command and immediate response, students can reflect the situated knowledge via system feedback and they can decide whether they use knowledge correctly or not. This leads to Total Scenario Response (TSR) design method.

TSR method could be used as the basis for learning design in DLP. It is named after Total Physical Response (TPR) method previously developed by Asher (1969) for second language learning. The principle of TPR is "to have the students listen to a command in a foreign language and immediately obey with a physical action." In other words, students respond to commands that require physical movement. Analogue to this, TSR requires that the scenario (learning context environment) respond to the commands of the learners. As a result, learners should readily understand from the response of the scenario. In TSR, the following principles (Table 1) could be applied

Table 1: Principles of Total Scenario Response (TSR) Design Method

Component	Principles
Total	Total means complete to include the following: • The effect of the command (based on the knowledge) from learners should be responded in the Scenario so that the learners understand the effect of the knowledge • *All* knowledge to be learnt is transformed into commands • Immediate responses are provided and affordance of the response is acceptable
Scenario	• The interactive contextual environment is built in the classroom by using digital technologies • Scenario can have proper and understandable response of the effect of the knowledge • Scenario contains a mission that can be broken down into learning activities, tasks, or commands
Response	• The commands from the learners should be based on the knowledge to be learnt. • Each learning activity consists of input and output where the input is a knowledge command and the output is the effect or representation of the knowledge • Output is immediately shown as a response to input

The TSR in practice is derived further into the following tasks for teachers and students: (1) Teachers: They do knowledge orientation/demonstration to teach how to use the DLP and how to apply knowledge by interacting with the system in the environment to accomplish learning tasks; in which case, commands represent knowledge. They demonstrate how to interact with DLP to construct knowledge. (2) Learners: They attend to orientation and demonstration from teachers, experience knowledge application, do reflective observation, for example, by watching others actions (knowledge observation), discuss practical experience of other students, and do active experimentation. Thus the DLP facilitate demonstration/orientation, application, and observation of knowledge.

As previously mentioned that Act-Respond-Reflect cycle is devised for experiential learning in DLP, in order to be able to do these cycle for classroom learning, the DLP provides appropriate context for experiencing knowledge (microworld) and tasks to let student use knowledge to move towards to the goals of authentic tasks. Context may be derived from Scenario component whereas tasks from Total and Response components (Table 1). Therefore, Total Scenario Response is proposed to design a DLP for students to recognize problems, use knowledge to solve them, and experience the effect of knowledge.

The DLP designed based on TSR

Figure 2 shows the basic form of DLP realization with TSR design method. In this arrangement of dramatic stage metaphor, the vertical screen of DLP presents situational scenarios for designing the learning content and the table forms a learning space that classroom teachers and students can stand around and perform tasks. Digitalization of a dramatic stage into a DLP gives benefit that it can provide immediate responses for the actions learners did so they can learn by experiencing. This is not always the case in a real context: upon doing one thing based on learners' knowledge, the learners may not immediately get reaction from the environment for their action. Figure 3 represents another example of DLP.

