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Message from the Editor-in-Chief

Dear Readers,

The Turkish Online Journal of Educational Technology, Governors State University, Sakarya University, Cleveland State University, Ohio University, and Istanbul University will organize 11th International Educational Technology Conference (IETC – www.iet-c.net) in May, 2011 in Istanbul, Turkey. 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.

TOJET is interested in educational technology. The articles should be on how to use educational technology in classroom for teaching and learning activities, how educational technology changes learning and teaching activities, and distance education. These articles should educators to improve the quality of both theory and practice in the field of educational technology.

We have two guest editors for this issue. The first guest editor of this issue was Prof. Dr. Yavuz AKPINAR. He reviewed IETC-2010 papers. The second guest editor was Associate Prof. Dr. Eric Zhi Feng Liu. He reviewed normal submitted papers. TOJET thanks and appreciate both guest editors and the editorial board who have acted as reviewers for one or more submissions of this issue for their valuable contributions. TOJET's reviewers are drawn quite widely from all over the world.

Call for Papers
TOJET invites article contributions. Submitted articles should be about all aspects of educational technology and may address assessment, attitudes, beliefs, curriculum, equity, research, translating research into practice, learning theory, alternative conceptions, socio-cultural issues, special populations, and integration of subjects. The articles should also discuss the perspectives of students, teachers, school administrators and communities.

The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to TOJET.

Prof. Dr. Aytekin İŞMAN
Sakarya University

Preface to the Guest Editorial

There are a few of educational technology journals, e.g., Computers and Education, Journal of Computer Assisted Learning, British Journal of Educational Technology, Educational Technology and Society, and Turkish Online Journal of Educational Technology, being indexed in the social science citation index (in short, SSCI) database. The community of educational technology researchers is gradually growing to a large scale and Turkish Online Journal of Educational Technology received many submissions. In order to speed up the review process of Turkish Online Journal of Educational Technology, Prof. Aytekin İŞMAN, editor of Turkish Online Journal of Education Technology, has invited me to be the guest editor and to organize the review board for Turkish Online Journal of Educational Technology October issue. After the rigorous review process, there are no more than 25% of all submitted papers accepted for publication.

I would like to thank all reviewers of this issue for their hard work, and their names are listed in alphabetic order: Adile Aşkım Kurt, Agah Gümüş, Aydem Çiftçioğlu, Ben Chang, Berna Arda, Burcin Acar Sesen, C. L. Wu, Carol H. C. Chu, Chao Hsiu Chen, Chi Yuan Chen, Chiann Ru Song, Chih Lung Lin, Ching Lin Shih, Ching Sing Chai, Chiung Sui Chang, Chun Hung Lin, Chun Mei Chou, Chun Min Wang, Chun Yi Shen, Cindy Yung, Farhad Seraji, Guan Yu Lin, Guan Ze Liao, Guey Shya Chen, Hong Ren Chen, Hsin Kai Wu, Hsing Mei, Huei Tse Hou, İlhan Turan, Jen Chia Chang, Jun Ming Su, Kadir Ulusoy, Khanale Prakash, Koong H. C. Lin, Kuo Liang Ou, Liang Yi Lee, M. Kemal Karaman, Maiga Chang, Mehmet Karahan, Meltem Huri Baturay, Min Jou, Ming Hsui Tsai, Mustafa Meral, Özgen Korkmaz, P. H. Chen, Pramela Krish, Rachel Chu, Refet Polat, Ria Kuo, Ruey S. Hsien, Sami Şahin, San San Cheng, Şerife Ak, Sheng Yi Wu, Shi Jer Lou, Shiang Tung Liu, Shyan Ming Yuan, Shu Chen Cheng, Sunny San Ju Lin, Suzan Duygu Bedir Eristi, Svetlana Cicevic, T. Y. Chuang, Tam Shu Sim, Tamer Kutluca, Tzu Hua Wang, Vincent Ru Chu Shih, Wu Yuin Hwang, Yasar Guneri Sahin, Yu Fang Chang, Yu Tzu Chiang, Yung Fang Chen, Yung Wei Hao, Yusuf Koc

Best Regards,
Eric Zhi Feng Liu (Guest Editor)
October 2010

Preface to the Guest Editorial

Hello again. It has not been long since I wrote the preface to the guest editorial of TOJET July 2010 issue. Some of the selected presentations of IETC2010 presented either in English or in Turkish, were earlier invited to be developed for the TOJET: The ones whose development were completed and review process ended up with approval of referees were published in July issue. And the ones whose development, re-review or review were not completed by the publication date of July issue, are now ready for publication. Four papers of IETC2010 developed for TOJET October 2010 issue with the help of referees may be outlined as follows:

The first article titled "Hypothesized learners' technology preferences based on learning style dimensions" is developed by Zahra NAIMIE and her friends, from Malaysia. The paper reports the impact of teaching and learning style preferences and their match or mismatch on learners' achievement and secondly, the proposed technology preferences for learners based on learning styles dimension. It found that the students show a positive response and higher achievement when their learning preferences and needs are accommodated by their lecturers with the help technology.

The second paper is also a co-authored by Shi-Jer LOU and friends from Taiwan. The work is titled as "The influences of the sixth graders' parents' internet literacy and parenting style on internet parenting". With a considerably large sample from Taiwan, it explored parents' behavior of Internet usage, parenting style, Internet literacy, and Internet parenting. It reported that there are meaningful relationships among the parents' behavior of Internet usage, parenting style, Internet literacy, and Internet parenting.

The third research report was submitted by Çetin GÜLER and Arif ALTUN, from Turkey. They titled the study as "Teacher trainees as learning object designers: Problems and issues in learning object development process". The work aimed to explore problems and issues teacher trainees experience when designing SCORM compliant learning objects. The findings indicated that teacher trainees experienced content development related issues such as, understanding learning object paradigm, development software and environments, content packaging and repository the most.

The last paper selected from the IETC2010 and invited to the journal was the work by Cemil YÜCEL and his colleagues from Turkey. The work was titled as "A model to explore Turkish teachers' ICT integration stages". They reported a model for school teachers' ICT integration into classroom work. The reported study aimed mainly to determine teachers' ICT integration stages according to CEO Forum's standards and factors affecting their integration. A model showing interrelationships among factors influencing ICT integration behaviors were extracted to be explored in further research.

Because IETC2010 accepted many papers from a wide range topic, the selected and invited works were not on a single topic focusing on a specific issue. This caused to include works whose aims were different. May be the most common property of the papers were that all four works selected from IETC2010 and developed for this issue were products of collaborative efforts of the authors. I wish that these collaborative works will help readers broaden their view educational technology.

I would like to thank, again, all IETC2010 presenters and the authors of this special issue, and the following reviewers whose help was prized to set up this special IETC2010 section in TOJET: Ahmet Eskicumalı; Ali Şimşek; Andrew Sturc; Arif Altun; Aytekin İşman; Eralp Altun; Erol Karakırık; Zehra Altınay; Ferhan Odabaşı; Feza Orhan; Gunizi Kartal; Hakan Tüzün; Harun Yılmaz; Işıl Kabakçı; Lee Tsi Moon; Murat Ataizi; Mübin Kıyıcı; Özcan Erkan Akgün; Rauf Yıldız; Sadi Seferoğlu; Servet Bayram; Şirin Karadeniz; Tufan Adıgüzel; Vincent Shi; Yavuz Akbulut; Aşkım Kurt; Hamdi Erkunt; Servet Demir; Yavuz Erdoğan; Mehmet Sincar; Melek Demirel; Mary Reznitsky; Devrim Özdemir, Kurt Schwarz, Chan Win Lee, Semiral Öncü, Abdullah Kuzu, Bunyamin Atıcı.

Hopefully the works reported in this issue will trigger new ideas and research questions whose answers will contribute to our rapidly changing field of educational technology. And, in turn, the new implementation of technology avoids repeating the same sort of mistakes witnessed throughout the history of integration of technology for learning.

All the best,
Yavuz Akpınar (Guest Editor)
October 2010

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A MODEL TO EXPLORE TURKISH TEACHERS' ICT INTEGRATION STAGES

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ABSTRACT
The aim of the study is to determine teachers' ICT integration stages according to CEO Forum's standards and factors affecting their integration. Teachers are expected to use ICT in their teaching practice. Hence, it is crucial that their integration stages and factors affecting it are examined. A survey method was employed for this study. A sample of 200 teachers was selected randomly out of 460 teachers working in primary schools in Uşak, Turkey. Researchers of this study developed an ICT integration questionnaire. Analysis of the data reveals that the teachers are in three different stages in ICT integration. A significant relationship is discovered between feelings of inadequacy in using ICT and exhibiting stage 1 behaviors. It is also clear that the ICT knowledge of teachers is the most important variable for the teachers who were at the third (the highest) stage of ICT integration. A model showing interrelations among factors influencing ICT integration behaviors were drawn for further studies to be tested.
Keywords: ICT, Teachers, Integration Stages, Attitudes, Self Inadequacy

INTEGRATING ICT INTO TEACHING

The study investigates the relationships among teachers' Information and Communication Technologies (ICT) integration stages, teachers' feelings of self inadequacy in using ICT and level of perceived knowledge in ICT usage and their attitudes towards the use of ICT in teaching and learning.

In the literature ICT integration stages manifest itself in five different consecutive stages; entry, adoption, adaptation, appropriation and invention (CEO, 1999). Teachers' quality of use of ICT in teaching and learning, professional development, administrative work, etc. determines their stages of integration. The stages, teachers' typical applications in the stages and possible factors affecting ICT integration are discussed in the literature. Despite this and its importance, there is not enough body of empirical research trying to determine teachers' actual ICT integration stages.

Integrating ICT into teaching for subject teachers has become an important issue in Turkey for the last decade. There is a pressure onto teachers coming from almost every part of the society; from policy makers, senior management, their peers and students (Altun, 2002). Thus, teachers are expected to use ICT in their teaching practice one way or another. Hence, it is crucial that ICT integration stages and factors affecting the stages need to be examined.

ICT Integration Stages

According to Comber, Lawson and Hargreaves (1998), it is important to identify teachers' integration stages because necessary policies can be introduced at any time when trying to enhance quality of teachers' ICT usage. They (1998: 372) also argue that "…previous attempts to foster an 'educational revolution' through the introduction of computers largely failed because teachers were uncertain about how ICT could be integrated into the curriculum…"

The implementation of an innovation has an array of levels (Hall, 1995). Although there are similar technology adoption models (Dawes, 2001; Comber *et al.*, 1998; Toledo, 2005), CEO Forum's standards are most commonly used to illustrate the levels of teacher ICT integration (CEO, 1999). CEO Forum suggests five consecutive stages of integration.

> Entry: Students Learning to Use Technology. At this stage, teachers are not themselves users of technology. If students are using technology, they are using it in ways determined by someone other than the teacher without participation from the teacher.
> Adoption: Teachers Use Technology to Support Traditional Instruction. Teachers are beginning to use technology, usually to enhance their own productivity, mandated either by the school or through their own initiative. They experience an advantage doing traditional tasks with a new tool and begin to see the power of the tool for other applications…
> Adaptation: Technology Used to Enrich the Curriculum. Teachers begin to use technology in ways that are connected to the curriculum, and in ways that are already familiar. …Teachers at the adaptation stage tend to direct students to inquiry rather than allowing student-directed learning experience.
> Appropriation: Technology is Integrated, Used for its Unique Capabilities. … In the classrooms (of teachers) at this stage, technology begins to reveal its potential to produce improvements in learning, as students master higher-order thinking skills, and more complex concepts and skills than they would have encountered without technology…
> Invention: Discover New Uses for Technology. At this stage, teachers are defining classroom environments and creating learning experiences that truly leverage the power of technology to involve students in tasks that require higher-order thinking skills as well as mastering basic concepts and skills.
> CEO Forum (1999:14-15).

Teachers should be equipped with the necessary skills and knowledge in order to use ICT. They should also be trained to learn how to integrate information and communication technologies is a vital issue for educators to tackle. Therefore, teachers not only have to be able to handle ICT, but also have to be able to transfer skills and knowledge into the classroom, which requires that their ICT training has to have an element of education and pedagogy (Lawson and Comber, 2000).

As skills are important for teachers to be able improve their teaching and their students' learning experiences, knowledge is the pre-requisite as the basis on which skills are developed (Demiraslan and Usluel, 2008). The knowledge of teachers on how to best operate ICT on its own is not enough for an effective integrate in the classroom. Nevertheless, it would have been impossible to further any teacher in his/her ability to use ICT without a sound knowledge on how to operate ICT and how to improve teaching and learning in his/her subject area (Tanti and Moran, 2009). ICT integration attempts in the developed world has evolved in three phases; equipping schools with ICT, training teachers and student on how to operate ICT, and current (the last) phase is where teachers are taught how to utilize ICT in their specific area of expertise (Robinson, 1997).

Teachers are more likely to use ICT in teaching and improve their skills if their ICT training is meaningful for their individual needs (Lawson and Comber, 1999). Hence, any training intents to integrate ICT into classroom settings has to be provided by the trainers who are competent in teaching technology and curriculum needs. Moreover, it is important to note that teachers may be at different levels of technology integration stages (Acun, 2003).

Teachers at the higher-level of technology integration stages are more likely to utilize the benefits of ICT in their teaching. When teachers realize the potential for improving learning through the effective use of technology, and when their competencies in ICT are improved they become competent technology users. Only then they start to change the way they teach (Altun, 2002).

Studies on ICT identify some important points about having training in ICT: that it should be appropriate to classroom use, hands-on practice, provide on-the-spot help and provide opportunities to work and share with other teachers. Training must also be timely and appropriate for both teacher professional development and school resource development (SOIED, 1999; Acun, 2003). These, however, are not only factors affecting ICT integration. Their attitudes, feeling of adequacy/inadequacy, self efficacy and administrative support are also important when trying to further teachers in their ICT integration stages (Alev, Altun and Yiğit, 2009; Katic, 2008; Akkoyunlu and Kurbanoğlu, 2004; Jimoyiannis and Komis, 2007).

The role and importance of attitudes and beliefs in education is a very well documented area in educational research (Schiefele, 1991). This is also true when it comes to studying the relationship between attitudes and the usage (or lack of usage) and quality of ICT in education (Zhao and Bryant, 2006; Ertmer, 1999; Jedege, 2008). Although, there are contradicting research findings on the relationship mentioned above, it is safe to say that literature shows attitudes are significant factors in integration and diffusion of ICT in schools (Kzenek and

Christensen, 2008). Research dealing with the issue suggests that positive attitudes toward ICT might have a positive effect on ICT integration in terms of both quantity and quality of usage by teachers and students a like (Yavuz and Coşkun, 2008).

As in positive attitudes, feeling of adequacy could be an important factor for teachers to be willing to utilize ICT in and out of classroom for educational purposes. Studies show that teachers who are further in their careers (nearing to the retirement), tend to feel inadequate and have more negative attitudes towards ICT most probably because of the difficulty in acquiring new knowledge and skills on how to integrate ICT (Binghimlas, 2009, Koehler and Mishra, 2009).

Accesses to ICT, technical and administrative support are crucial too. Having appropriate hardware and software, an ICT integration policy, technical support and future improvements appear to be the characteristics of successful schools in terms of ICT integration (Kennewell *et al.*, 2000). Hence, informed by the literature, this study includes attitudes, feeling of inadequacy, level of ICT knowledge of teachers and administrative support as the factors that might be affecting teachers level of ICT integration,

IMPORTANCE OF THE STUDY

The present study contributes to theory by providing insights into teachers' actual ICT integration stages. The level of teachers' ICT integration and quality of their use determine whether or not they create any added values to teaching practice. Studies examining the issue of ICT integration in teaching and learning mostly concentrate on the factors affecting the integration on a holistic approach. That is; integration stages models and models explaining the factors that are affecting the integration do not concentrate on the individual teachers as the unit of analysis. Rather, they describe certain characteristics of ICT integration stages in terms of teachers' behaviors, students' behaviors, arrangement of classroom environment, quality or lack of administrative support, ect (Alev, Altun, and Yiğit, 2009; Katic, 2008; Jimoyiannis and Komis, 2007, Leng, 2008).

These and many other variables are important factors affecting the integration. Nevertheless, trying to determine the individual teacher's integration stage with this design of this current research is unique, and has it advantages over other studies. Hall (1995) argues that implementation of a change in any innovation has to be assessed at the individual level. The present study attempts to identify at which stage the teachers are in ICT integration on an individual basis, and then investigates factors affecting their integration stages.

METHOD

Research Question

The main research questions formulated for the study are:
What are the teachers' ICT integration levels in each stage?
How are knowledge, attitudes, feeling of self inadequacy of teachers, and administrative support related to the level of ICT integration stages?

Population and Sample

The population of the study consists of 460 primary (4-8 grades) school teachers working in the public school system of Uşak, Turkey. Grades in primary schools were divided into three stages, the first stage is 1 to 3, the second stage is 4 to 5 and the third stage is 6 to 8. Since the most of ICT usage is intensified in the last two stages, our sample was drawn from the second and the third stages. Instruments were distributed to a random sample of 200 teachers in 37 primary schools over the course of five days. The number of instruments returned was 149.

Depended and Independent Variables

The study utilized the integration stages as depended variables. The integration stages described in the literature are most probably contingent upon teachers' attitudes towards ICT usage, their feeling of self inadequacy and their perceived level of knowledge about ICT usage. Hence, in this study attitudes, knowledge and self inadequacy were treated as independent variables to explain the variance in teachers' ICT stages. Such treatments of variables as in this study is not very common. The study also includes gender, years of experience, and administrative support as background or demographic independent variables.

Procedures

To measure teachers' integration stages, attitudes, self inadequacy, knowledge, and administrative support, a set of item pools were generated for every and each of the variables. The items in all instruments were subjected to a factor analysis spontaneously. A varimax rotation was used to extract factors. The varimax rotation in factor analysis revealed seven dimensions. After operational definitions have been formulated for each dimension, a

score on each dimension was calculated for each respondent by adding teachers' responses grouped under each dimension. The score was divided by the number of items in the respected dimension. This procedure yielded a score on each dimension for each teacher. Likert type scaling was used across all items. For items in ICT integration stages, self inadequacy and administrative support, teachers were asked to rate their behaviors on the following scale: (1) Never, (2) Seldom, (3), Occasionally, (4) Often, (5) Always. For items in attitudes scale, teachers were asked to rate their attitudes on the following scale: (1) Never feel like this, (2) Seldom feel like this, (3) Occasionally feel like this, (4) Often feel like this, (5) Almost always feel like this. Teachers were asked to rate their knowledge about ICT on the following scale; (1) have no knowledge, (2) have little knowledge, (3) have some knowledge, (4) have a great deal of knowledge. Resulting factor structure is shown in the table 1. As shown at the bottom of the table 1, reliabilities (Crombach's Alpha) of each dimension were very high.

Table 1 Factor analysis of items in the instruments

	Dimensions						
	Inadequacy	Knowledge	Stage3	Attitudes	Stage2	Stage1	Administration
	inadeq8(.79)	knowled9(.81)	stage25(.76)	attitu8 (.80)	stage7 (.75)	stage1(.72)	administ1(.80)
	inadeq3(.79)	knowled1(.79)	stage24(.72)	attitu11(.77)	stage8 (.74)	stage6(.69)	administ4(.78)
	inadeq1(.78)	knowled10(.77)	Stage18(.69)	attitu9 (.75)	stage10(.74)	stage2(.65)	administ2(.62)
	inadeq2(.77)	knowled8(.75)	stage22(.67)	attitu13(.70)	stage14(.63)	stage4(.49)	
	inadeq9(.71)	knowled6(.74)	stage13(.67)	attitu5 (.67)	stage12(.60)		
	inadeq7(.69)	knowled7(.73)	stage23(.67)	attitu3 (.62)	stage9 (.59)		
	inadeq6(.63)	knowled4(.65)	stage19(.66)	attitu7 (.60)	stage15(.57)		
	inadeq4(.61)	knowled3(.58)	stage20(.61)	attitu12(.55)			
Variance	11.85	11.42	10.20	9.86	8.35	5.51	4.31
Cumulative Variance	11.85	23.28	33.48	43.34	51.69	57.20	61.52
Reliability	.92	.91	.86	.86	.85	.74	.65

Note: The numbers in parentheses are factor loadings under their respective dimension.

CEO Forum's a-five-stage ICT integration model was used for the study. However, items generated to measure teachers' ICT integration in five different stages converged under three dimensions in factor analysis as shown in table 1. Content and meaning of items in each dimension were examined and named accordingly. Dimensions were named as Stage 1, Stage 2 and Stage 3. Items in the first stage comprise such characteristics of people's showing basic skills and having little knowledge of ICT. They use ICT because their students use them. The second stage items reveal that teachers started to use ICT in their daily life, and to make their everyday school operation easier and smoother in such applications as typing lesson plans, worksheet and keeping students' registry. Items in the third stage show that teachers started to manipulate existing ICT applications and software for their subject teaching. They started to use the Internet and e-mail to enrich their teaching and students' learning experiences but still rely mostly upon conventional classroom environments. The CEO Forum classification of stages is somehow reduced to three stages in the present study. That is; stages of 2 and 3 in CEO Forum's classification (adoption and adaptation) converge into one in our research and stage 5 (innovation) behaviors were not displayed at all by the teachers involved in this study.