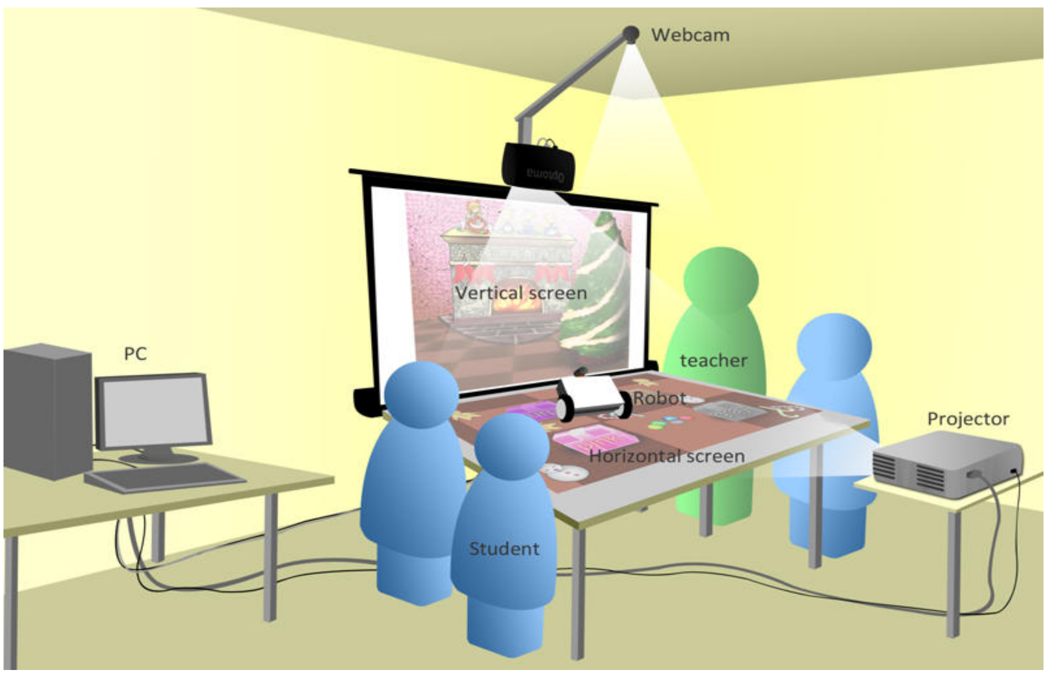

Figure 2: Basic Arrangement of DLP realization with TSR Design Method

Figure 3: RoboStage: Another Example of DLP to Realize Playground Based Learning (Chang, Lee, Wang, et al., 2010)

To learn experientially in DLP, a situation comprising of learning context and mission for experimenting the target knowledge is created. The mission can be broken down into learning activities that can be further broken down into tasks and then commands (Table 1). The learning context may be represented in many ways: It can be a contextual environment designed according to learning subject where technology like Kinect and tangible interaction can be used. It can be a real field where students interact in the context as if they were in real environment. It can also be a simulated or emulated (mixed reality) environment. Learning activities then can be designed based on knowledge and knowledge map, in which learners can do activities and knowledge experiment.

The situation created in DLP provides situated learning, learning that requires context to apply the knowledge. It is when situated learning is combined with play elements that it may become a learning playground. To create learning context representing the situation needs to design contextual environment based on learning subject. The environment can be a real field or a simulated or emulated (mixed reality) environment. Learning activities are then designed based on the knowledge or knowledge map, which could be activities or knowledge experiments. Finally, tasks or mission needs to be found so the activities will be oriented to this. These three elements – learning context, learning activities, and task or mission – build a learning playground environment.
In the environment, learners will interact with contextual field and this is not a new thing but this interaction has gone through an evolution in some phases. The first phase is Windows Icon Menus Pointers (WIMP), which is later called Graphical User Interface (GUI), when windows, icon, menus, and pointers kind of interaction are used. The second phase is delegation or virtual partner such as by using robots or avatars. The third phase is human emergent in the field with natural interaction (via body movement, hand gesture, and voice) or tangible interfaces. The DLP anticipates this third phase of interaction because tangible things like robots are believed to give more benefits than virtual agents (Chang, Lee, Wang, et al., 2010). Wainer, Feil-Seifer, Shell, and Mataric (2007) found that an embodied robot was more appealing and perceptive of the world than non-embodied robots. Moreover, the embodied robot was seen as most helpful, watchful, and enjoyable when compared to a remote tele-present robot and a simulated robot.