Analysis

Stepwise regression techniques were used to explain variance in level of ICT integration stages. To explain variances in each stage, attitudes, self inadequacy, knowledge, administration support, gender, years of experience were entered into the model as independent variables. Variances accounted for by the remaining independent variables are explained. Using the stepwise regression results, a path model for integration was generated for to be tested in further studies.

RESULTS

Findings suggest that teachers tend to score high on entry stage (mean=4.11), followed by stage two (mean=3.63) and stage three (mean=2.15). These mean that it becomes harder to show integration behavior as stages becomes higher. This is theoretically sound. Table 2 shows descriptive statistics related to major variables.

Table 2 Descriptive Statistics (n=149)

	Mean	Std. Deviation
Stage3	2,15	,85
Stage2	3,63	,95
Stage1	4,11	,78
Teachers' Feeling of Self Inadequacy	2,06	,83
Teachers' Knowledge	2,96	,56
Teachers' negative attitudes towards ICT	1,67	,75
Lack of administrative Support	2,24	,91
Years of Experience	12,76	9,14

Correlation analysis was carried out to explain the relationships among dependent and independent variables.

Table 3 Correlations among Variables (n=149)

	Experience	Stage 3	Stage 2	Stage 1	Inadequacy	Knowledge	Attitudes	Administrative
Experience	1,00							
Stage3	,09	1,00						
Stage2	-,26	,29	1,00					
Stage1	-,19	,10	,31	1,00				
Inadequacy	,29	-,14	-,48	-,53	1,00			
Knowledge	-,03	,43	,37	,39	-,44	1,00		
Attitudes	,19	,12	-,32	-,38	,44	-,10	1,00	
Administrative	,11	-,01	-,13	-,17	,22	-,15	,17	1,00

Note: Correlations larger than .17 (absolute value) are significant at .05 level

Correlations among variables as show in table 3 reveal that stages have low or moderate relationships among themselves. This suggests that each stage's behavior is relatively independent of each other. Mastering in one stage does not guarantee graduating into the next stage. As stage 1 behaviors are more likely to be related to teachers' self inadequacy ($r=-.53$, $p<.01$). Stage 3 behaviors are more likely to be related to teachers' ICT knowledge ($r=.43$, $p<.01$). Similarly stage 2 behaviors are more likely to be related to teachers' feeling of self inadequacy ($r=-.48$, $p<.01$). Moreover, while negative attitudes towards technology are related to stage1 and 2 behaviors ($r=-.38$ and $r=-.32$, respectively, $p<.01$ for both), they are not related to stage 3 behaviors. These results imply that for stage 3 negative attitudes and self inadequacy do not explain teachers' behaviors. Behaviors in stage 3 appear to be dependent on teachers' level of knowledge in ICT. Thus, it is important to improve teachers' know-how on ICT to further teachers in stage 3 behaviors rather than working on their attitudes.

Negative attitude is not directly related to teachers' knowledge on ICT and yet self inadequacy is related to both knowledge and attitudes. This may imply that self inadequacy is a mediating variable between ICT knowledge of teachers and their attitudes towards ICT. The effect of level of knowledge on attitudes towards ICT is contingent upon and runs through self adequacy. For knowledge to have any negative or positive impact on attitudes, level of self inadequacy is an important mediator. In-service training will not have any effect on teachers' attitudes towards ICT unless their feeling of self inadequacy is improved. This is an interesting and important finding. Any knowledge based activity that intends to help teachers integrate ICT into teaching in stages 2 and 3 has to tackle with their feeling of adequacy.

Level of lack of perceived administrative support is found to be related to only stage 1 behaviors, which means that teachers already reached up to stage 2 and 3 does not concern with the lack of administrative support. For those who are at the second and third stage are not influenced by administrative support. This might be mostly because they internalized those behaviors and became self sufficient in dealing with small technical problems, etc. However, one should not disregard that administrative support is important for the teachers at the first stage. Additionally, it is a fact that passing from stage 1 through stage 3 depends on reaching to stage 2. Nevertheless stage 1 does not necessarily guarantee to reach stage 2. A tendency has been discovered as the year of experience increases, perceived inadequacy and negative attitudes increase. Similar tendency occurs for displaying stage 1 and 2 behaviors.

A difference between male and female teachers is observed for stage 3 behaviors and attitudes towards ICT. On average male teachers (mean=2.35) more frequently exercise stage 3 behaviors than female (mean=1.92) teachers (p<.001). Male teachers (mean=1.82) tend to have more negative attitudes towards ICT than female (mean=1.50) teachers (p=.01).

Stepwise regression procedures were used to examine the contribution of negative attitudes, self inadequacy, knowledge, years of experience and gender to each stage of teachers' ICT integration. It seems that negative attitudes and self inadequacy did not account for a significant change in explaining the variance in teachers' ICT integration for stage 3 behaviors. It is found that a teacher is more likely to exhibit stage 3 behaviors when he/she has high level of knowledge on ICT and when he/she reaches stage 2. Additionally, male teachers are more likely to reach stage 3 than female teachers.

Table4 Stepwise Regression for Predicting Variables Affecting Stage3 Behaviors

	β	Std Error	Std. β	t	*p*
Constant	.654	.400		1.634	.104
Knowledge	.492	.118	.325	4.162	.000
Gender	-.417	.124	-.246	-3.360	.001
Stage2	.179	.070	.201	2.572	.011

$R^{2=}$.26; Adj.$R^{2=}$.24; F=16.89 p<.001

When stepwise regression method is used a linear combination of level of ICT knowledge, level of stage 2 behaviors and gender, altogether, explained 26 percent of variance in stage 3 behaviors (F=16.89, p<.001). All other variables did not contribute an increment into the variance in stage 3 behaviors above and beyond the contribution of these variables. The highest unique contribution belongs to level of teachers' knowledge followed by gender and stage 2 behaviors.

Table5 Stepwise Regression for Predicting Variables Affecting Stage 2 Behaviors

	β	Std Error	Std. β	t	*p*
Constant	3.043	.558		5.448	.000
Self Inadequacy	-.455	.089	-.398	-5.107	.000
Knowledge	.357	.133	.210	2.681	.008
Gender	.319	.134	.168	2.384	.018

R^2= .29; Adj.R^2=.28; F=19.81 p<.001

Stepwise regression revealed that 29 percent of variance in stage 2 behaviors is explained by the linear combination of level of knowledge, feeling of self inadequacy and gender (F=19.81, p<001). All other variables did not contribute an increment into the variance in stage 2 behaviors above and beyond the contribution of these variables. The highest unique contribution belongs to level of teachers' self inadequacy followed by level of ICT knowledge and gender of teachers. Contrary to the findings in the significant correlation between stage 1 and 2, stepwise regression suggests that these two stages are not directly related. Feeling of inadequacy and level of knowledge seems to moderate this finding. It seems that further studies need to be conducted to uncover mediating variables unknown in this model.

Table 6 Stepwise Regression for Predicting Variables Affecting Stage1 Behaviors

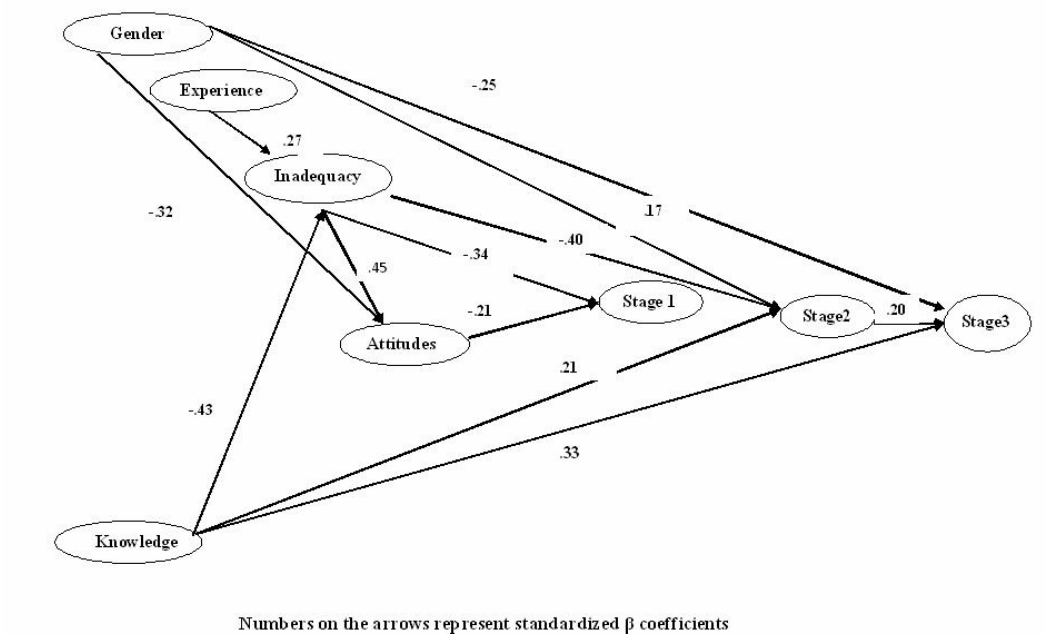
	β	Std Error	Std. β	t	*p*
Constant	4.244	.398		10.675	.000
Self Inadequacy	-.316	.078	-.338	-4.043	.000
Teachers' Knowledge	.299	.105	.215	2.851	.005
Teachers' Attitudes	-.221	.078	-.213	-.826	.005

R^2=.34; Adj.R^2=.33; F=25.27 p<.001

Stepwise regression revealed that 34 percent of variance in stage 1 behaviors is explained by the linear combination of self inadequacy, level of knowledge and negative attitudes towards ICT usage (F=25.27, p<001). All other variables did not contribute an increment into the variance in stage 1 behaviors above and beyond the

contribution of these variables. The highest unique contribution belongs to level of teachers' self inadequacy followed by level of ICT knowledge and negative attitudes.

The model resulting from stepwise regressions showing the relationships among variables that explain the variances in level of ICT integration stages is generated to be tested in further studies. Male participants in gender variable were coded as 1, and females as 2 in the model. The attitudes variable represents negative attitudes towards ICT.



Numbers on the arrows represent standardized β coefficients

CONCLUSION

This study suggests that in Turkish context a five-staged ICT integration requires a new classification. In CEO Forum's classification stages, informed by the findings of this study, somehow need to be adjusted into 3 stages. That is, adoption and adaptation stages converge into one in our research and innovation stage behaviors were not exhibited by the teachers involved in this study. Teachers have different and distinguishable levels of ICT integration stages. Every stage requires different set of applications and behaviors. This is an indication of relative independence of each stage's behavior. Acquiring enough skills and knowledge in one stage does not secure reaching up to the next stage. Advancing from the lowest integration stage to the highest one does not necessarily follow a linear path.

Knowledge is the most important variable in showing stage 3 behaviors while self inadequacy is the most important variable for exhibiting stage 2 behaviors. Any attempt aimed at improving teachers' stage 3 behaviors has to deal with their knowledge rather than concentrating on improving their attitudes. Self inadequacy does not have a direct effect on stage 3 behaviors.

Although self inadequacy has a relationship with knowledge and attitudes, negative attitudes are not related to knowledge. This might be an evidence of self inadequacy's possible role in being a mediating variable between ICT knowledge and attitudes. For knowledge to have any negative or positive impact on attitudes, level of self inadequacy must be lessened. According to the model shown above any effort trying to improve teachers' attitudes is not likely to have a direct impact unless their feeling of self adequacy is improved. Any knowledge-based activity that intends to help teachers integrate ICT into teaching in stage 2 has to nourish their feeling of adequacy. Stage 1 and 2 are not directly related. Administrative support or lack of it seems to be not an issue for those who are at the second and third stage. This might be mostly because teachers displaying stage 2 and 3 behavior are self sufficient in dealing with small technical problems, etc. In contrast, administrative support is imperative for the teachers at the first stage. Additionally, it is a fact that passing from stage 1 through stage 3 depends on reaching to stage 2. Nevertheless stage 1 does not necessarily guarantee to reach stage 2. There must be some paths between stage 1 and stage 2. Further studies need to be conducted to uncover mediating variables unknown in this model. Moderating and mediating variables to explain variances in all stage behaviors needs to be discovered in further studies. There is some evidence of as to which variables to be included for the further

research with a similar approach to integration stages of teacher with similar data collection instruments and analysis procedures. Ease of use, social desirability and prestige, usefulness studied in the literature (Davis, 1989; Akbulut, Kesim and Odabasi, 2007; Shen *et* al, 2006) are among the variables which could be considered as the variables to be considered for further studies.

REFERENCES

Acun, I. (2003). *Changing History and Geography Teaching with ICT: the Impact of the Internet*, Unpublished Ed.D Thesis, University of Leicester, England.

Akbulut, Y., Kesim, K. and Odabasi, F. (2007). Construct validation of ICT indicators measurement scale (ICTIMS). *International Journal of Education and Development using Information and Communication Technology (IJEDICT).* 3 (3), 60-77.

Akkoyunlu, B. ve Kurbanoğlu, S. (2004). Öğretmenlerin bilgi okuryazarlığı öz-yeterlik inancı üzerine bir çalışma. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 27, 11-20.

Alev, N., Altun, T. and Yiğit, N. (2009). Perceptions of Pre-Service Science Teachers About the Use of ICT in Educatıon. *Proceedings of IETC2009*, Ankara, Hacettepe University.

Altun, T. (2002). *Factors Influencing Teachers' Change in Classroom Practice due to Introduction of ICT in Turkey*, Unpublished EdD Thesis, University of Nott'ham, UK.

Binghimlas, K. A. (2009). Barriers to the successful integration of ICT in teaching and learning: A Review of literature. *Eurosia Journal of Matematics, Science and Technology Education.* 5 (3), 235-245.

CEO Forum on Education and Technology (1999). *School Technology and Readiness Report on Professional Development: A link to better learning,* Retrieved from http://www.ceoforum.org/reports.cfm

Comber, C., Lawson, T. and Hargreaves, L. (1998). From familiarisation to adaptation: Teachers' responses to the introduction of ICT into the classroom. *Proceedings of IN-TELE 98*.

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

Dawes, L. (2001). What stops teachers using new technology? In Leask, M. (Ed.), *Issues in teaching using ICT* (pp.61-80). London: RoutledgeFalmer.

Demiraslan, Y. and Usluel, Y. (2008). ICT integration processes in Turkish schools: Using activity theory to study issues and contradictions. *Australasian Journal of Educational Technology.* 24 (4), 458-474.

Ertmer, P. A. (1999). First and second order barriers to change: strategies for technology integration. *ETR&D,* 47 (4), 47-61.

Hall, G. E. (1995) 'The Local Educational Change Process and Policy Implementation' in Carter, D.S.G, and O'Neill, M.H (Eds.), *International Perspectives on Educational Reform and Policy Implementation* (pp. 101-125). London: The Falmer Press.

Jedege, P. O. (2008). ICT attitudinal characteristics and use level of Nigerian teachers. *Issues in Informing Science and Information Technology.* 5, 261-266.

Jimoyiannis, A. and Komis, V. (2007). Examining teachers' believes about ICT in education: implications of a teacher preparation programme. *Teacher Development,* 11 (2), 149-173.

Katic, E. K. (2008). Pre-service teachers' conceptions about computers: an ongoing search for transformative appropriations of modern technologies. *Teachers and Teaching,* 14 (2), 157-179.

Kennewell, S., Parkinson, J., and Tanner, H. (2000). *Developing the ICT capable schools.* London: RoutledgeFalmer.

Koehler, M. J. and Mishra, P. (2009). What is pedagogical technological content knowledge. *Contemporary Issues in Technology and Teacher Education.* 9 (1), 60-70

Kzenek, G. and Christensen, R. (2008). The importance of computer attitudes and competencies in primary and secondary schools. In J. Voogt & G. Kzenek (eds.). *Internationa Handbook of Information Technology in Primary and Secondary Education* (pp.321-328). New York: Springer.

Lawson, T. and Comber, C. (1999). Superhighways technologies: personnel factors leading to successful integration of information and communication technology in schools and colleges. *Journal of Information Technology for Teacher Education,* 8 (1), 41-53.

Lawson, T. and Comber, C. (2000). Introducing ICT into schools: blurring boundaries. *British Journal of Sociology of Education,* 21 (3), 419-433.

Leng, Wee, Ng (2008). Transformational Leadership and Integration of ICT into Teaching, *The Asia Pasific Educational Researcher,* 17 (1), 1-14.

Robinson, B. (1997). Getting ready to change: the place of change theory in the information technology education of teachers. In D. Passey and B. Samways (eds.). *Information Technology: Supporting change through teacher education*(pp.40-46). London:Chapman & Hall.

Schiefele, U. (1991). Interest, learning and motivation. *Educational Psychologist,* 26 (3&4), 299-323.

Shen, D., Laffey, J., Lin, Y. and Huan, X. (2006). Social influence of perceived usefulness and ease-of-use of course delivery systems. *Journal of Interactive Online Learning,* 5 (3), 270-282.

SOIED (1999). *Teachers' ICT skills and knowledge needs*, *final report*. Retrieved from http://www.scotland.gov.uk/library/ict/append-section1.htm

Tanti, M. and Moran, W. (2009). Warts and All: Integration ICT in Teacher Training. *The International Journal of Learning.* 16 (8), 641-655

Toledo, C. (2005). A five-stage model of computer technology integration into teacher education curriculum. *Contemporary Issues in Technology and Teacher Education,* 5 (2), 177-191.

Yavuz, S. and Coskun, A. E. (2008) Sınıf öğretmenliği öğrencilerinin eğitimde teknoloji kullanımına ilişkin tutum ve düşünceleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi.* 34, 276-286.

Zhao, Y. and Bryant, F. L. (2006). Can Teacher Technology Integration Training Alone Lead to High Levels of Technology Integration? A Qualitative Look at Teachers' Technology Integration after State Mandated Technology Training. *Electronic Journal for the Integration of Technology in Education,* 5, 53-62.

A PROCESS-BASED KNOWLEDGE MANAGEMENT SYSTEM FOR SCHOOLS: A CASE STUDY IN TAIWAN

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ABSTRACT
Knowledge management systems, or KMSs, have been widely adopted in business organizations, yet little research exists on the actual integration of the knowledge management model and the application of KMSs in secondary schools. In the present study, the common difficulties and limitations regarding the implementation of knowledge management into schools' organizational cultures are reviewed and discussed. Furthermore, relevant theories of knowledge management models are summarized, and a model of process-based knowledge management appropriate for schools is proposed.

Based on the proposed model, this study applied a low-cost, open-source software development framework to establish a process-based knowledge management system for schools, or PKMSS. We conducted a 30-day empirical observation and survey at a secondary school in Taiwan. This case study used methods including a satisfaction survey, qualitative content analysis of knowledge discussion, and unstructured interviews to explore the progress, performance, and limitations of PKMSS implementation. It was determined that PKMSS has some value in promoting schools' knowledge management. It not only facilitates the externalization and combination of knowledge and effectively keeps the objectives of knowledge sharing in focus, but it also promotes inter-member interactions. However, this study also found certain restrictions in terms of the classification of knowledge content and system functions. Based on the above findings, we propose relevant suggestions as references for the evaluation and introduction of a KMS in educational organizations.
Keywords: knowledge management, knowledge sharing, secondary education, knowledge management system

INTRODUCTION

Knowledge management encourages an organization's members to share knowledge and improves the organization's efficiency, performance, and competitiveness (Shin, 2004). Commercial organizations in the business sector have adopted different strategies and technologies to manage intra-organizational knowledge. In terms of school organizations, however, there are still many potential restrictions regarding the implementation of knowledge management (Carroll et al., 2003; Tyack & Cuban, 1995). Due to the new era of Web 2.0 and the influence of highly interactive online information technology, schools' internal management and knowledge application procedures are becoming increasingly complex. Therefore, previous studies have considered the need for schools to utilize knowledge management procedures and KMSs (Richard, 2001; David, 1999; Kuo, 2003; McKenzie et al., 2001). A key philosophy in education is the generation and use of knowledge (David, 1999). Therefore, schools should continue to improve their existing operating models and should understand the appropriate procedures of searching, storage, duplication, and application in order to gather necessary knowledge (Richard, 2001). Kuo (2003) further emphasized the trend and necessity of using information technology to conduct knowledge management in schools and believed that school members should gain a deeper understanding of knowledge management. Schools should also actively learn from their members' active feedback about knowledge management to improve their managerial performance (McKenzie, Truc & Winkelen, 2001).

However, efficient knowledge management in schools is difficult. The primary limitations include difficulty determining the objectives of knowledge sharing and the lack of interactive knowledge-sharing behavior within the organizational culture of teachers (Carroll et al., 2003; Tyack & Cuban, 1995). Due to different organizational cultures influence intra-organizational knowledge sharing differently (Yang, 2007; Yang & Chen, 2007; Bock et al., 2005), knowledge management strategies and process models adopted by businesses may not be suitable for educational organizations. Many studies have pointed out the influence of the incentive system on an organization's inter-member

knowledge sharing (Constant et al., 1994; Nelson & Cooprider, 1996; Ryu et al., 2003; Kankanhalli et al., 2005). For most secondary schools in Taiwan with limited budgets, however, the external rewards they can provide may be limited. Therefore, an important topic of this research is how to design and introduce an appropriate knowledge management process model based on the organizational culture of schools. This model may improve intrinsic rewards and motivation and promote sharing and feedback among members of the school (including teachers and administrators). A KMS environment based on the process model will also motivate school members to establish and share knowledge documents to achieve the objective of increasing school performance with knowledge management.

Many researches explored the professional development issues for teachers (e.g., Koçoğlu, 2008; Hou et al., 2009a; Duran et al., 2009; Masood, 2010; Orhan & Yilmaz, 2010) and the application of technology on teachers' knowledge sharing recently (e.g., Erkunt, 2010; Duran et al, 2009; Chang & Liu, 2008). Although research exists on knowledge sharing in the teacher communities (e.g., Joaquín, David and Carme, 2010; Hou et al., 2009a, 2009b; Snow-Gerono, 2005; McCotter, 2001; Olson & Craig, 2001; Hsu, 2004), it focuses primarily on communities for teacher professional development. There is little empirical research on the progress, performance, applications, and implementation of knowledge management models in school organizations. Many knowledge management process models (e.g., the knowledge transfer/creation process) have been widely adopted and discussed (e.g., Nonaksa & Takeuchi, 1995; Hayes and Walsham, 2003; Nissen and Espino, 2000; Tiwana, 2002; Metaxiotis et al., 2003). Thus, if a set of knowledge management process models dedicated to schools could be designed, a more structured knowledge management system could be provided for the relatively isolated organizational culture of teachers (Tyack & Cuban, 1995). Considering the limited information personnel and funding in some schools (especially the vast number of smaller elementary schools and secondary schools), another important question is how to develop KMSs and improve members' internal motivation.

This case study addresses the aforementioned limitations of the organizational culture of schools. We designed a knowledge management process model that promotes knowledge transfer and sharing among the members of a school (including teachers and administrators). Based on the proposed model, we designed system modules that match each knowledge management procedure, and we used free or low-cost open-source software resources to develop a process-based knowledge management system for schools, or PKMSS, that is appropriate for schools and improves their knowledge management performance.

We observed a secondary school in Taiwan and introduced the PKMSS gathering, integration, sharing, and feedback of information knowledge required by school members. We also conducted an in-depth exploration of the actual uses of PKMSS.

The specific purposes of this study are as follows:

(1) To summarize the existing knowledge management models and propose a knowledge management process model appropriate for schools based on their organizational cultures and limitations.
(2) To develop a PKMSS system that meets the needs of schools' actual practices based on the above model.
(3) To observe and explore the progress, performance, and limitations of PKMSS by examining a secondary school in Taiwan.

PROCESS-BASED KNOWLEDGE MANAGEMENT SYSTEM FOR SCHOOLS (PKMSS)

Knowledge management helps an organization discover, acquire, and properly utilize knowledge (O'Dell and Grayson, 1998). The concept and model of knowledge management (Sarvary, 1999; O'Dell and Grayson, 1998; Shin, 2004) and various knowledge management processes (e.g., Shin, Holden and Schmidt, 2001; Nissen and Espino, 2000; Tiwana, 2002; Metaxiotis et al., 2003, etc.) have been widely discussed and studied. For example, Shin, Holden and Schmidt (2001) summarized previous studies and proposed the knowledge management value chain, which can be divided into four major steps: knowledge creation, knowledge storage, knowledge distribution, and knowledge application. Tiwana (2002) pointed out that the basic procedures of knowledge management include knowledge acquisition, knowledge sharing, and knowledge utilization. There is an increasing tendency to apply these knowledge management procedures to business operations.

Due to the increasing diversification and digitization of educational resources and administration, many studies have also pointed out the importance of introducing knowledge management into schools (Richard, 2001; David, 1999; Kuo, 2003; McKenzie et al., 2001). However, many factors influence inter-member knowledge interactions (Bock et al., 2005; Kankanhalli et al., 2005; Wasko & Faraj, 2005; Hsu, et al., 2007), and knowledge interaction is closely related to an organization's culture and characteristics (Yang, 2007; Yang & Chen, 2007; Bock et al., 2005). Therefore, the design of knowledge management procedures must consider a school's organizational culture to ensure that the procedures are appropriate.

This study reviews and summarizes existing literature on knowledge management (e.g., Shin, Holden and Schmidt, 2001; Nissen and Espino, 2000; Tiwana, 2002; Metaxiotis et al. 2003; Nonaksa & Takeuchi, 1995; Gilbert & Gordey, 1996; Davenport & Prusak, 1998; Hendriks 1999; Beckman, 1999) to design a knowledge management process model based on the organizational features of schools. Due to the competitive nature of business organizations, an organization's knowledge management and its performance are often closely related. Furthermore, the external incentives and binding forces of the employment relationship in a business organization make the implementation of knowledge sharing and knowledge transfer different from their educational counterparts. Factors such as information systems, organizational culture, incentives, and knowledge management project groups are all essential to determining whether knowledge management can be implemented (Sarvary, 1999). Educational organizations often lack the organizational culture of knowledge interaction (Carroll et al., 2003; Tyack & Cuban, 1995). Because of the lack of inter-member interactions in the organizational culture, it is often difficult to determine the objectives for knowledge-sharing (Carroll et al., 2003). In addition, rewards are limited, which may affect the performance of knowledge sharing. Schools also lack dedicated departments or teams to introduce knowledge management. Therefore, to keep costs low, another key procedure in school knowledge management is to choose active members to handle its implementation.

This study examined the characteristics and limitations of school organizations (mentioned above) and analyzed the factors that influence the applicability of different knowledge management process models in schools. We refer to the well-known knowledge transfer process proposed by Nonaksa & Takeuchi (1995) and various studies of the knowledge-management process (e.g., Shin, Holden and Schmidt, 2001; Nissen and Espino, 2000; Tiwana, 2002; Metaxiotis et al., 2003, etc.) to design a process-based knowledge management model that meet the needs of schools. Two critical teams are needed for the project group that introduces the proposed model to a school: (1) the knowledge management team, consisting of managers who specialize in knowledge management or KMSs, and (2) the knowledge construction team, consisting of members with knowledge expertise and high knowledge-sharing motivation. Any organizational member who utilizes organizational knowledge is classified as a knowledge user (including all members of the knowledge management team or the knowledge construction team). The specific procedures and corresponding knowledge transfer behaviors of our model are shown in Table 1.

The above process model needs to be implemented with a KMS in order to understand its potential performance and limitations. Though there are some studies on the KMS in education (e.g., Spector, 2002; Plass, 2002), they are mostly focused on proposing a KMS framework rather than developing an educational KMS based on a process model of knowledge management. Based on our proposed model and relevant KMS studies (e.g., Chua, 2004; Spector, 2002; Plass, 2002; Bowman, 2002), this study designed and developed the PKMSS system that addresses the concepts behind each procedure in Table 1. The features of each module of the PKMSS and the corresponding knowledge management procedures are shown in Table 2.

As shown in Tables 1 and 2, when knowledge management is in progress, knowledge types also change and generate meaningful knowledge transfer behaviors. During actual practice, knowledge constructors transform tacit knowledge into explicit knowledge through externalization. The Knowledge Searching and Knowledge Discussion Modules that allow the internalization and socialization of inter-member discussions and observations are provided. Through compilation by knowledge managers/users and inter-member discussion and evaluation, explicit knowledge is combined to form more sophisticated knowledge. Through the e-newsletters issued by the Knowledge Feedback Module, members' internalization motivation and behavior are encouraged. The feedback mechanism also encourages members to learn professional knowledge from other members through the internalization process of reading newsletters and discussing. The entire process meets the knowledge transfer model proposed by Nonaksa & Takeuchi (1995).

Table 1. Procedures of the knowledge management process model for schools

Procedures of School Knowledge Management	Description	Corresponding Knowledge Transfer Behavior
Knowledge Generation and Acquisition	The knowledge construction team generates working knowledge by writing digital work reports and promotes "externalization" and documentation of tacit knowledge. This effort is integrated into the daily routine, saving the members from extra work. The combination of a knowledge construction team and digital work reports helps a school acquire professional and accurate knowledge.	Externalization of knowledge
Sharing and Communication of Knowledge	Through a KMS, the documented knowledge is announced and shared. An environment that allows the "internalization and socialization" of inter-member discussions and observations is provided. In order to provide the school with the necessary correct knowledge, the senior knowledge managers determine what knowledge is to be shared, and these documents are only shared	Internalization of knowledge Socialization of knowledge

	after being approved by the knowledge management team. This helps avoid the distribution of incorrect or redundant knowledge and helps the community focus on the key objectives of knowledge sharing.	
Application and Evaluation of Knowledge	In this stage, knowledge users can "combine" the knowledge and apply it to actual practice by integrating the published knowledge documents. The approved knowledge is evaluated by an online voting and discussion mechanism, which allows users to evaluate and comment on knowledge documents. The knowledge management team may check the click rate or response rate of the knowledge documents. They may also check the knowledge users' online polling to determine the status of knowledge application and review comments. This mechanism provides information on how the knowledge management strategy should be adjusted.	Combination of knowledge
Knowledge Compilation and Feedback	After the KMS has operated for some time, the knowledge managers regularly compile the important and critical organizational knowledge as e-newsletters and send them to all the members as feedback to actively "combine" knowledge. Knowledge compilation allows the combination of knowledge in a sophisticated and professional manner. This mechanism also increases the knowledge construction team's motivation to write the digital work reports, thus achieving the objective of writing the knowledge documents. This improves knowledge users' level of participation, prompts them to review and "internalize" existing discussions or documents, and helps them focus on the objectives of knowledge sharing.	Combination of knowledge Internalization of knowledge

In this process, crucial organizational knowledge is gradually shaped and applied and becomes the knowledge needed by an organization. Knowledge managers report the crucial practical knowledge to users and knowledge constructors, potentially stimulating new knowledge and forming a cycle of increasing knowledge sophistication by reviewing and innovating knowledge documents.

Table 2. Functions of PKMSS Modules

PKMSS Modules	Function Description	Corresponding Knowledge Management Procedures
Work Report Module	Provides an interface for knowledge constructors to write digital work reports, allowing tacit knowledge to be externalized and documented.	Knowledge Generation and Acquisition
Knowledge Searching Module	Announces the latest knowledge documents and allows users to browse or search for knowledge documents by inputting key words.	Knowledge Sharing and Communication
Knowledge Discussion Module	Serves as a forum that allows users to discuss and comment on published knowledge documents.	Sharing and Communication of Knowledge Application and Evaluation of Knowledge
Knowledge Evaluation Module	Consists of a voting mechanism that allows knowledge users to evaluate published knowledge documents. Knowledge managers may also reference this information and compile the knowledge that has been applied or discussed. The compiled knowledge promotes the effective integration and transfer of crucial knowledge.	Application and Evaluation of Knowledge
Knowledge Feedback Module	Provides an interface that allows knowledge mangers to edit the compiled critical knowledge and sends out e-newsletters. This approach actively disseminates crucial knowledge to members and encourages	Knowledge Compilation and Feedback

	knowledge constructors to continue their work. This approach also deepens knowledge users' learning impressions and encourages them to continue reading, internalizing knowledge, and engaging in discussions.	Sharing and Communication of Knowledge

The PKMSS utilizes the APM framework (i.e., Apache, PHP, and MySQL). All the development software is free and allows for customization by a school's information staff. The system is fully web-based and easy to learn. The provided modules allow knowledge managers to configure, edit, add, or delete files and to manage the PKMSS without program-writing or website-designing skills. We used this system to combine knowledge management theories and information technology and conducted an empirical case study to understand the process.

As for the user interface, Figure 1 shows the Knowledge Searching Module in the PKMSS as an example. As shown in the figure, knowledge documents which have been approved by the knowledge manager are shared in the module. The module provides the document list, the searching function, and the title, category, and detail content of the knowledge document. Members of the community can browse, search and go to Knowledge Discussion Module to comment on the documents. In each module of the PKMSS, the system provides a friendly interface for users to access, apply, manage, and evaluate the knowledge documents.

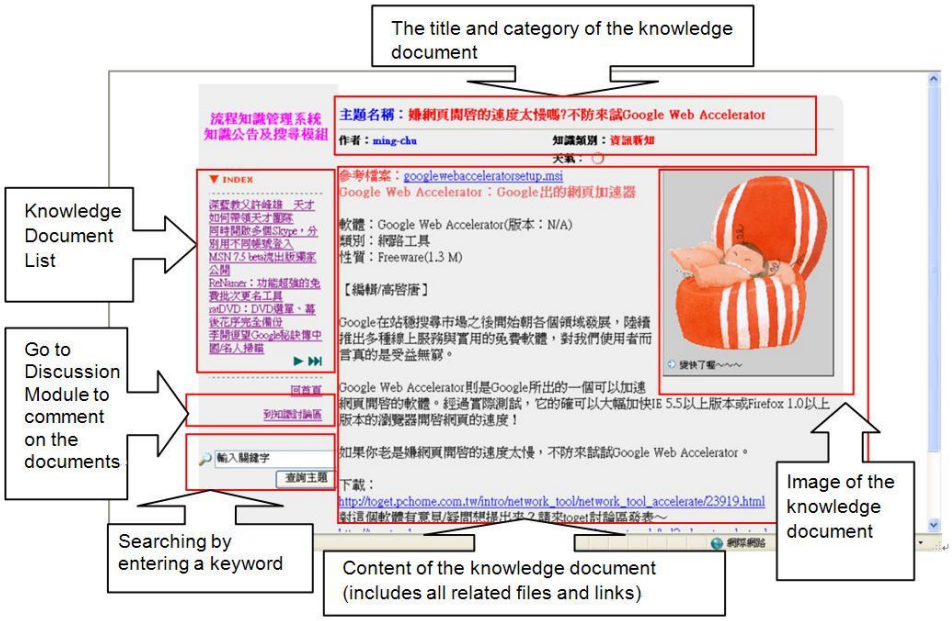

Figure 1. The interface of the Knowledge Searching Module in the PKMSS

METHOD

Organizational Background and Participants

A secondary school, located in Taipei City, Taiwan, was selected as the site for our introduction and observation of the PKMSS. The core professional knowledge we hoped to introduce to the school was "knowledge relevant to the Internet information technology." With the growth of Internet technology and educational technology, the school's teachers and administrators frequently use information technology to facilitate teaching and administration. Although the teachers have participated in workshops provided by training facilities, they still face problems when attempting to apply the technology, and not all the problems that arise were covered during their training. In addition, different members have received different amounts of training on different content. Thus, their information literacy also differs. Consequently, the members may not be able to fully share their knowledge, solve each other's problems, or receive timely assistance, thereby hindering the organization's performance.

Moreover, the school's information center receives calls from different departments asking for help regarding computers or the Internet. Certain problems share common attributes and can be solved by users themselves through certain procedures. Currently, most problems are solved by instructing the callers over the phone; if problems persist, the information staff goes to the site to address the situation. This practice is inefficient and does not allow common information-related knowledge to be distributed or accumulated into organizational knowledge. Therefore, the school hopes to introduce and manage knowledge relevant to Internet information technology using the PKMSS system. The school administration hopes to acquire the tacit knowledge held by its information staff or members who are information specialists. The tacit knowledge will then be shared, applied, and transferred to help the organization

efficiently solve information-related problems, improve the school's information service, and establish the information service knowledge database.

After the research team promoted the PKMSS in the school for about a month, 45 members signed up for the knowledge management project. Based on the members' information backgrounds, we appointed one knowledge manager (the director of the school's information center) and nine members of the knowledge construction team. All members who registered and joined the knowledge application were considered knowledge users (including knowledge managers and knowledge constructors). These users included members who worked at different levels and positions, including the principal, directors, teachers, administrators, and nurses. All of the above members acquired the basic skills of PKMSS through the same training program.

Design and Procedures

The process of introducing knowledge management to an organization is complex. In order to gain a deeper understanding of the knowledge management process and the performance and limitations of the system as proposed in this study, we applied both quantitative and qualitative analysis methods, including satisfaction surveys, qualitative content analysis of online discussions, and unstructured interviews. In the first step of this study, the researchers provided all participants with an introduction and training in PKMSS. Then, based on the assigned groups, the knowledge constructors wrote digital work reports about the knowledge and experiences of their daily work. The knowledge manager then evaluated and gave feedback on these reports. All knowledge users used the PKMSS modules to discuss, ask questions, provide additional information/comments, and evaluate the posted knowledge. The entire observation lasted 30 days. After the observation period, a survey on knowledge management satisfaction (see the section 3.3 below) was conducted to assess member satisfaction. The entire online discussion content in PKMSS was recorded and analyzed to understand the process of knowledge sharing/application among members. Finally, we conducted open-ended, unstructured interviews with the members to explore their attitudes about the knowledge management project and PKMSS. The interview question was, "What are your thoughts and comments about PKMSS?"

Instrument

We adopted an instrument that measured five dimensions of user satisfaction about knowledge management systems (USKMS) devised by Ong and Lai (2004). This instrument specifically deals with KMS satisfaction. It was rigorously tested with high reliability and validity; the Cronbach's alpha was 0.94, including 21 items and five dimensions (i.e., knowledge content, knowledge mapping, knowledge manipulation, knowledge community, and personalization). In the PKMSS, some functions of these dimensions are not provided. Therefore, some items in the USKMS were removed or adjusted for our study. Additionally, we included questions that evaluated the effectiveness of general online information systems (e.g., Rai, Lang and Welker, 2002; Muylle, Moenaert and Despontin, 2004) to understand whether users were satisfied with the interfaces and operations of PKMSS. The compiled and organized questionnaire contained 15 questions that included the four dimensions proposed by Ong and Lai (2004): knowledge content, knowledge mapping, knowledge manipulation, and knowledge community. The questionnaire also included the dimension of "system use," added by this study, for a total of five dimensions. The questions are listed in Table 3.

Table 3. Satisfaction Survey Questionnaire on PKMSS

Dimension	Question
Knowledge Content	Q1. PKMSS provides correct content.
	Q2. PKMSS provides integral content.
	Q3. PKMSS provides logical content.
	Q4. The content provided by PKMSS is easy to read.
	Q5. PKMSS provides practical content.
Knowledge Mapping	Q6. The knowledge classification of expertise in PKMSS is clear and easy to understand.
	Q7. The classification of expertise in the PKMSS is consistent with my cognition.
Knowledge Manipulation	Q8. PKMSS makes it easy for me to search/retrieve knowledge documents.
Knowledge Community	Q9. PKMSS makes it convenient for me to discuss with other people in the knowledge community.
	Q10. PKMSS makes it convenient for me to input comments and feedback in the knowledge community.
	Q11. PKMSS makes it convenient for me to share knowledge with other people in the knowledge community.
	Q12. PKMSS makes it convenient for me to access the shared content from the knowledge community.

System Use	Q13. I think that operating PKMSS is quick and easy. Q14. I think the user interface on PKMSS is friendly. Q15. I think the hyperlinks in PKMSS correctly state where they will take me.

The questionnaire utilizes a 5-point Likert scale, in which a higher score indicates a higher level of agreement with the statement. One point was given if the respondent was "strongly dissatisfied," and 5 points were given if the respondent was "strongly satisfied." Besides the dimension of system use, the questions in all other dimensions covered topics relevant to the knowledge management process proposed in this study. For example, the dimension of "knowledge content" was used to verify whether the generated and acquired knowledge documents were correct and logical. The dimension of "knowledge mapping" helped us verify whether knowledge classification in the PKMSS was appropriate to the externalization process of knowledge generation, acquisition, and compilation. The dimension of "knowledge manipulation" helped us understand how easy it was to search for specific knowledge. The dimension of "knowledge community" allowed us to verify the effectiveness of knowledge sharing, communication, and feedback.

RESULTS AND DISCUSSION

After the empirical observation was implemented for 30 days and the members who were unable to fully participate during the period were filtered out, a total of 31 members underwent questionnaire and interview surveys. The Cronbach's alpha of the satisfaction survey was 0.92. Based on the question items for each dimension listed in Table 2, we calculated the mean of the mean scores of all questions in each dimension as the satisfaction score of that dimension. The satisfaction scores of the five dimensions are listed in Table 4.

Table 4. Satisfaction scores of the five dimensions on PKMSS

Dimension	N	Mean	SD
Knowledge Content	31	4.17	.498
Knowledge Mapping	31	4.11	.704
Knowledge Manipulation	31	4.19	.703
Knowledge Community	31	4.39	.478
System Use	31	4.31	.531

As shown in Table 4, the participants were positive towards all dimensions of PKMSS. The dimension that yielded the highest level of satisfaction was "knowledge community," followed by "system use." The satisfaction with "knowledge mapping" was relatively lower. The main analyzing framework in this study was based on the dimensions covered in the satisfaction questionnaire. We also analyzed the open-ended interview transcripts and the content of knowledge discussions recorded in the system and conducted a cross-discussion and triangulation with the findings of the satisfaction survey.