To end this section, our works based on the DLP have been related to robot, board game, and users' direct involvement with interactive card (Jiang, Chen, Wu, & Lee, 2011). In the beginning before the digital stage was built, the research examined the educational use of a robot in a classroom, e.g. Chang et al. (2010), in which the classroom setting was used as the context. Later research, a digital stage, as a stage based learning game, was built for the robot (Wang et al., 2010). Another development adopted board game in horizontal stage with vertical screen was used for simulative context (Chen, Wu, & Chen, 2011). Another experiment using the DLP, a robot functioning as a learning partner/companion was shown to engage students in learning English (Chen, Chi, Huang, Fan, & Wu, 2011).

DISCUSSION AND CONCLUSION

A digital playground, called Digital learning playground, as a platform is aimed at building a near real context field that the knowledge is to be used to achieve mission and complete tasks. With this platform, experimenting with and making explicit of the process of authentic learning, learning by doing, or situated learning by using technology is possible.

The Digital Learning Playground involving robot has been created to help students learn in authentic environment. Currently, a modified version of the playground utilizes digital board game in its tabletop featuring touch enabled pad in which the students learning are also engaged and satisfied by means of a gaming flow (Chen, Wu, & Chen, 2011). Another finding (Chang, Lee, Wang, et al., 2010) confirms that robot character is better than virtual character in terms of authenticity, engagement, and motivation; thus this may increase learning performance. These hopefully may motivate future researches in the use of similar computerized tangible technological products for learning. In other words, this may inspire other educational researchers to innovate further so that learners can learn by doing and playing.

Viewed from the context of learning researches and innovations, robot itself has potential to be used as an instructional tool in the context of classroom setting due to its beneficial characteristics in supporting instructional goals (Chang, Lee, Chao, et al., 2010). Furthermore, by including a robot on the tabletop in DLP context, as compared to using virtual character, the finding suggests that learners' preference to interact with is robot (Chang, Lee, Wang, et al., 2010). This implies that physical things have higher potential to engage and to support authentic and possibly experiential learning due to its higher sense of being and reality. Although the experiment was applied in the context of learning English, it may open a possibility to extend for the purpose of learning other subjects, such as Math.In another context, with current existing technology support, affordable near authentic learning environment can be brought to classrooms. However, this may have implication that teachers may find it difficult to prepare lessons with DLP by themselves until a mechanism such as a "DLP authoring tool" is developed or invented in the future. The tool is supposed to be easy to learn and to use by the teacher. Alternatively, there might be an educational company developing and providing a complete set of DLP hardware and teaching-ware available for every subject or lesson.

Future development of the platform will be working toward constructing natural tangible interaction for the learners and trying to consolidate theory base of Digital Learning Playground and Total Scenario Response method. Besides, as previously mentioned, another possibility is to investigate the application of the platform to different courses.

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REFERENCES

Asher, J. J. (1969). The Total Physical Response Approach to Second Language Learning. *The Modern Language Journal*, *53*(1), 3-17.

Chang, C.-W., Lee, J.-H., Chao, P.-Y., Wang, C.-Y., & Chen, G.-D. (2010). Exploring the possibility of using humanoid robots as instructional tools for teaching a second language in primary school. *Educational Technology & Society*, *13*(2), 13-24.

Chang, C.-W., Lee, J.-H., Wang, C.-Y., & Chen, G.-D. (2010). Improving the authentic learning experience by integrating robots into the mixed-reality environment. *Computers & Education*, *55*(4), 1572-1578. doi:16/j.compedu.2010.06.023

Chen, G.-D., Chi, Y.-L., Huang, C.-W., Fan, C.-Y., & Wu, C.-J. (2011). Design a Partner Robot with Emotions in the Mixed Reality Learning Environment. In M. Chang, W.-Y. Hwang, M.-P. Chen, & W. Müller (Eds.), *Edutainment Technologies. Educational Games and Virtual Reality/Augmented Reality Applications* (Vol. 6872, pp. 457-463). Berlin, Heidelberg: Springer Berlin Heidelberg. Retrieved from http://www.springerlink.com/content/l4832n174v9466m4/

Chen, G.-D., Lee, J.-H., Wang, C.-Y., Chao, P.-Y., Li, L.-Y., & Lee, T.-Y. (2011). An Empathic Avatar in a Computer-Aided Learning Program to Encourage and Persuade Learners. *Educational Technology & Society*.