The dimension of "knowledge content" (Q1-Q5) mainly focused on whether the content of knowledge documents provided by PKMSS was correct, complete, logical, easy to follow, and practical. The satisfaction score for this dimension was 4.17. The users were quite satisfied with the knowledge documents. Most respondents (93.5%) were especially satisfied with their "practicality" (Q5). This indicates that mechanisms such as sharing, feedback, discussion, and evaluation on PKMSS generate a level of practicality in terms of knowledge generation and acquisition. The knowledge documents in our system were correct, logical, and practical. During the interviews, the members acknowledged the knowledge content and gave suggestions:

Member A: I really like this system because it allows me to acquire all sorts of new information...I believe its greatest advantage is that knowledge can be shared with others, and everyone is motivated to participate.…I wish they would include information such as campus activities, governmental regulations, and human resources in the system in the future….(#0302-5)

Member B: I wish it could be connected with external knowledge management platforms as this would provide more knowledge documents and promote sharing among the school staff. (#0106)

Member C: I wish it could be integrated with other educational resources and subjects. (#0404)

In addition to positive comments, the above excerpts also indicated that the organization's members wanted to see the knowledge documents in the system integrated with other resources. For example, Member A mentioned documents related to the dimension of education administration, Member B mentioned external KMSs, and Member C mentioned professional subjects and knowledge. Because this study only conducted an initial trial run of PKMSS, knowledge themes were limited and only focused on information-related knowledge. However, because the practice of education is complex and covers diverse domains of knowledge, an important topic for future research is how to integrate information from different knowledge sources. The era of Web 2.0 emphasizes active and highly interactive knowledge sharing (Musser, O'Reilly & the O'Reilly Radar Team, 2006). Open, cross-campus educational platforms, such as

teachers' blogs, are increasing (e.g., Author et al., 2009b). Many members (such as Member B above) also wished to see a connection that links the knowledge documents in different community platforms and schools. This kind of knowledge interaction (where the internal system provides diverse and convenient information sharing that allows the practical resources discovered by members in external community platforms to be shared) should be a future trend to promote depth and breadth in knowledge externalization and combination.

The dimension of "knowledge mapping" (Q6-Q7) allows us to understand whether the classification and manifestation of dedicated knowledge in the PKMSS matches users' understanding. The satisfaction score for "knowledge mapping" was 4.11. The questionnaires indicated that users were less satisfied with this dimension in PKMSS compared to other dimensions. Currently, campus information knowledge is classified into ten default categories in PKMSS. However, an inappropriate default knowledge classification in the system may result in users' failure to understand the knowledge classification, hindering knowledge access. Since knowledge document searching in PKMSS currently features listing and searching for knowledge documents and knowledge categories are only listed after a user clicks on a document, users cannot fully understand what kinds of knowledge categories exist and may be confused by how categories are displayed and arranged. An example is the comment given by Teacher D in an interview:

Teacher D: Regarding knowledge announcement in the system, I think it should allow users to freely select the knowledge categories they wish to see. (#0403)

Teacher D recommended that the future PKMSS should allow browsing based on categories of knowledge acquisition. Moreover, similar problems were found when the content of the knowledge forum was analyzed, because some users did not know how to look for the knowledge documents being discussed by their peers. The following is excerpted from the forum and describes how the members felt when they were looking for the knowledge document shared by Member E, who was a knowledge constructor.

Discussion article number #D0201

Knowledge manager: Teacher E must have given us the links to online virus-removal sites because he has become really tired of getting rid of computer viruses for us. Ha! Anyways, let's give him some applause!

Teacher E (knowledge constructor): Ha, ha! Actually, I just want everyone to regularly update their OS and virus definitions, and develop good online habits such as not opening suspicious files or websites. That's how you stay away from being infected!

...

Teacher G (knowledge user): Thank you, Teacher E. But I would like to ask you where I can access the "great collection" you have shared?

Knowledge manager: Go to "Knowledge Announcement and Search Module," input the key word of "virus removal" to browse the database, and you will see that knowledge document.

Teacher G (knowledge user): Thank you, Knowledge Manager and Teacher E. I've found it. Thanks again.

The above example indicates that the current method in PKMSS that only allows searching using keywords does not really help knowledge users understand the important frameworks of classification in a knowledge domain, and it does not promote effective knowledge internalization and sharing. Important considerations include how to handle the high cognitive load generated by the simultaneous presentation of multiple knowledge categories and how to guide users to access knowledge based on the categories. Further, inappropriate classification may lead to concept confusion or redundancy (Voß, 2007). Therefore, users' understanding of and experience with information-related knowledge should be surveyed and relevant research should be reviewed to develop a system of knowledge classification that is both effective and meets the consensus of an organization's members (e.g., Milton, 2007; Santos-Neto, Ripeanu & Iamnitchi, 2007) in an effort to use knowledge classification to better meet users' needs.

The satisfaction score for "knowledge manipulation" (Q8) was 4.17, and 87% of the users indicated that it was easy to search for knowledge documents via PKMSS and expressed satisfaction with the searching feature. However, the search feature could be improved if searching or browsing could be based on knowledge categories, as discussed in the above section on knowledge mapping.

The satisfaction score for knowledge community (Q9-Q12) was 4.39. This was the highest of all dimensions, and most participants agreed that it was easy to discuss with others, provide comments and feedback, and share knowledge through PKMSS. This also indicates that the mechanisms of knowledge communication, sharing, and feedback in this process are effective and facilitate the externalization and combination of knowledge. Examples include the following excerpts:

Member A: When there were difficulties, I was able to receive help through this system, and the online colleagues were very enthusiastic and provided much assistance. To me, it was very helpful. The greatest reason that

attracted me to use it was that the knowledge documents could be discussed and shared. We were not alone when facing problems, and help was available through the system. (#0301-3)

Member H: PKMSS promotes interpersonal communication among the campus community and promotes knowledge sharing. (#0409)

Member I: When I faced difficulties, there were ways that could help me, and knowledge could be shared with everyone. (#0410)

Member J: I believe this is an excellent platform that facilitates both teaching and learning. When I provided my comments, others also gave their feedback, allowing me to grow during this exchange of thoughts.…The system has an interactive platform that allows us to discuss with our fellow teachers, and we can also get help from the experts when we have information-related problems. It feels very efficient. (#0201-3)

As mentioned earlier, past research indicates that teachers often lack interaction with one another, and it is difficult for them to determine the objectives of knowledge sharing (Carroll et al., 2003). The comments on PKMSS seen above indicate that mechanisms that combine actual practice, knowledge documents, and problem solving may achieve work-related consensus and turn this consensus into knowledge-sharing objectives. Mechanisms such as the evaluation module, e-newsletters, and forums also enhance the community's knowledge interactions. Interactions yield practical resources (such as knowledge documents, newsletters, and discussions) that may provide assistance for teachers whose organizational culture is isolated (Tyack & Cuban, 1995), as suggested by Members A, I, and J. In order to further understand the process of knowledge interaction in the educational community, we include here an excerpt from the knowledge forum. In this example, Member K was interested in a knowledge document and asked more questions in the "Knowledge Discussion Module" to find answers to his problems.

Discussion article number #D0103

Member K: Can I use Ghost to backup the disk partitions? If not, is there any other way to do it?

Knowledge manager: If you "ghost" the entire hard-drive and copy it to another hard-drive, the disk partition information is also copied over. Also, I don't think many people back up their disk partition information.

Member K: Because I made the partitions and it was quite a troublesome process, so I figured if I could "ghost" the partition information, it would make things easier for me in the future. So…I guess your answer was a "yes?" Can I just ghost the whole thing after the hard-drive is partitioned? Or, the operating system has to be ghosted at the same time as well? Also, what I would like to suggest is that the ghost procedures you guys posted seem too simplified. Could you give a more detailed, step-by-step instruction for people such as me who know less about computers? Thank you!

Knowledge manager: Hmm…About that knowledge document, it was intended as a reference for beginners. You can ask any questions about any procedure that you are still confused with.

Member L (another knowledge user): Frankly, there are so many different versions of "Ghost," and they basically work the same way. However, there are different kinds of combination and applications depending on your OS and needs. It is unlikely that you will need all the features of Ghost or to "ghost" all the time! Here is an online article that may help you out!
(The URL of the online article)

Knowledge manager: Thank you, L, for your input. The article you posted indeed has many detailed instructions on how to use Ghost.

In the above excerpt, Member K read and internalized a knowledge document relevant to his needs and asked extensive questions. Furthermore, the member also provided suggestions regarding the content of the knowledge document that served as valuable references for improving the quality of future knowledge-managers' or constructors' knowledge externalization and combination. Knowledge managers and other users were able to propose additional correct input regarding the knowledge document through the discussion mechanism, allowing better knowledge socialization and internalization. This process may provide assistance for the problem of lacking in-depth knowledge interactions in teachers' virtual community as mentioned in previous studies (e.g., Author et al, 2009a; Barab et al., 2001). This has also verified the benefits of PKMSS on schools' knowledge-sharing.

Finally, the satisfaction score for "system use" (Q13-Q15) was 4.31, and the completed questionnaires indicated that 84% of the respondents agreed or strongly agreed that PKMSS yields good system use, including speed, a user-friendly interface, and clear and correct hyperlinks. Some users made recommendations for improvements or additions.

Member M: Could you increase the allowed size of photo uploads? (#0509)
Member N: The content of the newsletter could be further expanded. (#0510)

The limitations of system capacity and newsletter content restrict knowledge externalization and feedback. The issue of capacity involves the cost of the storage device. More knowledge managers would be required if the content of the newsletter were to be improved, resulting in additional costs. Another important topic for future research is how schools

can improve KMS with limited funding. The above discussion gives us an initial understanding of the performance and limitations of PKMSS in a school.

CONCLUSION

The constant improvement of Internet technology and the increasing digitization and complexity of educational practices have made it critical for school organizations to introduce knowledge management (Richard, 2001; David, 1999; Kuo, 2003; McKenzie et al., 2001). Due to limitations in schools' organizational cultures, budget, and incentives, test runs and development of knowledge management processes and models are needed to allow us the development of low-cost and effective knowledge-management solutions for schools.

This study proposed a knowledge management process model and PKMSS system for schools. The month-long observation and satisfaction survey conducted in a secondary school revealed that PKMSS and the mechanisms of knowledge communication, sharing, and feedback are effective and practical in terms of schools' knowledge management. Benefits include the externalizing and combining of knowledge, determining the objectives of knowledge sharing, combining knowledge documents and practices to solve problems, and promoting inter-member interactions.

However, there are many insufficiencies with the current PKMSS, including limited knowledge classification, limited diversity of knowledge content, and limitations with certain system features.

In terms of limitations in knowledge categorization, there has been much research on the tagging system (e.g., Golder & Huberman, 2006; Rivadeneira, Gruen, Muller, & Millen, 2007; Voß, 2007). We recommend that future researchers design school-oriented tagging mechanisms in KMSs that allow teachers to flexibly categorize professional knowledge. These mechanisms could improve the clarity and comprehensiveness of the knowledge map. We recommend that the diversity of knowledge content be integrated with knowledge domains, such as subject-domain knowledge and instructional design. In terms of the limitations of the system's features, a dynamic consideration of cost and users' needs would be required before PKMSS could be further enhanced.

A future study on a larger scale that examines multiple schools is recommended to supplement this case study. Furthermore, there are many factors that affect knowledge sharing (e.g., Bock et al., 2005; Kankanhalli et al., 2005; Wasko & Faraj, 2005; Hsu et al., 2007) and teachers' perceptions of educational technology (e.g., James, 2008; Taiwo, 2009), and their influences on PKMSS are waiting to be uncovered by future studies. We hope that our initial findings and the experience of PKMSS may serve as a valuable reference for knowledge management in schools. This will help schools with a limited workforce and limited funding encourage their members to actively and effectively conduct knowledge transfer, innovation, and sharing.

REFERENCES

Barab, S. A., MaKinster, J. G., Moore, J. A., Cunningham, D. J., & The ILF Design Team (2001). Designing and building an on-line community: The struggle to support sociability in the inquiry learning forum. *Educational Technology Research and Development, 49*, 71-96.

Beckman, T. J. (1999). The current state of knowledge management. In J. Liebowitz (Ed.), *Knowledge Management Handbook* (pp. 1-22). Boca Raton: CRC Press.

Bock, G. W., Zmud, R. W., Kim, Y., & Lee, J. (2005). Behavioral intention formation knowledge sharing: Examining roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS Quarterly, 29*(1), 87-111.

Bowman, B. J. (2002). Building Knowledge Management Systems. *Information Systems Management, 19*(3), 32-40.

Carroll, J. M., Choo, C. W., Dunlap, D. R., Isenhour, P. L., Kerr, S. T., MacLean, A., & Rosson, M. B. (2003). Knowledge management support for teachers. *Educational Technology Research and Development, 51*(4), 42-64.

Chang, Y. F., & Liu, E. Z. F. (2008). Genre analysis of teachers' blogs. *Journal of Scientific and Technological Studies, 42*(1), 119-138.

Chua, A. (2004). Knowledge management system architecture: a bridge between KM consultants and technologists. *International Journal of Information Management, 24*, 87-98.

Constant, D., Kiesler, S., Sproull, L. (1994). What's mine is ours, or is it? A study of attitudes about information sharing. *Information Systems Research, 5*(4), 400-421.

Davenport, T.H. & Prusak, L. (1998). *Working Knowledge. How Organization Manage what they Know*. Harvard Business School Press, Boston.

David, H. H. (1999). The knowledge-creating school. *British Journal of Educational Studies, 47(2)*, 122-144.

Duran, M., Brunvand, S., Fossum, P. R. (2009). Preparing Science Teachers to Teach With Technology: Exploring a K-16 Networked Learning Community Approach, *The Turkish Online Journal of Educational Technology, 8(*4), 21-42.

Erkunt, H. (2010). Emergence of Epistemic Agency in College Level Educational Technology Course for Pre-Service Teachers Engaged in CSCL, *The Turkish Online Journal of Educational Technology, 9*(3), 38-51.

Gilbert, M., & Gordey-Hayes, M. (1996). Understanding the process of knowledge transfer to achieve successful technological innovation. *Technovation, 16*(6), 301-312.
Golder, S. A. & Huberman, B. A. (2006). Usage patterns of collaborative tagging systems. *Journal of Information Science*, *32*(2), 198-208.
Hayes, N. and Walsham, G. (2003). Knowledge sharing and ICTs: a relational perspective. In Easterby-Smith, M. and Lyles, M. A. (eds.): *The Blackwell handbook of organizational learning and knowledge management (*pp.54-77). Malden, MA: Blackwell Publishing.
Hendriks, P. (1999). Why share knowledge? The influence of ICT on the motivation for knowledge sharing. *Knowledge and Process Management, 6*(2), 91-100.
Hou, H. T., Chang, K. E., & Sung, Y. T. (2009a). Using Blogs as a Professional Development Tool for Teachers: Analysis of Interaction Behavioral Patterns, *Interactive Learning Environments*, *17*(4), 325-340.
Hou, H. T., Sung, Y. T., & Chang, K. E. (2009b). Exploring the behavioral patterns of an online knowledge sharing discussion activity among teachers with problem-solving strategy. *Teaching and Teacher Education, 25*(1), 101-108.
Hsu, M. H., Ju, T. L., Yen, C.H., & Chang, C. M. (2007). Knowledge sharing behavior in virtual communities: The relationship between trust, self-efficacy, and outcome expectations. *Int. J. Human-Computer Studies, 65*, 153-169.
Hsu, S. (2004). Using case discussion on the web to develop student teacher problem solving skills. *Teaching and Teacher Education, 20*, 681-692.
James, P. TJ. (2008). Academic Staff Perceptions of ICT and Elearning: A Thai HE Case Study, *The Turkish Online Journal of Educational Technology, 7(*4), 36-45.
Joaquín, G. S., David, R. G., & Carme, A. A. (2010). Who exactly is the moderator? A consideration of online knowledge management network moderation in educational organisations. *Computers & Education*, *55(1)*, 304-312.
Kankanhalli, A., Tan, C. Y. B., & Wei, K. K. (2005). Contributing knowledge to electronic knowledge repositories: an empirical investigation. *MIS Quarterly, 29*(1), 113-143.
Koçoğlu Z. (2008). Turkish EFL Student Teachers' Perceptions on the Role of Electronic Portfolios in their Professional Development, *The Turkish Online Journal of Educational Technology, 7(*3), 71-79.
Kuo, Y. F. (2003). A study on service quality of virtual community. *Total QualityManagement & Business Excellence, 14*(4), 461-473.
Masood, M. (2010). An Initial Comparison of Educational Technology Courses for Training Teachers at Malaysian Universities: A Comparative Study, *The Turkish Online Journal of Educational Technology, 9(*1), 23-27.
McCotter, S. S. (2001). Collaborative groups as professional development. *Teaching and Teacher Education, 17*, 685-704.
McKenzie, J., & Truc, A., & Winkelen, C. (2001). Winning commitment forknowledge management initiatives. *Journal of Change Management, 2*(2), 115-127.
Metaxiotis, K., Ergazakis, K., Samouilidis, E. and Psarras, J. (2003). Decision support through knowledge management: the role of the artificial intelligence. *Information Management & Computer Security, 11*(5), 216-221.
Milton, M. (2007). Filtering an Organization's Critical Knowledge. *Knowledge Management Review*, *10*(1), 28-33.
Musser, J., O'Reilly, T. & the O'Reilly Radar Team. (2006). *Web 2.0: principles and best practices*. Sebastopol, CA: O'Reilly Media, Inc.
Muylle, S., Moenaert, R. and Despontin, M. (2004). The Conceptualization and empirical validation of web site user satisfaction. *Information and Management, 41*, 543-560.
Nelson, K. M., Cooprider, J. G. (1996). The contribution of shared knowledge to IS group performance. *MIS Quarterly, 21*(4), 409-429.
Nissen, M. E. & Espino, J. (2000). Knowledge Process and System Design for the Coast Guard. *Knowledge and Process Management Journal, (7)*3, 165-176.
Nonaksa, Ikujiro & Hirotaka Takeuchi. (1995). *The Knowledge Creating Company*. NY: Oxford University Press.
O'Dell, C. and Grayson, C. J. (1998). If Only We Knew What We Know: Identification and Transfer of Internal Best Practices. *California Management Review, (40)*3, 154-174.
Olson, M.R., & Craig, C. J. (2001). Opportunities and challenges in the development of teachers' knowledge: the development of narrative authority through knowledge communities. *Teaching and Teacher Education, 17*, 667-684
Ong, C. S., & Lai, J. Y. (2004). Developing an instrument for measuring user satisfaction with knowledge management systems. In *Proceedings of the 37th Hawaii International Conference on System Sciences* (pp.1-10). Hawaii.
Orhan, F., & Yilmaz, M. B. (2010). Pre-Service English Teachers in Blended Learning Environment in Respect to Their Learning Approaches, *The Turkish Online Journal of Educational Technology, 9(*1), 157-164.
Plass, J. and Salisbury, M. (2002). A living systems design model for Web-based knowledge management systems. *Educational Technology, Research & Development, 50*(1), 35-57.
Rai, A., Lang, S. S. and Welker, R. B. (2002). Assessing the Validity of IS Success Models: An Empirical Test and Theoretical Analysis. *Information Systems Research, 13*(1), 50-69.
Richard, D. R. (2001). Technology: Where students learn. *American School & University, 47*(3), 360-363.

Rivadeneira, A. W., Gruen, D. M., Muller, M. J., & Millen, D. R. (2007). Getting Our Head in the Clouds: Toward Evaluation Studies of Tagclouds. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 995-998). San Jose, California, USA.

Ryu, S., Ho, S. H., Han, I. (2003). Knowledge sharing behavior of physicians in hospitals. *Expert Systems with Applications, 25*(1), 113-122.

Santos-Neto, E., Ripeanu, M., & Iamnitchi, A. (2007, June). *Tracking User Attention in Collaborative Tagging Communities*. Paper presented at *ACM/IEEE Workshop on Contextualized Attention Metadata,* Vancouver, Canada.

Sarvary, M. (1999). Knowledge Management and Competition in the Consulting Industry. *California Management Review, 41*(2), 95-107.

Shin, M. (2004). A framework for evaluating economics of knowledge management systems. *Information and Management, 42*, 179-196.

Shin, M., Holden, T. and Schmidt, R. A. (2001). From Knowledge Theory to Management Practice : Towards and Integrated Approach. *Information Processing and Management, 37*, 335-355.

Snow-Gerono, J.L. (2005). Professional development in a culture of inquiry: PDS teachers identify of benefits of professional learning communities. *Teaching and Teacher Education, 21*, 241-256.

Spector, M. (2002). Knowledge management tools for instructional design. *Educational Technology Research and Development, 50*(4), 37-46.

Taiwo, S. (2009). Teachers' Perception of the Role of Media in Classroom Teaching in Secondary Schools, *The Turkish Online Journal of Educational Technology, 8(*1), 75-83.

Tiwana, A. (2002). *The Knowledge Management Toolkit* (2nd ed.). Prentice Hall.

Tyack, D., & Cuban, L. (1995). *Tinkering toward utopia: A century of public school reform.* Cambridge, MA: Harvard University Press.

Voβ. J. (2007). Tagging, Folksonomy & Co-Renaissance of Manual Indexing. In *Proceedings* of *The 10th International Symposium for Information Science* (pp.234- 254). Cologne, Germany.

Wasko, M. M., & Faraj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practices. *MIS Quarterly, 29*(1), 35-58

Yang, C., & Chen, L.C. (2007). Can organizational knowledge capabilities affect knowledge sharing behavior? , *Journal of Informational Science, 33*(1), 95-109.

Yang, J. T. (2007). Knowledge sharing: Investigating appropriate leadership roles and collaborative culture. *Tourism Management, 28(*2), 530-543.

AN EMPIRICAL INVESTIGATION INTO THE ROLE OF ENJOYMENT, COMPUTER ANXIETY, COMPUTER SELF-EFFICACY AND INTERNET EXPERIENCE IN INFLUENCING THE STUDENTS' INTENTION TO USE E-LEARNING: A CASE STUDY FROM SAUDI ARABIAN GOVERNMENTAL UNIVERSITIES

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ABSTRACT
E-learning as an effective educational tool has been integrated into many offered courses provided by higher education institutions. Throughout eliminating the barriers of time and distance, students' lifelong learning can be achieved. Due to a broad global attention given to e-Learning, various studies had been conducted by academe, different organizations as well as the government of various nations (Rosenberg, 2001). Saudi Arabian universities are among those universal universities that implement E-learning system. However, recent research indicated that majority of students in Saudi's universities are still unwilling to use online system. Therefore, many factors need to be determined in order to enhance the students' intention to use E-learning tools and participate effectively in their courses using the accessible electronic channels. The current study has extended Technology Acceptance Model (TAM) to investigate the role of Enjoyment, computer anxiety, computer self-efficacy and Internet experience in influencing the students' intention to use E-learning in Saudi's universities. 402 governmental universities' students were participated to test the proposed hypotheses and to determine weather the proposed variables have an effect on the students' intention to use E-learning system. The results of stepwise regression indicated that computer anxiety, computer self-efficacy and Enjoyment were significantly influence the students' intention to use E-learning while the Internet experience was insignificantly influence them. Furthermore, the importance of Attitude in mediating the relationship between perceived usefulness, perceived ease of use and the students' behavioral intention was confirmed.
Keywords: E-learning intention; Intention; TAM; Saudi Arabia

INTRODUCTION
E-learning has been used in education as early as 1950's. At that time E-learning was referred to as distance learning (Clark, 2000). The term E-learning refers to the learning methods which use electronic channels to deliver the instructional content. Moreover, E-learning is also referred to as web-based learning; technology based learning; online learning; networked learning and so on (Trombley & Lee, 2002; Wilson, 2001; Gotschall, 2000). Due to a broad global attention given to e-Learning, various reports and studies had been conducted by academe, different organizations as well as the government of various nations (Rosenberg, 2001). The Saudi Ministry of Higher Education is among those educational organizations that proposed the use of e-learning in Saudi Arabia. The Saudi Ministry of Higher Education initiates the need of integrating Information and Communication Technology (ICT) in various universities in Saudi Arabia. The Saudi Gazette (2008) by Madar Research reported that "the Saudi Arabian E-learning industry is projected to reach USD 125 million in 2008 and is set to grow at a compound annual rate of 33 per cent over the next five years". The increased projection shows vital focus on the advantages of e-Learning in Saudi Arabia's modern education. However, many factors still influence negatively the students' participation in the online courses. Al-Jarf (2007) pointed out that online system for her English course is total failure, ineffective and unsuccessful due to various factors. The reasons behind this low percentage of participation and willingness with the E-learning courses have not confirmed yet. Therefore, the researcher is interested empirically in investigation into the role of Enjoyment, Computer anxiety, Computer self-efficacy and Internet experience in influencing the students' intention to use E-learning.

LITERATURE REVIEW
Technology Acceptance Model (TAM)
The Technology Intention Model (TAM) is one of the most widely applied models to studies individual intention and the usage of technologies. TAM was adapted from the more general human behaviour which is the theory of reasoned action (TRA). The model was initially developed and validate by Davis (1986, 1989). Davis, at al. (1989) developed TAM as a theoretical basis to provide an explanation of the determinants human computer usage behaviour that is general directly from generic TRA (Fishbein & Ajzen 1975). Moreover, According to Davis, Bagozzi, and Warshaw (1989, p. 985) TAM is the proficient of explaining users' behavior crossways of a broad range of end-user computing technologies, alongside both parsimonious and hypothetically justified. TAM model has been extensively validated across an array of settings and contexts (Davis et al., 1989; Venkatesh & Morris, 2000; Venkatesh & Davis, 2000;

Venkatesh, Morris, Davis, & Davis, 2003). Furthermore, many studies have examined TAM's applicability and validity to investigate students' intention in using the e-learning technology in higher education institutions. (Selim 2003; Saadé & Bahli 2005;Saadé & Galloway 2005; Roca et al. 2006 ; Landry ,Rodger , & Hartman 2006; Ngai et al. 2007; Masrom 2007). TAM suggests that perceived ease of use and perceived usefulness of information Technology (IT) are the main determinants factors of IT usage. Davis (1989, p. 447) defines perceived ease of use (PEU) as, "the degree to which an individual believes that using a particular system would be free of physical and mental effort". Moreover, Davis (1989) defined perceived usefulness (PU) as "the degree of which a person believes that using a particular system would enhance his or her job performance". The two major keys constructs of TAM, PU and PEOU, have capability to predict an individual's attitude towards using a particular system. Both constructs PU and PEOU will influence an individual's attitude (A). (Davis et al. 1989) defined attitude as individual's positive or negative assessment of the behavior and is a function of Perceived Usefulness and Perceived Ease of Use .Attitude (A) will influence the Behavioral Intention (BI) of using particular system, and in sequence, Actual use of use the system (AU). Actual use (AU) will be predicted by the individual's Behavioral Intention (BI). Behavioral Intention (BI).Refers to individual's intention to perform a behavior and is a function of Attitude and Perceived Usefulness (Davis et al., 1989). The relationships between the mentioned constructs are presented in Figure 2.4, as shown below. Therefore, TAM model will be basic and theoretical grounding for the current study.

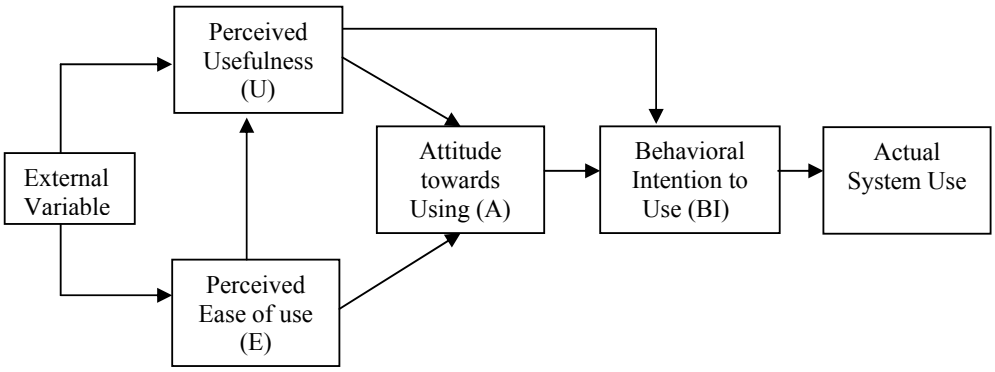

Figure 1: Technology Intention Model (TAM)
Source: Davis, et al., 1989

Enjoyment (EN)
Saadé, Tan, & Nebebe (2008) have conducted empirical research on examining students' intention of a web-based learning system. The authors incorporated the technology intention model (TAM) to include enjoyment as intrinsic motivator. The study was extended TAM to include perceived enjoyment in order to clarify students' behavioral intention in using web-based learning system from a motivational perspective. This study was conducted on two different subjects (China vs. Canada). The results demonstrate that both perceived usefulness and enjoyment have significant impact on students' intention to use the system in two groups. Nevertheless, in contrast to Chinese group, Canadian participants do not consider ease of use has an impact on their intention to use the system. The study also indicated that perceived ease of use does not posses a significant direct effect on behavioral intention in the Canadian group. However, in the Chinese subjects, the relationship between ease of use and intention to use WLS was significant. Lee, Cheung & Chen (2005) have conducted a study in the role of extrinsic and intrinsic motivation on students' Intention of internet-based learning medium. The authors have used technology intention model as theoretical basis for their research. They postulated that perceived usefulness and perceived ease of use as extrinsic motivator and perceived enjoyment as intrinsic motivator. The two proposed motivators were modeled in order to capture and explain students' intention to use the internet-based learning medium. The study findings showed that perceived enjoyment has significant relationship on the students' intention of online learning and directly influencing their intention. While, the perceived usefulness was significantly correlated with the students' intention, however, the perceived ease of use did not record any impact on student attitude or intention towards e-learning usage.

Sun & Zhang (2005) have conducted empirical study on causal relationships between perceived enjoyment and perceived ease of use. The aim of this study was to distinguish their impact on each other is side and their impact on the students' intention from other side. The findings indicated that the causal direction of perceived enjoyment was stronger on perceived ease of use, while, the direct relationship between perceived ease of use was not that strong in the path analysis.

Atkinson and Kydd (1997) have carried out a study to discover the critical factors influencing the students' intention to use World Wide Web. The study involves 162 business (graduate & under graduate) students. The study indicated that

perceived enjoyment was extremely sign fact, whereas, the perceived usefulness was not. Teo, Tan, and Wong (1998) have investigated the role of perceived usefulness, perceived ease of use and perceived enjoyment on the intention to use the Internet. The authors distributed 1370 surveys. The findings indicated that the usefulness used to be not significant, while, the perceived enjoyment used to have a strong relationship with internet usage. To sum up, the enjoyment seems to be very important factors that could affect the E-learning intention in higher education environment. Thus, the researcher will consider enjoyment as important variables need to be investigated.

Computer anxiety (ANX)

Computer anxiety (ANX) is defined as an individual's apprehension or even fear, when she/he is faced with the possibility of using computers (Simonson et al., 1987, cited in Venkatesh, 2000). Moreover, Howard (1986) defines that computer anxiety as the tendency of a person to experience a level of uneasiness over his or her impending use of a computer. In fact, students' who are using E-learning as new educational tools could have some anxiety towards using it. Several researches have investigated computer anxiety as a key factor in influencing the different types of technology intention such as E-mail (Elasmar & Cartar 1996) and computer usage (Compeau & Higgins 1995). Recently, several researches have been conducted in the area of E-learning intention to investigate the role of computer anxiety on students' intention (Ndubisi, 2004; Saadé & Kira 2006).

Saadé and Kira (2006) have conducted research to assess the emotional state of students' perception towards online learning system based on the technology intention model (TAM). The authors have extended technology intention model to include Anxiety and Affect as antecedents and for both perceived usefulness and perceived ease of use. The findings from the study indicated that the perceived usefulness of using online system is not determined by the students' computer anxiety. However, it has indirect influence through the perceived ease of use on the students' intention of online learning system. Furthermore, the anxiety has a positive influence on students' intention of using online system. In conclusion, the emotional state has no direct impact on perceived usefulness of an online learning system, whereas, it has power in predicting the easy of use on online learning system. Thus, the computer anxiety will be tested as antecedents in the current research.

Ndubisi (2004) has conducted research to investigate the critical factors that influence the student' intention to adopt E-learning in Malaysia. The authors examined many factors on students' intention to use the Blackboard system such as users' attitude, subjective norm, perceived behavioral control, perceived usefulness and ease of use of the system. Some of those factor use to mediate and other to test directly the proposed variables. The findings show that the computer anxiety has contributed significantly and has predicted that bout 22% of variation in perceived behavioral control. The findings also indicate that the students with high level of computer anxiety have less perceived behavioral control which will ultimately influences the behavioral intention to use E-learning tools.

In brief, computer anxiety seems to be a crucial factor that could influence the E-learning adoption in higher education institutions. Thus, the computer anxiety in this research will consider critical factors and will be investigated in higher educational context.

Computer self–efficacy (CSE)

Computer Self-efficacy is individuals' beliefs about the users' ability and motivation to perform specific tasks (Agarwal, Sambamurthy, & Stair 2000).While, Self-efficacy as a concept is defined as "judgment of one's ability to use a technology to accomplish a particular job or task" (Venkatesh, Morris, Davis, & Davis, 2000 p. 432). Computer self-efficacy has been studied in different domains. For instance, computer self-efficacy had a positive influence on the computer learning performance (Hasan & Ali, 2004; Yi & Im 2004). Several studies have been conducted to study the influence of computer self- efficacy on the technology intention model (Venkatesh & Davis 1996; Madorin & Iwasiw 1999; Hayashi, Chen, Ryan, & Wu 2004; Lee 2006). Compeau and Higgins (1995) as cited in (Lee 2006) have proposed three dimensions of computer self-efficacy; 1) The "magnitude of computer self-efficacy" is defined as the extent to which people believe they can accomplish difficult tasks using a computer, 2) The "strength of computer self-efficacy" is interpreted as reflecting the power of self-judgment by individuals, 3) the "generalisability of computer self-efficacy" refers to the perception by people of their ability to use various computer software and hardware devices. The computer self-efficacy will be used as antecedents of perceived usefulness and ease of use. The magnitude, strength and generalisability of computer self-efficacy will have a positive effect on the students' ability and confident towards their intention of E-learning tools.

Madorin and Iwasiw (1999) have investigated the effects of computer self-efficacy on using instructional technology in education particularly computer-assisted instruction in the faculty of nursing students. The findings stated that the students' computer self-efficacy has strong influence on the perceived ease of computer use for learning purposes. However, the computer self-efficacy did not have a positive relationship with the perceived usefulness. This result is not inconsistent with the (Venkatesh & Davis 1996) findings regarding to the effect of computer self-efficacy and perceived usefulness.

Lee (2006) has conducted empirical study so as to investigate the factors influencing the adoption of an e-learning system in both mandatory and voluntary settings. The research has confirmed the capability of perceived usefulness and perceived ease of use in predicating the success of E-learning adoption in both contexts. The findings related to computer self-efficacy were important. Computer self-efficacy demonstrated significant impact on perceived ease of use. However, the significant relationship between computer self-efficacy and perceived usefulness was not strong. Furthermore, Lim (2000) found that computer self-efficacy had a direct influence on the students' participation in distance education activities.

Briefly, the computer self-efficacy seems to have the ability to provide the students with high level of using E-learning system. It also seems to be an enthusiasm factor towards E-learning intention.

Internet Experience (IE)

Internet experience can be defined as the extent of a person's experience to perform specific tasks using the internet. Several studies have used the experience as antecedents in technology intention model and they have tested the relationship between perceived ease of use and perceived usefulness (Chang 2004; Wolk 2007). At the same time, some studies have tested internet experiences as external variable with the intention to use distance and E-learning (Fusilier & Durlabhji 2005; Kerka 1999, Rezaei et al. 2008).

Rezaei et al. (2008) has applied and extended technology intention model to predict the students' intention of E-learning application in agriculture at the higher educational level. They have extended TAM to include more external variables such as internet experience, computer self-efficacy, computer anxiety and affect and age. The results had demonstrated that there was a positive relationship between students' intention to use e-learning and its perceived usefulness, perceived ease of use, internet experience, computer self-efficacy and affect. Conversely, the computer anxiety and age had a negative relationship with students' behavioral intention to use e-learning application.

Fusilier and Durlabhji (2005) conducted a study to explore behavioral intention of users' intention in internet technology. They have incorporated the experience with the direct relationship with the intention to use the internet technology. The findings have shown that the relationship between intention of using the internet and experience was stronger and it depended on the level of experiences. Moreover, the experience has complex influence on the students' intention to use internet technology. Thus, the level and the rate of experience play a significant role on the intention to use a particular system.

In brief, the four mentioned variables have tremendous influenced on the students' intention of E-learning implementation and other related technology as cited in the literature. Thus, the researcher will employ these variables in his proposed research model in order to determine whether these variables could influence the students' intention of E-learning in higher educational institutions in Saudi Arabia.

RESEARCH MODEL AND HYPOTHESES

Illustration upon the main TAM model frame work and the findings from previous research regarding to enjoyment, computer anxiety, computer self-efficacy and Internet experience, the research model is proposed as depicted in Figure 2.2. Based on the previous controversial findings in the literature review regarding to these four variables, null hypotheses were summarised as following:

$H_0$1: Enjoyment will have no influence on the students' intention to use E-learning.
$H_0$2: Computer anxiety will have no influence on the students' intention to use E-learning.
$H_0$3: Computer Self-efficacy will have no influence on the students' intention to use E-learning.
$H_0$4: Internet experience will have no influence on the students' intention to use E-learning.
$H_0$5: Attitude towards using E-learning does not mediate the relationship between perceived usefulness and behavioral intention to use E-learning.
$H_0$6: Attitude towards using E-learning does not mediate the relationship between perceived ease of use and behavioral intention to use E-learning.
$H_0$7: There is no relationship between perceived usefulness and perceived Ease of use.
$H_0$8: There is no relationship between perceived usefulness and behavioral intention to use E-learning.

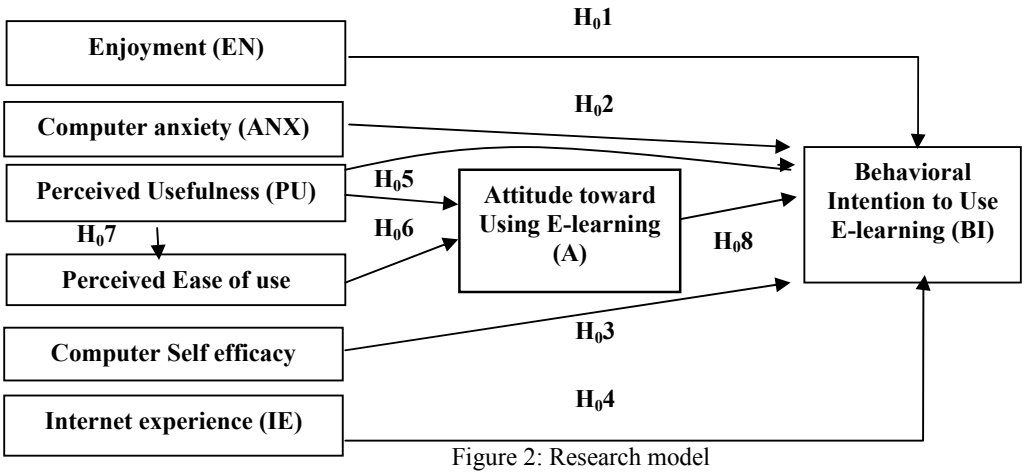

Figure 2: Research model

RESEARCH METHODOLOGY

Instrumentation Development

The questionnaire was consisted of 37 Items (Table2.1) in order to measure the proposed research model variables. The measurement was adapted from prior research (Suh, C & Lee, T, 2007; Saade, Tan, &Nebebe, 2008; Saade, & Kira, 2006; Pituch,& Lee ,2006). Pilot study was conducted in order to develop the measurements adapted scales. Moreover, the pilot study was performed in order to detect the internal consistency and reliability of utlised questionnaire. The questionnaire was distributed to 50 students from Al-Jouf University in session one 2009/2010. The returned and usable questionnaires were 48 and two questionnaires were excluded from the analysis due to massive unanswered questions. The analysis of internal consistency was obtained from the interval scale items only. Overall, the pilot study data revealed acceptable high alpha reliability coefficient of all items. Therefore, all items were retained for the main study. Thus, the questionnaire can be distributed to the targeted sample.

Table 1: The research adapted instrumentation references, No. of items and reliability

Factor	Variable	No. Items	Cronbach alpha (α)		Reference
			Original scale	Pilot Study	
TAM	Perceived Usefulness (PU)	5	0.79	0.82	Suh, C & Lee, T (2007)
	Perceived Easy of Use (PEU)	6	0.89	0.79	
	Attitude toward Using E-learning (A)	3	0.88	0.72	
	Behavioral Intention to Use E-learning (BI)	4	0.90	0 .80	
	Enjoyment(EN)	3	0.86	0 .85	Saade, R ;Tan, W &Nebebe, F (2008)
	Computer anxiety(ANX)	5	0.87	0.83	Saade, R& Kira,D (2006)
	Computer Self-efficacy(CSE)	4	0.91	0.74	Pituch, K.& Lee, Y. (2006)
	Internet experience(IE)	7	0.82	0.74	

Sample and Data Collection

The current research aimed in investigating empirically the role of Enjoyment, Computer anxiety, Computer self-efficacy and Internet experience in influencing the students' intention to use E-learning 480 questionnaires were distributed to the students at five universities in Saudi Arabia. The usable response rate was 85 % with 408 undergraduate students from five different governmental universities. The profile of respondents is portrayed in Table 4.2.