Chen, K.-C., Wu, C.-J., & Chen, G.-D. (2011). A Digital Board Game Based Learning System for Authentic Learning. *Advanced Learning Technologies, IEEE International Conference on* (pp. 25-29). Los Alamitos, CA, USA: IEEE Computer Society. doi:http://doi.ieeecomputersociety.org/10.1109/ICALT.2011.16

Chen, W., & Levinson, D. M. (2006). Effectiveness of Learning Transportation Network Growth through Simulation. *Journal of Professional Issues in Engineering Education and Practice*, *132*(1), 29. doi:10.1061/(ASCE)1052-3928(2006)132:1(29)

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, Motivation, and Learning: A Research and Practice Model. *Simulation & Gaming*, *33*(4), 441 -467. doi:10.1177/1046878102238607

Jiang, J.-S., Chen, G.-D., Wu, C.-J., & Lee, W.-J. (2011). A Scenario-triggered Learning Environment with Augmented Reality for Situated Learning. *Proceedings of the 19th International Conference on Computers in Education*. Presented at the ICCE, Chiang Mai, Thailand.

Jonassen, D. H., Howland, J. L., Marra, R. M., & Crismond, D. P. (2007). *Meaningful Learning with Technology* (3rd ed.). Prentice Hall.

Katerndahl, D. A. (2009). Lessons from Jurassic Park: patients as complex adaptive systems. *Journal of Evaluation in Clinical Practice*, *15*(4), 755-760. doi:10.1111/j.1365-2753.2009.01228.x

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development* (1st ed.). Englewood Cliffs, NJ: Prentice Hall.

Limniou, M., Roberts, D., & Papadopoulos, N. (2008). Full immersive virtual environment CAVETM in chemistry education. *Computers & Education*, *51*(2), 584-593. doi:10.1016/j.compedu.2007.06.014

Liu, W., Cheok, A. D., Mei-Ling, C. L., & Theng, Y.-L. (2007). Mixed reality classroom (p. 65). ACM Press. doi:10.1145/1306813.1306833

Malone, T. W. (1980). What makes things fun to learn? heuristics for designing instructional computer games. *Proceedings of the 3rd ACM SIGSMALL symposium and the first SIGPC symposium on Small systems*, SIGSMALL ’80 (pp. 162–169). New York, NY, USA: ACM. doi:10.1145/800088.802839

Marshall, P. (2007). Do tangible interfaces enhance learning? (pp. 163-170). Presented at the Proceedings of the 1st international conference on Tangible and embedded interaction, ACM.

Moore’s law - Wikipedia, the free encyclopedia. (n.d.). . Retrieved November 28, 2011, from http://en.wikipedia.org/wiki/Moore%27s_law

Ören, T. (2011). A Critical Review of Definitions and About 400 Types of Modeling and Simulation.

Reiser, R. A. (2001). A history of instructional design and technology: Part I: A history of instructional media. *Educational Technology Research and Development*, *49*, 53-64. doi:10.1007/BF02504506

Sawyer, R. K. (2006). *The Cambridge Handbook of the Learning Sciences* (1st ed.). Cambridge University Press.

Schaf, F. M., Müller, D., Pereira, C. E., & Bruns, F. W. (2008). Computer Supported Collaborative Social Environment for Education, Training and Work. *Remote Engineering and Virtual Instrumentation*.

Seitinger, S., Sylvan, E., Zuckerman, O., Popovic, M., & Zuckerman, O. (2006). A new playground experience: going digital? *CHI ’06 extended abstracts on Human factors in computing systems*, CHI EA ’06 (pp. 303–308). New York, NY, USA: ACM. doi:10.1145/1125451.1125520

Steinberg, R. N. (2000). Computers in teaching science: To simulate or not to simulate? *American Journal of Physics*, *68*, S37. doi:10.1119/1.19517

Sturm, J., Bekker, T., Groenendaal, B., Wesselink, R., & Eggen, B. (2008). Key issues for the successful design of an intelligent, interactive playground. *Proceedings of the 7th international conference on Interaction design and children*, IDC ’08 (pp. 258–265). New York, NY, USA: ACM. doi:10.1145/1463689.1463764

Wainer, J., Feil-Seifer, D. J., Shell, D. A., & Mataric, M. J. (2007). Embodiment and Human-Robot Interaction: A Task-Based Perspective. *The 16th IEEE International Symposium on Robot and Human interactive Communication, 2007. RO-MAN 2007* (pp. 872-877). Presented at the The 16th IEEE International Symposium on Robot and Human interactive Communication, 2007. RO-MAN 2007, IEEE. doi:10.1109/ROMAN.2007.4415207

Wang, C.-Y., Chen, C.-hung, Wu, C.-J., Chi, Y.-L., Lee, J.-H., & Chen, G.-D. (2010). Constructing a Digital Authentic Learning Playground by a Mixed Reality Platform and a Robot. *Proceedings of the 18th International Conference on Computers in Education* (pp. 121-128). Presented at the International Conference on Computers in Education, Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education.

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, *53*, 5-23. doi:10.1007/BF02504682

Westera, W. (2010). Technology-Enhanced Learning: review and prospects. *Serdica Journal of Computing*, *4*,

159-182.
Zull, J. E. (2004). The art of changing the brain. *Educational Leadership*, *62*, 68-72.

A COMPARATIVE STUDY OF "THE INTERNATIONAL EDUCATIONAL TECHNOLOGY CONFERENCE" (IETC) AND "THE INTERNATIONAL CONFERENCE ON COMPUTERS IN EDUCATION" (ICCE): THE PROGRAM, ESSAY DISTRIBUTION, THE THEMES, AND RESEARCH METHODS

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ABSTRACT
The article aims to compare international conferences, The International Educational Technology Conference (IETC, 2011) and The International Conference on Computers in Education (ICCE, 2010), from various dimensions. The comparison is expected to conclude a better approach for every IETC and ICCE to be held.
Keywords: The Turkish Online Journal of Educational Technology(TOJET), The Asia-Pacific Society of Computers in Education(APSCE), Comparative Study

1. INTRODUCTION
"The International Educational Technology Conference" (IETC) held in Turkey and Turkish Republic of Northern Cyprus has added up to 11 sessions and has expanded its effects within collaborative periodical "The Turkish Online Journal of Educational Technology" (TOJET) as well as SSCI. As the 12th session will leave the Mediterranean for Eastern Asia for the first time, its influence will continue to expand. "The International Conference on Computers in Education" (ICCE), a prestigious event held since 1989, shall be a great reference for the IETC to be held in APEC region; Thus this article sets its aims at comparison and analysis on the two events.

2. CONCEPTUAL FRAMEWORK AND ANALYSIS SCHEMA
The IETC and ICCE are both crucial events aiming at the technological application to education with a view to better efficiency in learning; the former has been held annually in both Turkey and Turkish Republic of Northern Cyprus since 2001 while the latter has gone through 19 sessions so far since 1989, hosted by various nations within APEC region. These events adopt similar historical background and objectives, both promoted from the region to the globe.

The study compares the development and programs of the two conferences, which were chosen because the front is founded in Turkey and promotes the TOJET, and the later is organized by Asia Pacific Society for Computers in Education(APSCE).

The study analyzes the aforementioned conferences with the Comparative Methods proposed by George Bereday (1964), which conducts description, interpretation, juxtaposition, and comparison. Bereday's view widely used in the comparative study of education policy, cross-country comparisons and other research, also commonly used to compare national standards for e-learning. In this article, the development and the latest agenda of each conference are processed through the method of documentation survey while the nation/ region of authors (the first authors or corresponding authors), themes, and research methods are subjects to a statistical analysis.