Table 2: profile of respondents

University	Frequency	Percentage
King Saud University	125	30.6
King AbdulAziz University	161	39.5
King Faisl University	38	9.3
King Khalid University	45	11.0
Aljouf University	39	9.6
Total	**408**	**100.0**
Major	**Frequency**	**Percentage**
SCIENCE	263	64.5
ART	145	35.5
Total	**408**	**100.0**
Major	**Frequency**	**Percentage**
MALE	254	62.3
FEMALE	154	37.7
Total	**408**	**100.0**
Age	**Frequency**	**Percentage**
18-21	127	31.1
22-25	259	63.5
26-29	22	5.4
Total	**408**	**100.0**
PC ownership	**Frequency**	**Percentage**
Yes	383	93.9
No	25	6.1
Total	**408**	**100.0**
Years using computer	**Frequency**	**Percentage**
<1 Year	104	25.5
1-3 Years	150	36.8
4-8 Years	126	30.9
>8 Years	28	6.9
Total	**408**	**100.0**
Years using Internet	**Frequency**	**Percentage**
<1 Year	236	57.8
2-4 Years	144	35.3
>4 Years	28	6.9
Total	**408**	**100.0**
E-learning usage	**Frequency**	**Percentage**
One per month	199	48.8
Littlie per month	110	27.0
Littlie per week	75	18.4
One per day	24	5.9
Total	**408**	**100.0**

DATA ANALYSIS AND FINDINGS

Factor and Reliability Analysis

Construct validity and reliability analysis were examined to ensure that the obtained responses are valid and reliable for further analysis. Exploratory factor analysis (EFA) represented by principal components analysis (PCA) with Varimax rotation were performed. All required criterion were achieved. Kaiser-Guttman criterion was applied regarding to the number of factors to be extracted which is only factors with an eigenvalues equal or greater than one can be extracted (Guttman 1954; Kaiser & Dickman 1959). The items with only loading 0.300 or greater were consider as acceptable (Hair et al., 1998). The factor analysis has individually performed of each following scales because the ratio of five subjects per item (5:10) suggested by Coakes and steed (2003) and the ratio of ten subjects per item (1:10) to run a single factor analysis were not achieved (Hair et al., 1998). Therefore, the factor analysis has performed separately. Table 4.3 represents the obtained results from factor analysis of TAM model. Table 4.4 represents the obtained results from factor analysis of Enjoyment, Computer anxiety, Computer self-efficacy and Internet experience

Table3: Factor analysis of TAM model (Behavioral Intention) (Attitude) (Perceived Ease of Use1 & Perceived Usefulness1)

Items	1	2	3	4	α
Behavioral Intention1(BI1)	0.802				
Behavioral Intention2(BI2)	0.795				
Behavioral Intention3(BI3)	0.789				0.79
Behavioral Intention4(BI4)	0.736				
Attitude 1 (A1)		0.830			
Attitude 2 (A2)		0.824			
Attitude 3 (A3)		0.701			0.70
Perceived Ease of Use1 (PEU1)			0.730		
Perceived Ease of Use2 (PEU2)			0.712		
Perceived Ease of Use3 (PEU3)			0.693		
Perceived Ease of Use4 (PEU4)			0.684		
Perceived Ease of Use5 (PEU5)			0.656		0.76
Perceived Ease of Use6 (PEU6)			0.453		
Perceived Usefulness1(PU1)				0.771	
Perceived Usefulness2(PU2)				0.726	
Perceived Usefulness3(PU3)				0.724	0.75
Perceived Usefulness4(PU4)				0.678	
Perceived Usefulness5(PU5)				0.634	
Eigenvalues	2.441	1.860	3.338	1.949	
Percentage of Variance Explained	61.020	61.987	24.366	23.699	
Total Variance explained	61.020	61.987	48.065	48.065	
KMO	0.761	0.639	0.815	0.815	
Bartlett's test of sphericity approx. chi square	457.676	222.718	998.357	998.357	
Df	6	3	55	55	
Sig.	.000	.000	.000	.000	

The Behavioral Intention (BI) KMO was 0.761 which consider acceptable (> 0.500) and Bartlett's test of sphericity was significant (p<0.000). The mentioned values were indicated that the appropriateness of conducted factor analysis for E-learning intention variables. Results from Varimax rotated analysis indicated that Behavioral Intention (BI) accounted 61.020% of the total variance explained with an eigenvalues of 2.441 (>1).Factor loading for the BI items ranged from 0.736 to 0.802. Therefore, the results provide initial support for Behavioral Intention (BI) to measure the students' intention to use E-learning**.** All other TAM's variables were acceptable based on above criteria**.**

Table4: Factor analysis of Enjoyment, Computer anxiety, Computer self-efficacy and Internet experience

Items	Component 1	Component 2	Component 3	Component 4	α
Internet Experince1 (IE1)	0.748				
Internet Experince2 (IE2)	0.745				
Internet Experince3 (IE3)	0.677				
Internet Experince7 (IE4)	0.656				0.82
Internet Experince4 (IE5)	0.642				
Internet Experince5 (IE6)	0.594				
Internet Experince6 (IE7)	0.469				
Computer Anxiety1 (ANX1)		.783			
Computer Anxiety2 (ANX2)		.754			
Computer Anxiety3 (ANX3)		.746			0.78
Computer Anxiety4 (ANX4)		.743			
Computer Self –efficacy1 (CSE1)			.814		

Computer Self –efficacy2 (CSE2)			.771		
Computer Self –efficacy3 (CSE3)			.764		0.75
Computer Self –efficacy4 (CSE4)			.567		
Enjoyment1 (EN1)				.877	
Enjoyment2 (EN2)				.836	0.78
Enjoyment3 (EN3)				.815	
Eigenvalues	3.492	3.277	1.966	1.549	
Percentage of Variance Explained	19.399	18.204	10.920	8.606	
Total Variance explained	57.129				
KMO	.727				
Bartlett's test of sphericity approx. chi square	2483.843				
Df	153				
Sig.	.000				

Overall, the factor analyses of Enjoyment, Computer anxiety, Computer self-efficacy and Internet experience were acceptable. Therefore, the construct validity was achieved. The Cronbach's alpha coefficient (α) was performed in order to assess the internal consistency. It was ranged from 0.70 to 0.82 which considered acceptable because many researchers believed that the ideal Cronbach's alpha coefficient should be above 0.70 (Pallant 2001; Hair et al. 2006).

Hypotheses Testing

Three analysis techniques were used in order to testing the proposed hypotheses. Stepwise regression analysis was performed in order to investigate the variables' influence on the students' behavioral intention to use e-learning. Moreover, hierarchical regression analysis and Baron and Kenny criteria in order to test the mediation affect of the students' attitude towards using E-learning. The finial technique used was product-moment correlation analysis in order to test the relationship between perceived usefulness with perceived ease of use and behavioral intention to use E-learning. Before testing the proposed hypotheses, several assumptions were met mainly normality, linearity, homoscedasticity and independence of errors terms, multicollinearity and multivariate outliers (Hair et al 1998; 2006; Pallant 2001; Coakes & steed 2003). To examine the hypothesized statement (**$H_0$1- $H_0$4)**, stepwise regression analysis was performed. Table 4.45 shows the results of stepwise multiple regression analysis.

Table 5: Stepwise multiple regression analysis: psychological factor's variables as predictors of E-learning intention.

Predictors	R Square	Adjusted R Square	Unstandardized Coefficients B	Standardized Coefficients Beta	t	p- value (Sig)
Computer anxiety	.360	.358	.637	.552	12.697	.000**
Computer Self-efficacy	.371	.368	.137	.120	2.756	.006**
Enjoyment	.378	.373	-.094	-.081	-2.045	.041*

** p > 0.01, * p > 0.05

As represented in Table 5, the examined variables namely enjoyment, computer anxiety, computer self-efficacy and internet experience were regressed in stepwise technique. The regression model utlised to predict students' intention to use E-learning resulted in Adjusted R Square = 37.3% at significant 0.05 levels. Out of four examined psychological predictors, three predictors were activated prediction equation and also were associated with a significant percentage of variance in E-learning intention, $F_{(3, 398)} = 80.564$, $p<0.001$. The first significant variable that predict E-learning intention is Computer anxiety with $\beta = .552$, $t = 12.697$, at the significant level of $p < .001$, two tailed. The second significant variable predicted the e-learning intention is Computer Self-efficacy with $\beta = .120$, $t = 2.756$, at the significant level of $p < .05$. The third significant variable predicted the e-learning intention is Computer Self-efficacy with $\beta = -.081$, $t = -2.045$, at the significant level of $p < .05$. However, the internet experience has excluded from the model due to its insignificant association with students' E-learning intention at the significant level of $p < .05$. From the psychological prospective and based on the findings, students' who have lower computer anxiety, higher computer self-efficacy and perceived enjoyment in practicing E-learning would have a better intention of e-learning activities. Therefore, $H_0$1 to $H_0$3 were rejected while $H_0$4 was accepted.

$H_0$5: Attitude towards using E-learning does not mediate the relationship between perceived usefulness and behavioral intention to use E-learning. To examine the hypothesized, Hierarchical regression was performed. The results in Table

4.6 demonstrate the results of hierarchical regression analysis using Attitude as A mediator in the relationship between perceived usefulness and E-learning intention.

Table 6: The results of hierarchical regression analysis using Attitude toward e-learning as A mediator in the relationship between perceived usefulness and E-learning intention.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Step1 (Model 1)	(Constant)	2.541	.201		12.659	.000
	PERCEIVED USEFULNESS	.127	.061	.104	2.085	.038
Step2 (Model2)	(Constant)	2.284	.237		9.664	.000
	PERCEIVED USEFULNESS	.111	.061	.091	1.815	.070
	ATTITUDE	.098	.049	.101	2.026	.043
$R^2 = 0.104$ in step 1; $R^2 = 0.144$ in step 2						

As portrayed in Table 6, the results indicate that in the first model, perceived usefulness is significantly contributed to E-learning intention, $R^2 = 0.104$, $F_{(1, 400)} = 4.346$, $p<0.05$. Model one shows that perceived usefulness is positively related to E-learning intention, QUOTE β β = .104, t = 2.085, at the significant level of $p < .05$. In model two, the Attitude was added to the equation, the R^2 = 0.144 significantly change with $F_{(2, 399)} = 4.241$, $p<0.05$. Model two shows that perceived usefulness is insignificantly reduced, QUOTE β β = .091, t = 1.815, at the significant level of $p < .05$ In testing the mediation effect of Attitude, In model 1 the relationship between perceived usefulness (IV) and E-learning intention (DV) was significant. While in Model 2 the relationship between IV and DV become insignificantly reduced. Therefore, the attitude towards E-learning fully mediates the relationship between perceived usefulness and E-learning intention.

$H_0$6: **Attitude towards using E-learning does not mediate the relationship between perceived ease of use and behavioral intention to use E-learning**. To examine the hypothesized statement, Hierarchical regression was performed. The results in Table 4.7 demonstrate the results of hierarchical regression analysis using Attitude as A mediator in the relationship between perceived ease of use and E-learning intention.

Table 7: The results of hierarchical regression analysis using Attitude toward e-learning as A mediator in the relationship between perceived ease of use and E-learning intention.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Step1 (Model 1)	(Constant)	2.452	.193		12.690	.000
	PERCEIVED EASE OF USE	.164	.062	.130	2.632	.009
Step2 (Model2)	(Constant)	2.274	.220		10.319	.000
	PERCEIVED EASE OF USE	.137	.064	.109	2.134	.033
	ATTITUDE	.083	.050	.086	1.674	.095
$R^2 = 0.130$ in step 1; $R^2 = 0.155$ in step 2						

As presented in Table 7, the results indicate that in the first model, perceived ease is significantly contributed to E-learning intention, $R^2 = 0.130$, $F_{(1, 400)} = 6.926$, $p<0.05$. Model one shows that perceived ease of use is positively related to E-learning intention, QUOTE $\beta\beta = .130$, $t = 2.632$, at the significant level of $p < .05$. In model two, the Attitude was added to the equation, the $R^2 =$ 0.156 significantly change with $F_{(2, 399)} = 4.880$, $p<0.05$. Model two shows that perceived ease of use still significantly but it reduced, QUOTE $\beta\beta = .109$, $t = 2.134$, at the significant level of $p < .05$ In testing the mediation effect of Attitude, In model 1 the relationship between perceived usefulness (IV) and E-learning intention (DV) was significant. While in Model 2 the relationship between IV and DV still significantly but the magnitude of the relationship between them is reduced (QUOTE $\beta\beta = .130$ to.109, $t = 2.632$ to 2.134. Hence and Based on Baron and Kenny approach, the attitude towards E-learning partially mediates the relationship between perceived usefulness and E-learning intention.

Secondly, the assumed null hypotheses of the relationship between perceived usefulness and perceived ease of use as well as the relationship between perceived usefulness and E-learning intention were examined using a Pearson product-moment correlation coefficient (*r*).

$H_0$7: **There is no relationship between perceived usefulness and perceived Ease of use**. In order to investigate the relationship between perceived usefulness and perceived Ease of use, Pearson correlation coefficient was used. Table 4.39 shows the results of correlation test between psychological factors and E-learning intention.

Table 8: The results of correlation test between perceived usefulness and perceived Ease of use (N=402)

		PERCEIVED USEFULNESS	PERCEIVED EASE OF USE
PERCEIVED USEFULNESS	Pearson Correlation	1	.254(**)
	Sig. (2-tailed)	.	.000
	N	402	402
PERCEIVED EASE OF USE	Pearson Correlation	.254(**)	1
	Sig. (2-tailed)	.000	.
	N	402	402

** Correlation is significant at the 0.01 level (2-tailed).

The result in Table 8, indicated that positive and small strength relationship between the *between perceived usefulness and perceived Ease of use* with the coefficient's value $r = 0.254$, $n = 402$, $p = 0.01$. Therefore, the null hypothesis is rejected.

$H_0$8: **There is no relationship between perceived usefulness and behavioral intention to use E-learning**. To examine the relationship between perceived usefulness and E-learning intention, Pearson correlation coefficient was utilized. Table 4.54 demonstrates the results of correlation test between perceived usefulness and E-learning intention.

Table 4.9: The results of correlation test between perceived usefulness and E-learning intention (N=402)

		PERCEIVED USEFULNESS	ELEARNING INTENTION
PERCEIVED USEFULNESS	Pearson Correlation	1	.104(*)
	Sig. (2-tailed)	.	.038
	N	402	402
ELEARNING INTENTION	Pearson Correlation	.104(*)	1
	Sig. (2-tailed)	.038	.
	N	402	402

* Correlation is significant at the 0.05 level (2-tailed).

According to Table 9, the results demonstrated that there is a positive and small strength of the relationship between perceived usefulness and E-learning intention with the coefficient's value $r = 0. .104$, $n = 402$, $p = 0.05$. Hence, the null hypothesis is rejected.

DISCUSSION AND IMPLICATIONS

The research findings were supported most previous researches on TAM model particularly the affect of both TAM predictors' namely perceived usefulness and perceived ease of use on the users' behavioral intention to use new

technology(Landry, Rodger, & Hartman 2006; Masrom 2007; Ngai et al. 2007; Roca, Chiu, & Martínez 2006; Selim 2003; Saadé & Bahli 2005; Saadé & Galloway 2005).The meditation effects of the Attitude on the relationship between perceived usefulness and perceived ease of use on the users' behavioral intention was confirmed on this research. These results were consistence with previous research in this area (Brown 2002; Lee, Cheung & Chen 2005; Brown 2002; Ngai et al. 2005; Saadé & Bahli 2005). While, the current findings regarding the mediation effects were contrary to some previous study (Yousafzai 2006; Venkatesh & Davis 1996). Despite of most of previous research study the current research proposed variables as antecedents, the current research was aimed to examine the direct affect of these variables on the intention to use E-learning. The results indicated that Enjoyment, Computer anxiety, Computer self-efficacy were significantly influence the students' intention to use E-learning. The findings were consistence mostly with the previous research ((Madorin & Iwasiw 1999; Compeau & Higgins 1995; Davis et al. 1992; Agarwal et al.2000; Anandarajan, Igbaria ,& Anakwe 2000; Venkatesh 2000; Tan & Teo 2000;Venkatesh et al. 2003; Ndubisi 2004; Yi & Hwang 2004; Lee, Cheung & Chen 2005; Sun & Zhang 2005; Saadé & Kira 2006; Saadé, Tan, & Nebebe 2008).The internet experience was insignificant in influencing the students' intention to use e-learning and it was contrary with other research findings (Fusilier & Durlabhji 2005; Kerka 1999; Rezaei et al. 2008). Therefore, the possible implications are that the students' intention to use E-learning might be increased through considering the key influence factors namely perceived usefulness, perceived ease of use , attitude, enjoyment, computer anxiety and computer self-efficacy in the e-learning process. The perceived ease of use, attitude, enjoyment seem to be related to the Learning management design. While, computer anxiety and computer self-efficacy are almost related to the institutions support in providing workshops and training for its students in order to renovate their negative behaviour and ability.

CONCLUSION

In conclusion, the tested null hypotheses are summarized in table 4.10.

Table 4.10: Summary of tested null hypotheses in question five using hierarchical regression and correlation analysis

Hypothesis	Statement	Analysis Technique used	Results
$H_0$1	Enjoyment will have no influence on the students' intention to use E-learning.		**Rejected**
$H_0$2	Computer anxiety will have no influence on the students' intention to use E-learning.	Stepwise regression analysis	**Rejected**
$H_0$3	Computer Self-efficacy will have no influence on the students' intention to use E-learning.		**Rejected**
$H_0$4	Internet experience will have no influence on the students' intention to use E-learning.		**Accepted**
$H_0$5	Attitude towards using E-learning does not mediate the relationship between perceived usefulness and behavioral intention to use E-learning.	hierarchical regression analysis and Baron and Kenny criteria	**Fully mediated**
$H_0$6	Attitude towards using E-learning does not mediate the relationship between perceived ease of use and behavioral intention to use E-learning.		**Partially mediated**
$H_0$7	There is no relationship between perceived usefulness and perceived Ease of use.	Pearson product-moment correlation coefficient	**rejected**
$H_0$8	There is no relationship between perceived usefulness and behavioral intention to use E-learning.		**rejected**

In conclusion, the practical contribution can be summarised in increasing the level of students' intention and participation to use E-learning system in higher education environment. The theoretical contribution can be observed in extended TAM model and testing its validity as well as applicability in Saudi higher education context. The proposed variables were tested as external independents variables not as antecedents. Future research need to investigate further variables in the area of E-learning acceptance particularly the physiological related variables.

REFERENCES

Agarwal, R., Sambamurthy, V., and Stair, R. ,2000, 'The evolving relationship between general and specific computer self-efficacy: an empirical investigation', *Information Systems Research,* Vol. 11, No. 4, pp. 418-30.

Al-Jarf, R. 2007, Cultural Issues in Online Collaborative Learning in EFL. Paper presented at the 3rd International Online Conference on Second and Foreign Language Teaching and Research.], Vol.

Atkinson, M. A. and Kydd, C. 1997, 'Individual characteristics associated with World Wide Web use: an empirical study of playfulness and motivation', *ACM SIGMIS Database,* Vol. 28, No. 2, pp. 53-62.

Chang, P. V. C. 2004, 'The validity of an extended technology acceptance model (TAM) for predicting the Intranet / Portal usage. SILS, puplished Master's Papers retrieved from http://hdl.handle.net/1901/78.' Vol.

Clark, R. E. 2000, 'Evaluating distance education: Strategies and cautions', *Quarterly Review of Distance Education,* Vol. 1, No. 1, pp. 3-16.
Coakes, S. J. and Steed, L. G. [2003], *SPSS: Analysis without anguish: Version 11.0 for Windows* (John Wiley).
Davis, F. D. 1986, 'A technology acceptance model for empirically testing new end-user information systems: theory and results', *Sloan School of Management, Massachusetts Institute of* Vol. 13, No. 3, pp. 319-40.
Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. 1989, 'User acceptance of computer technology: a comparison of two theoretical models', *Management science,* Vol. 35, No. 8, pp. 982-1003.
Fishbein, M. and Ajzen, I. 1975, 'Belief, attitude, intention and behavior: An introduction to theory and research', Vol., pp. Don Mills, Ontario: Addison-Wesley Pub. Co.
Fusilier, M. and Durlabhji, S. 2005, 'An exploration of student internet use in India', *Campus-Wide Information Systems,* Vol. 22, No. 4, pp. 233-46.
Gotschall, M. 2000, 'E-learning strategies for executive education and corporate training', *Fortune,* Vol. 141, No. 10, pp. S5-S59.
Guttman, L. 1954, 'Some necessary conditions for common-factor analysis', *Psychometrika,* Vol. 19, No. 2, pp. 149-61.
Hair, J. F., et al. 1998, ' Multivariate data analysis', *Upper Saddle River,* Vol.
--- [2006], *Multivariate Data Analysis* (Upper Saddle River, NJ: Prentice Hall).
Hasan, B. and Ali, J.M. 2004 , 'An empirical examination of a model of computer learning performance. Journal of Computer Information Systems, (),.' Vol. 44, No. 4, pp.27-34
Hayashi, A., et al. 2004, 'The role of social presence and moderating role of computer self efficacy in predicting the continuance usage of e-learning systems', *Journal of Information Systems Education,* Vol. 15, No. 2, pp. 139-54.
Howard, S. G. and , Smith, D. R. 1986 , 'Computer anxiety in management: Myth or reality? ' *Communicationsof the ACM,* Vol. 29, No. 7, pp. 611-15.
Kaiser, H. F. and Dickman, K. W. 1959, 'Analytic determination of common factors', *American Psychologist,* Vol. 14, No. 1, pp. 425-41.
Kerka, S. 1999, 'Distance Learning, the Internet, and the World Wide Web. ERIC Digest', Vol.
Landry, B. J. L., , Rodger G. , and , Hartman S. 2006, 'Measuring student perceptions of blackboard using the technology acceptance model', *Decision Sciences Journal of Innovative Education,* Vol. 4, No. 1, pp. 87-99.
Lee, M. K. O., Cheung, C. M. K., and Chen, Z. 2005, 'Acceptance of Internet-based learning medium: the role of extrinsic and intrinsic motivation', *Information & Management,* Vol. 42, No. 8, pp. 1095-104.
Madorin, S. and Iwasiw, C. 1999, 'The effects of computer-assisted instruction on the self-efficacy of baccalaureate nursing students', *The Journal of nursing education,* Vol. 38, No. 6, pp. 282-95.
Masrom, M. 2007, 'Technology Acceptance Model and E-learning', *the 12th International Conference on Education, Sultan Hassanal Bolkiah Institute of Education ,Universiti Brunei Darussalam.* .
Moon, J. W. and Kim, Y. G. 2001, 'Extending the TAM for a World-Wide-Web context', *Information & Management,* Vol. 38, No. 4, pp. 217-30.
Ndubisi, N. O. 2004, 'Factors influencing E-learning adoption intention: examining the determinant structure of the decomposed theory of planned behaviour constructs.' *aper presented at the HERDSA International Conference*, pp. 252-62.
Ngai, E. W. T., Poon, J. K. L., and Chan, Y. H. C. 2007, 'Empirical examination of the adoption of WebCT using TAM', *Computers & Education,* Vol. 48, No. 2, pp. 250-67.
Pallant, J. 2005, *SPSS survival manual* (Open Univ. Press).
Pituch, K. A. and Lee, Y.K. 2006, 'The influence of system characteristics on e-learning use', *Computers & Education,,* Vol. 27, No. 2, pp. 222-44.
Rezaei, M., et al. 2008 , 'Predicting e-learning application in agricultural higher education using Technology Acceptance Model.
' *Turkish Online Journal of Distance Education,* Vol. 98, No. 1, pp. 85-95.
Roca, J. C., Chiu, C. M., and Martnez, F. J. 2006, 'Understanding e-learning continuance intention: An extension of the Technology Acceptance Model', *International Journal of Human-Computer Studies,* Vol. 64, No. 8, pp. 683- 96.
Rosenberg, M. J. 2001, *E-learning: Strategies for delivering knowledge in the digital age* (McGraw-Hill New York).
Saade, R. G., Tan, W., and Nebebe, F. 2008, 'Impact of Motivation on Intentions in Online Learning: Canada vs China', *Setting Knowledge Free: The Journal of Issues in Informing Science and Information Technology* Vol. 5, pp. 137-49.
Saadé, R. and Bahli, B. 2005, 'The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model', *Information & Management,* Vol. 42, No. 2, pp. 317-27.
Saadé, R. G. and Galloway, I. 2005, 'Understanding intention to use multimedia information systems for learning', *Issues in Informing Science & Information Technology,* Vol. 2, pp. 287-96.
Saadé, R. G. and Kira, D. 2006, 'The emotional state of technology acceptance', *Issues in Informing Science & Information Technology,* Vol. 3, pp. 529-40.
Selim, H. M. 2003, 'An empirical investigation of student acceptance of course websites', *Computers & Education,* Vol. 40, No. 4, pp. 343-60.

Sun, H. and , Zhang, P. 2005, 'An Empirical Study on Causal Relationships betweenPerceived Enjoyment and Perceived Ease of Use', *Paper presented at the of the Fourth Annual Workshop on HCI Research in MIS* (Las Vegas, USA.).

Tan, M. and Teo, T. S. H. 2000, 'Factors influencing the adoption of Internet banking', *Journal of the AIS,* Vol. 1, No. 1es, pp. 5.

Teo, T. S. H. 2001, 'Demographic and motivation variables associated with Internet usage activities', *Internet Research: Electronic Networking Applications and Policy,* Vol. 11, No. 2, pp. 125-37.

Trombley, B. K. and Lee, D. 2002, 'Web-based Learning in Corporations: who is using it and why, who is not and why not?' *Learning, Media and Technology,* Vol. 27, No. 3, pp. 137-46.

Venkatesh, V. and Morris, M. G. 2000, 'Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior', *Mis Quarterly,* Vol. 24, No. 1, pp. 115-39.

Venkatesh, V. and Davis, F. D. 2000, 'A theoretical extension of the technology acceptance model: four longitudinal field studies', *Management science,* Vol. 46, No. 2, pp. 186-204.

Venkatesh, V. 2000, 'Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model', *Information systems research,* Vol. 11, No. 4, pp. 342-65.

Venkatesh, V., Speier, C., and Morris, M. G. 2002, 'User acceptance enablers in individual decision making about technology: Toward an integrated model', *Decision Sciences,* Vol. 33, No. 2, pp. 297-316.

Venkatesh, V., et al. 2003, 'User acceptance of information technology: Toward a unified view', *INFORM MANAGEMENT,* Vol. 27, No. 3, pp. 425-78.

Wilson, J. 2001, 'Lessons of a Virtual Timetable: Education', *The Economist,* Vol. 17.No.4 pp.27-41

Wolk, R. M. 2001, 'Using the Technology Acceptance Model for Outcomes Assessment in Higher Education', *Proc ISECON.*

Yi, M. Y. and Hwang, Y. 2003, 'Predicting the use of web-based information systems: self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model', *International Journal of Human-Computer Studies,* Vol. 59, No. 4, pp. 431-49.

Yi, M. Y. and Im, K.S. 2004, 'Predicting computer task performance: personal goal and self-efficacy', *Journal of Organizational and End-user Computing,* Vol. 16, No. 2, pp. 20-38.

ANALYSIS OF FACTORS IN TECHNOLOGICAL AND VOCATIONAL SCHOOL TEACHERS' PERCEIVED ORGANIZATIONAL INNOVATIVE CLIMATE AND CONTINUOUS USE OF E-TEACHING: USING COMPUTER SELF-EFFICACY AS AN INTERVENING VARIABLE

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ABSTRACT
This study aims to analyze the correlation (N=335) among technological and vocational school teachers' perceived organizational innovative climate, computer self-efficacy, and continuous use of e-teaching in Taiwan. Teachers' perceived organizational innovative climate includes five factors, namely, job autonomy, innovative leadership, resource support, innovative culture, and group cohesion. Computer self-efficacy includes four factors, namely, playfulness, ease of use, effectiveness, and usefulness. Continuous use of e-teaching includes three factors, namely, goal identification, instructional performance, and flow experience. Participants responded to a 5-point Likert-type scale for each factor. Analysis was conducted using the structural equation modeling (SEM), and a good model fit was found for both the measurement and structural models. Research findings demonstrate that technological and vocational schools teachers' organizational innovative climate significantly and directly influences continuous use of e-teaching. Organizational innovative climate significantly and indirectly influences continuous use of e-teaching by computer self-efficacy. Technological and vocational schools teachers' organizational innovative climate and computer self-efficacy fit the influence model and empirical data of continuous use of e-teaching.
Keywords: computer self-efficacy, continuous use of e-teaching, organizational innovative climate.

INTRODUCTION

In recent years, low birth rates and expansion of higher education suggest that when responding to industrial changes and manpower demands, technological and vocational schools should treat teaching excellence and creative teaching as the principle for sustainable operation (Chou, Shen, Hsiao, & Chen, 2010a). Upon educational technology, continuous use of e-teaching becomes the key of creative teaching. Internet information allows schools to promote organizational learning cultures of creative teaching and construct organizational innovative climates (Chou, Shen, & Hsiao, 2010b; Gumusluoglu, & Ilsev, 2009; Zaman, Ananda rajan, & Dai, 2010).

Regarding schools, the diffusion innovation theory indicates that innovation is diffused by members of social systems through certain channels. The organizational innovative climate of schools is based on organizational knowledge and an innovative culture, where individual innovative behavior is gradually formed through organizational interactions, which serves to enrich individual learning of the implication of innovative knowledge (Gumusluoglu, & Ilsev, 2009; Huang, & Chuang, 2007). Through interpersonal relationships in organizations, organizational innovative knowledge can be learned, instructed, and shared. After accumulating rich innovative experience and information technology knowledge in schools, teachers would learn and review operations of digital technology and innovative behaviors, and recognize innovative climates (Martinez, Sauleda, & Huber, 2001; Neill, McKee, & Rose, 2007).

Compeau and Higgins (1995) found that the encouragement of others, behavioral imitation, and high-rank supervisors' support would positively influence users' computer self-efficacy, and increased self-efficacy would positively influence computer performance. When teachers apply innovative instructional strategy to courses, such as the Lego Mindstorm module or the computer-assisted mechanical drawing of e-learning, students could obtain greater learning achievements. By innovative instructional strategies, teachers can take advantage of opportunities to "train at work" and learn through the experiences of problem solving through practical use, which would enhance their professional growth (Chen, Kao, & Huang, 2008).

In Taiwan, business information and e-commerce have developed rapidly, and in recent years, schools have promoted e-learning and distance learning. Hence, students are familiar with the Internet and related tools. Teachers can renew teaching materials and interact with students through the convenience of the e-platform (Ho, Kauffman & Liang, 2007;

Susser, & Ariga, 2006). By editing teaching materials and e-learning resources, teachers reorganize learning contents. In addition, the use of examples and analogies in teaching materials can be cognitive outcomes of teachers' teaching innovations and profession (Husual & Tirrib, 2007; Shulman & Quinlan, 1996; Teo, 2009a; Zaman, Ananda rajan, & Dai, 2010). Wu & Yang (2009) found that "innovative climate of information infused instruction," "pedagogical literacy of information infused instruction," and "innovative motivation of information infused instruction" have significant direct effect on "innovative behavior of information infused instruction". The attitudes of qualified instructors at vocational technology universities and colleges using IT to improve the quality of knowledge lectured. Computer literacy is the key factor that affects teachers' utilizations of IT in teaching. The policy and peers' factors have indirect effects on utilizations through interest and fit intermediate variable. The equipment variable has no effect on utilizations, but it relates some of external variables (Chu, Chu, & Hung, 2004)

Based on the above, teachers have the intention to spend time and efforts making e-teaching materials, which can be involved in instructions. There are some factors of teachers' continuous use of e-teaching were enhancement of students' learning outcomes by e-teaching, teachers' continuous use of e-teaching will allow schools to recognize technological and vocational school teachers' e-teaching demands, and improvements to innovative e-teaching instructions would respond to sustainable operations of technological and vocational schools.

PURPOSES OF THIS STUDY

The paper, Analysis of factors in technological and vocational school teachers perceived organizational innovation climate and continuous use of e-teaching: using computer self-efficacy as an intervening variable, discussed the variables which may influence vocational teachers continuous use of technology and found the relationships among the variables. The purposes of this study are to address the 4 following issues.

1. There is no significant correlation between technological and vocational school teachers' organizational innovative climate and continuous use of e-teaching.
2. There is no significant correlation between technological and vocational school teachers' perceived organizational innovative climate and computer self-efficacy.
3. There is no significant correlation between technological and vocational school teachers' computer self-efficacy and continuous use of e-teaching.
4. Influence models of technological and vocational school teachers' organizational innovative climate, computer self-efficacy, and continuous use of e-teaching fit the data collected by this study.

REVIEW OF LITERATURE

Organizational Innovative Climate

Innovative climate is based on innovative behaviors or outcomes; in other words, members identify and trust organizational innovation through behavioral traits, such as freedom, openness, adventure, and support shown by workers (Amabile, 1996; Iyer, LaPlaca & Sharma, 2006). Baer and Frese (2003) indicated that organizational development should not only be innovative, but also include an innovative climate and psychological security in order to result in constant innovation.

Regarding the effects of teachers' perceived organizational innovative climate on computer self-efficacy, according to Dunn and Mott (2009), organizational innovative climate influences organizational members' interactions and performances. Teachers' trust and identification would influence their innovative behavior, which would benefit the schools, increase the use multiple instructional methods, and develop students' multiple wisdom and creativity. In addition, they will actively promote innovative ideas and try to implement them. Morale in organizations influences workers' common consensus, and thus, their behaviors of mutual support, which will help enhancing organizational innovative performance (Reuvers, van Engen, Vinkenburg & Wilson-Evered, 2008; Weigl, Hartmann, Jahns, & Darkow, 2008; Zaman, Ananda rajan, & Dai, 2010).

Regarding the influence of teachers' perceived organizational innovative climate on continuous use of e-teaching, Wu & Yang (2009) found that "innovative climates of information infused instruction" have a significant direct effect on "pedagogical literacy of information infused instruction". By a task and technology fit model, Chu, Chu, and Hung (2004) demonstrated that the trend of teachers' use of information technology in support of traditional instruction would provide enhancement through the intervening variable of "cognitive fit". When teachers perceive higher relative benefits, compatibility, or a lower complexity of the e-teaching system, they would have higher intentions to adopt it (Hoffer & Alexander, 1992). Agarwal and Prasad (1997) indicated that observations, compatibility, and trial ability have significant and positive influences. Voluntary intentions have significant and negative influences; whereas, use intentions, relative benefits, and outcome demonstrations have significant and positive influences.

Based on the above, teachers' perceived high organizational innovative climate can enhance continuous use of e-teaching (Hoffer & Alexander, 1992; Wu & Yang, 2009), and organizational performance (Weigl, Hartmann, Jahns, & Darkow, 2008; Zaman, Ananda rajan, & Dai, 2010). Regarding the technology acceptance model, teachers' use of

technology and computer self-efficacy can influence teachers intentions and behaviors in the continuous use of e-teaching (Brinkerhoff, 2006; Hung., Lian & Chang, 2005; Matulich, Papp, & Haytko, 2008; Tung, & Chang, 2007). Thus, this study intends to further probe into the effects of computer self-efficacy between technological and vocational school teachers' perceived organizational innovative climate and continuous use of e-teaching.

Computer Self-Efficacy

Computer self-efficacy is an individual's judgment of their computer competence. It is emphasized that computer self-efficacy reflects individual perceptions and abilities to fulfill job requirements of computer competence, which is not related to practical computer skills (Compeau & Higgins, 1995; Wilfong, 2006). Computer self-efficacy focuses on an individual's perceived ability in computer related situations and refers to judgments of capacity to accomplish a computer related job (Guriting, Chunwen, Ndu, 2007; Koc, & Bakir, 2010; Saade, & Kira, 2009).

Igbahia and Iivari (1995) suggested that organizational support significantly influences self-efficacy. Factors of teachers' use of information technology include relative benefits, trial ability, compatibility, eases of use, effectiveness, usefulness, and complexity (Hoffer, & Alexander, 1992). Currently, many studies demonstrate that in comparison with traditional instructions, computer-based instructions can enhance instructional quality, and teachers' instructional effects will be enhanced by continuous use of e-teaching (Teo, 2009a; Wilfong, 2006).

Regarding the influence of teachers' computer self-efficacy on continuous use of e-teaching, teachers with high computer self-efficacy tend to master computer use and computer technology, thus, they are more likely to become involved in educational technology and continue using e-learning (Aderson, & Maninger, 2007; Faseyitan, Libii, & Hirschbuhl, 1996). Marakas, Yi, and Johnson (1998) found that computer self-efficacy could trigger teachers' motivations to use computers during instruction. Teachers with high computer self-efficacy are more willing to use e-teaching in instruction. Teachers with higher computer self-efficacy would significantly increase the use of electronic communications in teaching (Koc, & Bakir, 2010; Vajargah, & Jahani, 2010). Hill, Smith, and Mann (1987) suggested that students with higher computer self-efficacy would have greater intentions to learn and use computers. For teachers, e-teaching materials can be presented by vision, hearing and even kinesthetic capacities, and thus, would be easier for students of all learning types to comprehend the information, and effective clues will enhance students' memory. Student teachers' self-efficacy is a significant influence on whether they use technology in a traditionalist or constructivist way (Teo, 2009b).

Based on the above, for teachers, there is a close correlation between computer self-efficacy and continuous use of e-teaching (Olivier & Shapiro, 1993). Even with sufficient equipment, if teachers have low computer self-efficacy, their intention to use information technology during instruction is reduced (Faseyitan, Libii, & Hirschbuhl, 1996; Koc, & Bakir, 2010).

Continuous Use of E-Teaching

Continuous use of e-teaching methods indicates teachers' abilities to integrate media technology, such as characters, images, animation, video, and sound through technology and computers. In teaching, they function as learning materials for browsing, interactive operation, and media delivery in order to enhance students' learning effects (Barclay, Thompson, & Higgins, 1995; Marakas, Yi, & Johnson, 1998). Teachers intend to include on-line and off-line learning e-teaching activities, such as creating e-learning content, software, construction services, and courses through computer-based tools.

Teachers' continuous use of e-teaching indicates that according to instructional content and strategies, they have the abilities to apply computer media, the Internet, and treat information technology as instructional tools. Statements of teachers' continuous use of e-teaching methods are as below (Davis, & Venkatesh, 1996; Hsu, Ju, Yen, & Chang, 2007; Katz, Blumer & Gurevitch, 1974; Oliver, 1992):

1. Studies suggest that in regard to uses and gratifications, with students' psychological motivations and social expectations, teachers would have different patterns of media exposure, resulting in expectations toward "satisfaction of demands" and "other results" (Katz, Blumer & Gurevitch, 1974; Matulich, Papp, & Haytko, 2008). In teachers' continuous use of e-teaching, use motivation of instruction is related to teachers' instructional demands. Media of instructional materials is associated with teachers' use and reading of digital tools. Only proper instructional information devices will satisfy the demands of continuous use of e-teaching. Factors of technological and vocational school teachers' e-teaching include the contents of the teaching materials, the design of the teaching material, the instructional platform, services for users, the amount of information provided, and the difficulty of the interface (Vajargah, & Jahani, 2010) .
2. Regarding the Expectation Confirmation Theory (ECT), teachers judge instructional performance of e-teaching and students' learning satisfaction by comparing outcomes before and after e-learning (Huang, & Chuang, 2007; Oliver, 1992). ECT can be used to understand the factors that affect technological and vocational school teachers' continuous use of e-teaching (Benbasat & Barki, 2007). Bagozzi (2007) indicated that emotions could influence users' behaviors.

For teachers, e-teaching could enhance students' "playfulness" in learning, and thus, it is an issue worthy of further study.

3. The technology acceptance model aims to explain the decisive factors of users' acceptance of information technology, and analyzes the influences of external factors on users' beliefs, attitudes, and intentions of technology use (Davis, Bagozzi & Warsaw, 1989). Analysis of the factors of teachers' continuous use of e-teaching, through organizational innovative climate and computer self-efficacy, can help to probe into the perceived usefulness and ease of use. These two factors will influence users' attitudes, behavioral intentions, and use behaviors toward technology.

Bandura (1997) suggested that teachers' self-efficacy expectation is a key factor in goal-setting, choice of activities, willingness to invest extra efforts, and behavioral performance. Regarding e-teaching, besides the perspective of self-efficacy, teachers' perceived organizational innovative climate is also an important issue. Technological and vocational school teachers can accomplish more effective teaching goals by computer multimedia, and helping students to learn how to cultivate knowledge and skills in searching for information through technology. Teachers can more effectively prepare for instruction through technological tools, creating greater diversity in content and activities, and conduct more diverse evaluations, as information technology is the key to instruction.

METHODOLOGY

Research Design

This study employed a structural equation modeling (SEM) to analyze the relationships between technological and vocational school teachers' perceived organizational innovative climate, computer self-efficacy, and continuous use of e-teaching. Data were collected through a survey questionnaire, which is comprised of questions on demographics and multiple items for each construct in the study. Normal distribution testing of the related variables in the model of this study is shown in Table 1. Although all observation variables do not reach normal distribution ($p<.05$), multi-variance normal test is insignificant ($p>.05$), which demonstrates normal distribution. According to the conditions of ML, within the most commonly used approach in SEM one of the conditions should be a simple random sampling that meets multi-variance normal distribution. Samples of this study meet the conditions of ML. Some scholars suggest that it is influential only when Kurtosis is above 25; therefore, when Kurtosis is below 25, ML is still an applicable analysis. Boomsma and Hoogland (2001) compared and probed into the completeness of different estimation methods, and concluded that in regard to models with observation variables above 6 or 8. With non-normal distribution, ML has better statistical traits. Thus, although overall variables of this study meet the multi-variance normal distribution of ML, a single variable does not meet normal distribution. Kurtosis of multi-variance distribution is not large (<25); therefore, this research estimates the model by ML.

Table 1 Mean and standard deviations of variables and normal distribution test

Variables	Mean	Standard deviation	Skewness	Kurtosis	X2	p-value
Job autonomy	3.86	.58	-.15	.02	3745.06	.000
Innovative leadership	3.99	.60	-.22	-.36	3910.07	.000
Resource support	4.00	.62	-.47	.49	4818.47	.000
Innovative culture	3.66	.66	-.26	.12	3420.17	.000
Group cohesion	3.30	.77	.04	.28	3367.89	.000
Goal identification	4.27	.59	-.36	-.63	5235.28	.000
Instructional performance	4.18	.57	-.27	-.79	4142.41	.000
Flow experience	4.22	.54	-.43	-.22	3882.69	.000
Playfulness	4.24	.49	-.34	-.44	3646.63	.000
Ease of use	3.68	.63	.02	.15	4266.56	.000
Effectiveness	3.45	.74	-.03	.08	3710.11	.000
Usefulness	3.87	.65	-.18	-.01	4009.75	.000
Total	3.93	.40	-.26	-.08	221.03	1.000

Research Participants and Data Collection

This study treated teachers of technological and vocational schools as the population, and adopted random sampling and cluster sampling for a survey. A total of 335 valid samples were collected, and the analysis of their gender, seniority, current post, current level, teaching background, school attributes, school category, and number of students is shown in Table 2.