3. COMPARISON

3.1. Development and History

The study compares the most recent event of IETC2011) and ICCE2010 from the perspectives such as development, essay collection, and the agendas (http://www.iet-c.net/, http://www.icce2010.upm.edu.my/). Details are listed as Table 1.

3.2. Distribution of Papers Published

There are 155 papers in ICCE 2010 and 335 papers in IETC 2011. However, 133 papers in IETC2011 were not written with English, so we excluded these from analysis. 202 papers in IETC2011 were issued from 28nations/ regions, with the top five naming Turkey, Malaysia, Taiwan, USA, Jordan and India. 155 papers in ICCE2010 were issued from 21nations/ regions; with the top five naming Japan, Taiwan, Malaysia, Singapore and Korea. Nationality/ regions of authors in IETC2011 include Turkey and the Mediterranean (41.6%); those from Taiwan, USA and other nations in Asia-Pacific region take up 33.7%. Malaysia, the host nation of the ICCE2010, stands the 3rd place for the amount of papers issued, with the main circulation in Asia-Pacific region stands a rate of 94.8%:

Table 1. Comparing IETC2011 and ICCE2010

	IETC2011	ICCE2010
The first session	Turkey (2001)	Taiwan (1989)
Sessions (up to 2011)	11	19
Frequency	Annual	● Every two years (1989-1997) ● Annual since 1998
Venue (up to 2011)	● Turkey and Turkish Republic of Northern Cyprus ● A second place since the 3rd session	● Various economies in Asia-Pacific region: TW, SG, MAS, HK, PROC, JP, KOR, NZ, AU, TH. ● Out of TW since the 4th session
Essays/ themes of conference proposed	N	6
Papers	● 133 in Turkish ● 201 in English	● 155 in English
Publishing form	(full) paper	● Full paper ● Short paper ● Poster
Language of papers	English and Turkish	English
Count of nationality/ regions of the first authors	28	21
Collaborative periodicals & societies	TOJET	APSCE
Call for proposals	N	● Workshop Proposals ● Open Forum Proposals ● Panel Proposals ● Interactive Sessions Proposals ● Tutorial Proposals
Duration of conference	3	5
Theme of the year	N	Y
Major activities of the programmed	● Keynote addresses ● Full-paper publishing	● Keynote addresses ● Addresses by Theme-based Invited Speakers ● Workshop ● Doctoral Student Consortium ● 2009 APSCE Distinguished Researcher Award

Content analysis was carried out for topic and research methodology analysis. Descriptive statistics were used to analyze and report the data.

3.3. Research topic analysis
The field is widely interdisciplinary and includes members from cognitive science, educational psychology, computer science, anthropology, sociology, information sciences, neurosciences, education, design studies, instructional design, and other fields (Sawyer, 2006). Categories for paper classification might be as diverse as various viewpoints from different background. For there are five established academic societies are taking part in ICCE 2010: Association for Educational Communications and Technology (AECT), International Society of the Learning Sciences (ISLS), International Association of Mobile Learning (IAMLearn), IEEE Technical Committee of Learning Technology (IEEE TCLT) and International Artificial Intelligence in Education Society (AIED), six themes in the conference are designed, which means the six theme-based sub-conferences dedicated to foster the building of research communities in the field of Computers in Education. Consequently, papers in the conference belonged to one of the six themes. Therefore, we regard the six themes as topics for article categorization.

The six theme-based sub-conferences are
1. Artificial Intelligence in Education/Intelligent Tutoring System (AIED/ITS) and Adaptive Learning.
2. Computer-supported Collaborative Learning (CSCL) and Learning Sciences.
3. Advanced Learning Technologies, Open Contents, and Standards.
4. Classroom, Ubiquitous, and Mobile Technologies Enhanced Learning (CUMTEL).
5. Game and Toy Enhanced Learning and Society (GTEL&S).
6. Technology, Pedagogy and Education.

As a result, we categorize all papers to the six themes, and Table 3 shows frequencies and percentage of six themes in articles.

Table 2. Frequencies and percentage of nationality/ region of authors

	IETC2011 Amount(%)		ICCE2010 Amount(%)	
Top five nations/ regions of papers issued	1.Turkey	70 (34.7%)	1. Japan	52(33.5%)
	2.Malaysia	24 (11.9%)	2. Taiwan	38(24.5%)
	3.Taiwan	18 (8.9%)	3. Malaysia	15(9.7%)
	4.USA	13 (6.4%)	4. Singapore	10(6.5%)
	5.Jordan, India	7 (3.5%)	5. Korea	8(5.2%)
Total	Amount of papers in the top five nations/ regions	139(68.8%)	Amount of papers in the top five nations/ regions	123(79.4%)
	Other	63(31.2%)	Other	32(20.6%)
Regions	The Mediterranean	84 (41.6%)	The Mediterranean	0
	Asia-Pacific region	68 (33.7%)	Asia-Pacific region	147(94.8%)
	Other European areas	21 (10.4%)	Other European areas	8 (5.2%)
	Eastern & Mid Asia	15 (7.4%)	Eastern & Mid Asia	0
	Southern Asia	7 (3.5%)	Southern Asia	0
	Other regions	8(4.0%)	Other regions	0
Total		202(100%)		155(100%)

Table 3. Frequencies and percentage of six themes in articles

Themes \ Conferences	IETC2011 Frequency (%)		ICCE2010 Frequency (%)	
1. Artificial Intelligence in Education/Intelligent Tutoring System (AIED/ITS) and Adaptive Learning.	13	6.5%	23	14.8%
2. Computer-supported Collaborative Learning (CSCL) and Learning Sciences.	7	3.5%	20	12.9%
3. Advanced Learning Technologies, Open Contents, and Standards.	45	22.6%	19	12.3%
4. Classroom, Ubiquitous, and Mobile Technologies Enhanced Learning (CUMTEL).	10	5.0%	35	22.6%
5. Game and Toy Enhanced Learning and Society (GTEL&S).	8	4.0%	1	10.3%
6. Technology, Pedagogy and Education.	116	58.3%	42	27.1%

3.4. Research Methodology Analysis
Each paper was analyzed with three stages. We first determined the type of the paper. There are three types of

papers consisting of empirical paper which includes empirical data, paper with the description of concepts or systems without empirical data, and review papers. If this paper is empirical paper, we then determined the research design (step two) and research method (step three) of this paper. The analysis schema of research design and method was based on the work of Shih, Feng, & Tsai (2008). Table 4 is the result.

4.DATA ANALYSIS

4.1.Distribution of Essays Published

- Paper issuance in IETC2011 are distributed mainly in The Mediterranean, Europe, and Western Asia; with a broad distribution, six preceding nations/ regions take up 68.8% of paper issuance. ICCE2010 includes nations mainly from APEC region (94.8%); and 80% of papers are from the five preceding nations.
- Venue affects the attendance rate; moreover, essays written in the language of the hosting nation increases participation. Taking the IETC2011 as an instance, the event accepted 70 essays written in English by Turkish authors and 130 in Turkish.
- Sorting the accepted papers into 3 groups- full papers, short papers, and posters- helps programming and creates incentives for the participation in new issues without losing the focus.

4.2.Research topic

- Themes of essays in the IETC2011 mainly focus on Technology, Pedagogy and Education (58.3%); and Advanced Learning Technologies, Open Contents, and Standards (22.6%) along with 4 other themes (20%). ICCE2010 includes rather even dimensions: Technology, Pedagogy and Education (27%); Classroom, Ubiquitous, and Mobile Technologies Enhanced Learning (CUMTEL)(22.6%); and other themes rated between 10% to 15%.
- Diversity of themes may lie within distinct subjects to e-learning adopted by authors from various regions; diverse extent in application of ICT; or the criteria for subjects set up for essay acceptance by the host. The aforementioned factors cast influence on the decision made by the Program Committee.

Table 4. Frequencies and Ratio of Research Methodology in Articles

Conferences / Research Methodology		IETC2011 Frequency (%)		ICCE2010 Frequency (%)	
Types of papers	Empirical papers	145	72%	77	50%
	Papers with the description of concepts or systems	57	28%	78	50%
Research Design	Experimental research	23	16%	27	35%
	Descriptive research	97	67%	10	13%
	Developmental research	25	17%	40	52%
Research Method*	Testing	41	28%	56	73%
	Questionnaire	62	43%	33	43%
	Interview	20	14%	6	8%
	Observation	27	19%	21	27%
	Logged or archived data	19	13%	6	8%

*The ration exceeds 100 percent due to multiple methods adopted in partial essays.

4.3. Research methodology

- Types of papers : Empirical papers stand a major portion (72%) among the papers in the IETC2011, Papers with description of concepts or systems take up a portion of 28%; and in the ICCE2010, both stand even, suggesting an emphasis on Empirical papers in the IETC2011.
- Research Design: the Research Design of the IETC2011 features Descriptive research (67%); on the contrary, papers in the ICCE2011 stand the least portion (13%) of Descriptive research, 52% of Developmental research, and 35% of Experimental research. Diversity of Research Design may lie within diverse objectives, means of research or different results.
- Research Method: IETC2011 adopted a major portion (43%) of Questionnaire and Testing (28%) while the ICCE2010 conducted Testing at a ratio of 73% and Questionnaire at 43%. The aforementioned methods are obviously the major means adopted in the research of e-learning. Meanwhile, the diversity of ration suggests distinct objectives adopted by authors from various regions.

5. CONCLUSIONS AND SUGGESTIONS

While both themed on e-learning, the events each possesses merits; and diverse experiences of each shall be good reference for enhancing the quality of both. The IETC has more plenteous output of essays, greater variety of regions from which authors come, and more emphasis on distinct issues concerning education within regions.

Moreover, authors come from several backgrounds as Turkey, The Mediterranean, Western Asia, Taiwan, and USA. Meanwhile, ICCE, coming from a longer history, stands enriched themes from rather active collaboration among nations, mostly within Asia-Pacific region. The congregation features not only diversity but also renowned awarding for eminent researchers. Considering the diversity among education spaces in different regions, both conferences show great difference in themes and research methods, which reflect the various output resulted from technology applied to diverse setting of education.

Both congregations stand a prospect of progressing on a mutual basis over accumulated experiences, planned emphases are listed as the following:

- Venue: widening options for the venue with a view to increasing the effects of the events
- Call for proposals: sorting collected proposals to help programming without losing the focus. Meanwhile, the theme of the year may adopt an approach of both globalization and localization with a view to increasing contribution to the hosting nation.
- Programming: increase the diversity of themes and activities; for instance, planning workshops、open forums、panels、interactive sessions、tutorial forums、doctoral student consortiums etc. Meanwhile, quests for proposals shall be increased as the forms being standardized into 3 groups mentioned; such mechanism stands a prospect of propelling participation and interaction within the academia as well as achieving knowledge inheritance and progress through diverse forms of congregations
- Best paper award and researcher award: setting up an annually system for awarding may encourage participation as well as enhance the reputation and quality of the organizing mechanism

References

Bereday, G. Z. F. (1964). *Comparative Method in Education*. NY: Holt, Rinehart & Winston.

Sawyer, R. K. (2006). *Cambridge handbook of the learning sciences*. NY: Cambridge University Press.

Shih, M. L., Feng, J., & Tsai, C. C. (2008). Research and trends in the field of e-learning from 2001 to 2005: A content analysis of cognitive studies in selected journals. Computers & Education, 51(2), 955-967.