Table 2 Distribution of participants' background in formal scales

Basic information	Group	No of people	%
Gender	Male	231	69.0%
	Female	104	31.0%
Educational background	University (or below)	12	3.6%
	Master	105	31.3%

	Doctor	218	65.1%
Seniority	5 years (and below)	55	16.4%
	More than 5 years and less than 10 years	99	29.6%
	More than 10 years and less than 15 years	87	26.0%
	Over 15 years	94	28.1%
Current post	Full-time teachers and administration staff	159	47.5%
	Full-time teachers	176	52.5%
Current level	Professor	27	8.1%
	Associate professor	125	37.3%
	Assistant professor	97	29.0%
	Lecturer	86	25.7%
Teaching background	Science, engineering, agriculture and design	135	40.3%
	Business, management, tourism and recreation		
	Livelihood, health and medical care	134	40.0%
	Liberal arts, law, education and general	20	6.0%
	knowledge	46	13.7%
School attributes	Public	122	36.4%
	Private	213	63.6%
School category	University of technology	175	52.2%
	College of technology	160	47.8%
Number of students	5,000 (and below)	73	21.8%
	More than 5,001 and less than 10,000	159	47.5%
	Above 10,001	103	30.7%

Measures

A 43-item survey questionnaire was developed to measure participants' self-efficacy, uses of technology, and demographic information. The scale for organizational innovative climate included five constructs, namely, job autonomy (five items), innovative leadership (5 items), resource support (5 items), innovative culture (5 items), and group cohesion (TP) (five items). The scale for computer self-efficacy included playfulness (five items), ease of use (five items), effectiveness (five items), and usefulness (five items). The scale for continuous use of e-teaching included goal identification (five items), instructional performance (five items), and flow experience (five items). The items reflected in the questionnaire could allow participants to take reference from their personal experiences when responding. Each item was measured on a five-point Likert scale of 1=strongly disagree to 5=strongly agree. A total of 16 items were used to measure organizational innovative climate, 12 items were used to measure computer self-efficacy, and 15 items measure continuous use of e-teaching. These items are listed in the Appendix.

Research Tool

The research tool was the "Investigation of factors in technological and vocational school teachers' continuous use of creative teaching". The compilation of this scale was based on the concepts of the computer self-efficacy scale by Karsten. & Roth (1998), climates for innovation scales by King, Chemrmont, West, Dawson, and Hebl (2007), and the climate for innovation scale by King, Chemrmont, West, Dawson, and Hebl.

In this study, three experts evaluated the fitness of the questions in order to verify the expert fitness of the scale. Night teachers from technological and vocational schools were invited to answer the questionnaire in order to enhance content validity. Ten technological and vocational schools were selected for a pre-test, with 135 teachers as the subjects. A total of 120 valid samples were collected; with a valid return rate of 88.9%. The scale in this study was a self-reported inventory, based on a Likert 5-point scale, where the range of "agree" to "disagree" is denoted by 5 to 1, respectively. The factor names, number of items, validity, and reliability levels of each aspect in this scale are as shown in Table 3.

Table 3 Factors, number of items, validity and reliability of technological and vocational school teachers' perceived organizational innovative climate and computer self-efficacy on scale for creative teaching outcome

Scale for organizational innovative climate				**Scale for computer self-efficacy**				**Scale for constant use of e-teaching**			
Names of factor	**No of items**	**Factor loading**	**Cronbach α**	**Names of factor**	**No of items**	**Factor loading**	**Cronbach α**	**Names of factor**	**No of items**	**Factor loading**	**Cronbach α**
Innovative culture	3	17.42	.88	Playfulness	3	27.44	.93	Goal identification	5	24.37	.90
Job autonomy	3	14.68	.80	Ease of use	3	15.18	.88	Job achievement	5	22.03	.87
Resource support	4	12.03	.80	Effectiveness	3	14.66	.88	Flow experience	5	19.66	.76

Innovative leadership	3	10.79	.73	Usefulness	3	9.23	.77			
Group cohesion	3	7.16	.52							
Accumulated explained variance		62.09		Accumulated explained variance		66.53		Accumulated explained variance		66.06
kmo		.878		kmo		.886		kmo		.874
Total reliability Cronbach α			.91	Total reliability Cronbach α			.91	Total reliability Cronbach α		.91

Data Analysis

Regarding data processing of formal survey, the returned questionnaires were coded. Linear Structural Relations (LISREL) was used to validate the correlation and influences among creative teaching self-efficacy, organizational innovative climate, and creative teaching effect by Statistical Package for Social Science, SPSS 10.0. Statistical test criterion of this study is α=0.05.

FINDNGS

Fit test of Influence Model of Continuous Use of E-Teaching Materials

This study validated the model by LISERL8.52. The estimation method was determined after examining the samples, and model estimation was carried out by software. Parameters after software estimation are shown in Table 4. Before the model fit test, whether the estimation coefficient is over the defined scope was verified. Only when parameter coefficients estimated do not violate the estimation can the fit test be conducted.

According to the definitions of Hair, Anderson, Tatham, and Black (1998), the three following items can be used to examine estimation violations: 1) negative error variable exists; 2) normalized coefficient is above or approximate to 1 (0.95 is the usual threshold), and 3) significant standard deviation. According to Table 2, parameters estimations reveal positive error variables, and there are no negative variables. Normalized coefficient is 0.25~0.96, with only one parameter β10 above 0.95, and the remaining within the scope. Therefore, parameters estimations are not violated, and fit could be conducted.

Table 4 Normalized coefficients of path analysis of influence model of technological and vocational schools teachers' continuous use of e-teaching materials

Parameter	Non-normalized ML estimation	Standard deviation	t value	Normalized coefficient	Parameter	Non-normalized ML estimation	Standard deviation	t value
λ1	0.42	0.026	16.28*	0.15	ε1	0.54	0.013	11.84*
λ2	0.42	0.027	15.34*	0.18	ε2	0.49	0.015	12.23*
λ3	0.50	0.027	18.31*	0.14	ε3	0.64	0.013	10.67*
λ4	0.49	0.037	16.12*	0.21	ε4	0.53	0.018	11.91*
λ5	0.38	0.040	9.45*	0.50	ε5	0.22	0.037	13.57*
λ6	0.45	0.026	17.45*	0.13	ε6	0.61	0.013	10.38*
λ7	0.46	0.024	19.00*	0.09	ε7	0.69	0.093	8.81*
λ8	0.40	0.024	16.64*	0.11	ε8	0.58	0.011	10.97*
λ9	0.25	0.025	10.32*	0.17	ε9	0.27	0.013	13.15*
λ10	0.40	0.031	12.69*	0.25	ε10	0.39	0.020	12.22*
λ11	0.47	0.037	12.54*	0.35	ε11	0.38	0.029	12.30*
λ12	0.29	0.034	8.38*	0.36	ε12	0.19	0.026	13.57*

Note: Those without standard deviations are criterion indicators of *p<.05

This study conducted model fit testing by general criterion, according to fit measures estimated by the statistical method, in order to find out the fitness between the research data and model. Measures of this study are based on absolute fit, incremental fit, and parsimonious fit, as classified by Hair, Anderson, Tatham, & Black (1998). In addition, construct reliability and validity tests of variables were used to determine the internal structural fit. Analytical results are shown below.

Overall Fit

Based on the above, overall fit can be measured by absolute fit, incremental fit, and parsimonious fit. After estimation by LISERL8.52, according to Table 5, the chi-square of the model is = 407.56, p<.05, which is significant, and shows that there are significant differences between the covariance matrix of the model and the empirical data. Chi-square

testing can be easily influenced by the number of samples and normality of the data. Therefore, when evaluating overall model fit, this study includes other measures.

This study first examines theoretical validation of the model regarding unsatisfying evaluation standards. After reviewing MI, the model is modified according to the rationality of the theory. Although model fit after modification is enhanced, estimates of Usefulness and Computer self-efficacy do not reach a level of significance, and re-estimation is required. Although modified χ testing fails to reach a statistical significance level, the model fit is improved and mostly satisfies the standards. In addition, tests of overall fit are generally positive.

According to the analytical results of the revised model in Table 5, in absolute fit measures, GFI= 0.85, which is slightly lower than the standard of 0.9. According to Gefen, & Straub (2000), GFI should be above 0.90, thus, this model is rejected. AGFI= 0.77, which is lower than the standard of 0.8. Gefen and & Straub (2000) suggests that AGFI should be above 0.80 thus, thus, the model is rejected. RMSEA= .014 and <0.08. According to Jarvenpaa, Tractinsky, & Vitale, (2000), RMSEA should be lower than 0.08, thus, based on the measures above, absolute fit of this model is not good.

As to incremental fit and parsimonious fit measures, according to Gefen and & Straub (2000) and Hair et al. (1998), when NFI, IFI, RFI, and CFI are above 0.9, PNFI and PGFI should be above 0.5 in order for the model to be accepted. According to data tested, NFI= 0.91, which is above the standard 0.9. It shows that the model is accepted. IFI= 0.92, which is above 0.9 means that the model is accepted. RFI= 0.88, which is lower than the standard 0.9. It means that the model is almost acceptable. CFI= 0.92, thus, the model is relatively acceptable. PNFI= 0.70, which is above the standard 0.5 means that the model is relatively acceptable. PGFI= 0.55, which is above 0.5 means that the model is acceptable.

According to the incremental and parsimonious fit measures above, the models of this study are acceptable. However, absolute fit is not good, which suggests that the models are still acceptable, as the overall model meets empirical data. The lower GFI and AGFI levels mean that the model can hardly explain the empirical model theory.

Table 5 Results of overall model fit test of technological and vocational school teachers' continuous use of e-teaching

	Evaluation items and outcome (N=335)	**Evaluation standard**	**Scholars**	**Fit**
Absolute fit	χ2= 407.34			
	d .f.=51	<5	Hair et al. (1998)	Poor
	χ2/ d .f.=7.9	>0.9	Hair (2010)	Poor
	GFI= 0.85	>0.8	Hair (2010)	Poor
	AGFI= 0.77	<0.1	Hu & Bentler (1999)	Acceptable
	SRMR=0.08	<0.08	Jarvenpaa et al. (2000)	Acceptable
	RMSEA= .014			
Incremental fit	NFI= 0.91	>0.9	Bentler & Bonett (1980)	Acceptable
	NNFI=0.90	>0.9	Bentler & Bonett (1980)	Acceptable
	IFI= 0.92	>0.9	Bentler & Bonett (1980)	Acceptable
	CFI= 0.92	>0.9	Bagozzi&Yi (1988)	Acceptable
Parsimonious fit	PNFI= 0.70	>0.5	Bentler & Bonett (1980)	Acceptable
	PGFI= 0.55	>0.5	Bentler & Bonett (1980)	Acceptable

Structural Fit

Regarding structural model fit, Hair Jr. et al (1998) suggested the measurement significance test and the R2 of latent dependent variables of structural parameters. The R2 of dependent variables should be higher than the standard of 0.5, and correlation among the latent variables should be lower than 0.90.

Regarding the structural fit test, according to the structural parameters of the influence model of continuous use of e-teaching materials in Table 2, apart from organizational innovative climate, job values and computer self-efficacy are significant (t>1.96, p>.05). In addition, as to the evaluation of R2 latent dependent variables, according to Table 4-20, organizational innovative climate, and computer self-efficacy are 0.42 and 0.52, respectively. The R2 of job values is lower than the standard 0.50, and the R2 of computer self-efficacy is higher than 0.50, which meet the evaluation standards; therefore, the structural model fit of this study is not good.

Correlation coefficients of the latent variables in Table 6 are further tested. The coefficients of the three latent variables are 0.75~0.96. The correlation coefficient of job values on organizational innovative climate is higher than 0.90, while

the remaining are lower than 0.90. Thus, the three latent variables may affect the structural model fit due to overly high correlations.

Table 6 Average variances extracted and the correlation coefficient of latent variables on the influence model of continuous use of e-teaching materials

Latent variables	R2	Organizational innovative climate	Job values	Computer self-efficacy
Organizational innovative climate	0.75	1		
Continuous use of e-teaching	0.96	0.96	1	
Computer self-efficacy	0.79	0.75	0.79	1

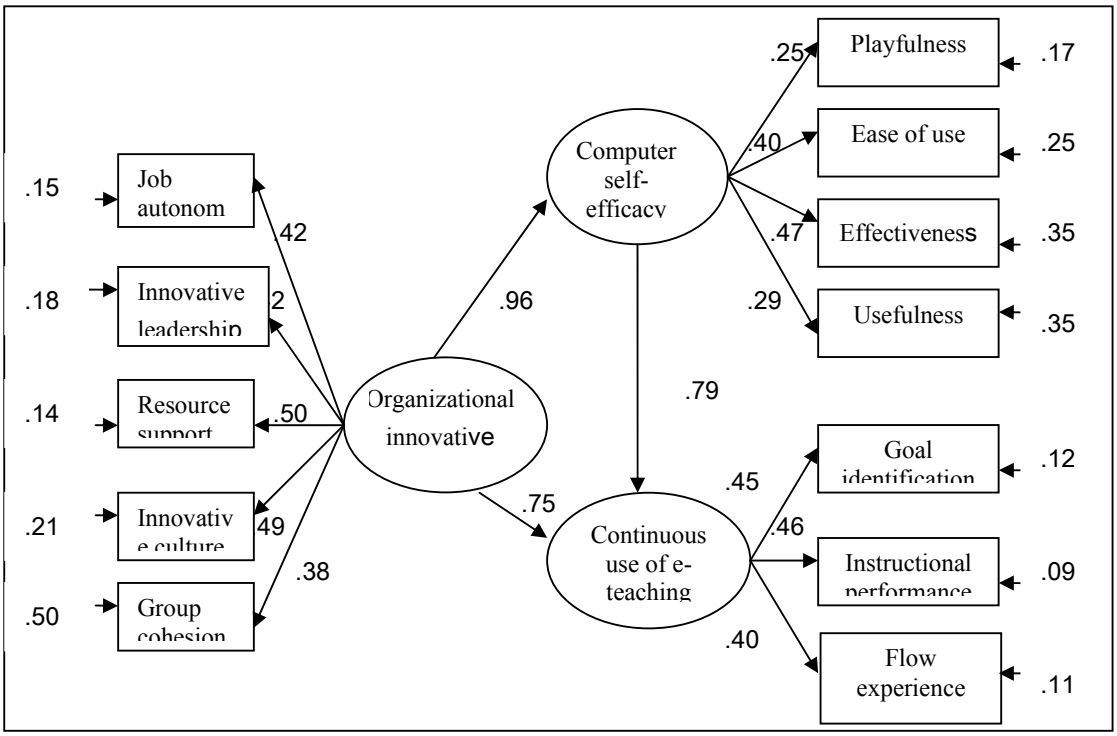

Figure 1 Path of technological and vocational school teachers' continuous use of e-teaching materials

DISCUSSION

This study aims to analyze the correlations among technological and vocational school teachers' perceived organizational innovative climates, computer self-efficacy, and continuous use of e-teaching in Taiwan. The findings are as shown below:

1. Technological and vocational school teachers' organizational innovative climate, resource support, and innovative leadership show significant influence on goal identification and instructional performance in continuous use of e-teaching. Innovative leadership and resource support allow teachers to recognize objectives of e-teaching in schools. When schools encounter environmental changes and competition, teachers gradually understand and trust the measures of the schools' innovative leadership. Through resource support and rewards by schools, teachers can fulfill their creativity and further develop courses and e-teaching design. This will allow them to accomplish school objectives and instructional performance in order to meet environmental changes (Damanpour & Wischnevsky, 2006).
2. Technological and vocational school teachers' organizational innovative climate, job autonomy, and innovative culture show significant influence on ease of use and effectiveness of computer self-efficacy. Goal identification and instructional performance in technological and vocational school teachers' continuous use of e-teaching significantly influence playfulness and ease of use" of computer self-efficacy. Teachers' perceived innovative culture and job autonomy will enhance teachers' new ideas, evaluations, and implementation of e-teaching. It is

one of the key factors on teachers' computer self-efficacy (Karsten, & Roth, 1998; Mohrman, Cohen & Mohrman, 1995).

3. Technological and vocational school teachers' organizational innovative climate significantly and directly influences continuous use of e-teaching. Organizational innovative climate significantly and indirectly influences continuous use of e-teaching through computer self-efficacy. Technological and vocational schools teachers' organizational innovative climate and computer self-efficacy fit influence model and empirical data of continuous use of e-teaching. Therefore, schools should respect and support instructional creativity. Through cognition of innovation and e-teaching, teachers can constantly ponder on innovative teaching approaches and information technology. They will enhance instructional performance and instructional goals. Teachers' active promotion of innovative ideas in e-teaching and practical use of e-learning will encourage students' learning. They identify with organizational goals through organizational innovative climate in order to develop e-teaching plan, and constantly adopt and implement e-teaching. Thus, they will result in useful e-teaching and flow experience (Angle & Van de Ven, 2000; Hage & Aiken, 1970; Igbahia & Iivari, 1995; Susser, & Ariga, 2006).
4. Although the model of this study reveals goodness of fit, the fit effect remains unsatisfying, which suggest that there are some latent variables that have not been elaborated. Variables in models sometimes fail to reveal the ideal explanatory effect; thus, this study further probes into the model with a more complete overall fit.

LIMITATIONS OF THE STUDY

1. This study focuses on the influence of technological and vocational school teachers' perceived organizational innovative climate on continuous use of e-teaching. Chou, Shen, Hsiao and Chen (2010a) found that technological and vocational school teachers that also undertake administrative jobs tend to identify more closely with the organizational innovative climate. When teachers undertake administration jobs, they use the school network system and are engaged in activities of e-processing. Would such activities cause them to highly identify with continuous use of e-teaching? This is a limitation of this study.
2. This study measures teachers' perceptions during the first, middle and final stages of e-teaching. Some teachers perceived e-teaching as a means to use multimedia, such as films and power point, during instruction. Teachers' perceived planning and evaluations of e-teaching are insufficient; meaning they may lack knowledge in two scales, namely, "computer self-efficacy" and "continuous use of e-teaching", and any effects between the two would be limited.
3. Scoring according to scales is based on teachers' self-evaluations; therefore, this study cannot eliminate samples that were influenced by situations, attitudes, emotions, or are seemingly unmatched with reality. Although the use of self-reports to collect data has its benefits, it may lead to a common method variance, namely, a situation that may inflate the true associations between variables.
4. This study aims to probe into the factors of technological and vocational school teachers' continuous use of e-teaching, which is significantly affected by students' feedback regarding learning outcomes. Future studies can include measurements of this variable, and modify the model in order to further probe into the cause-and-effect relations among the variables.

IMPLICATIONS FOR PRACTICE

The findings of this study demonstrate that "resource support" and "innovative leadership" of technological and vocational school teachers' "organizational innovative climate" significantly influence "continuous use of e-teaching". E-teaching users' use intentions depend on their attitudes toward e-teaching. Workplace and organizational support will indirectly affect users' intentions to use e-systems (Igbaria, Guimaraes & Davis,1995; Karahanna & Straub, 1999). Administrators of technological and vocational schools should create an open and autonomic organizational innovative climate that encourage teachers to continually contemplate on innovative instructional approaches, and through supervisors' respect and resource support, energize teachers' active promotions of innovative ideas for e-teaching and continuous implementation.

Second, according to results of this study, technological and vocational school teachers' "organizational innovative climate" significantly influences "computer self-efficacy". In the Theory of Diffusion of Innovation, the process by which teachers perceive new things or concepts through communication channels and school organizations, usually require a long period of adjustment time to gain acceptance of teachers. Organizational innovative climate in schools will influence users' use intentions of information technology. After information technology is introduced within an organization, if it is supported by high-ranking supervisors, the users' use attitude and intention would be indirectly influenced by the increased use opportunities, and subsequent experience (Sorensen, Mathiasen, & Dalsgaard, 2009; Taylor & Todd, 1995). Therefore, the specific measures to enhance technological and vocational school teachers' computer self-efficacy are as follows: 1) technological and vocational schools should systematically cultivate teachers' computer information competency; 2) schools should host studies groups such as web page editing, file management, basic concepts of multimedia, internet concepts, acquisition of internet resources, and the use and control of computers in order to develop teachers' computer competency; and 3) schools should establish e-teaching environments, such as constructing a main engine of a server, a wireless network environment, and an information platform.

Finally, the findings of this study indicate that "ease of use" and "effectiveness" of "computer self-efficacy" can enhance teachers' continuous use of e-teaching. Besides computer knowledge and techniques, computer self-efficacy also includes teachers' attitudes toward computer technology, such as cognition, value, emotion, and motive (Anderson, Klassen & Johnson, 1981). When teachers have greater knowledge of information systems, they are more likely to have intentions to use the new technology. There are significant and positive correlations among computer knowledge and skills, and users' computer use and performance (Geissler & Horridge,1993; Kay,1993 ; Kwon & Zmud,1987; Thong,1999). Measures to enhance technological and vocational school teachers' continuous use of e-teaching are as follows: 1) allow teachers to perceive the importance and growing trends in e-learning through teacher studies and job promotions; 2) assist teachers' with e-teaching in order to integrate the courses and resources of e-teaching; 3) instruct teachers to reorganize current teaching resources into a self-introduced e-learning environment; and 4) plan e-teaching activities of encouragement in order to energize teachers enthusiasm to adopt information in teaching.

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REFERENCES

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

Agarwal, R. & Prasad, J. (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. *Decision Sciences, 28*(3), 557-582.

Amabile, T. M., Conti, R., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal, 39*(5), 1154-1184.

Angle, H. L. & Van de Ven, A.H. (2000). Suggestions for managing the innovation journey. In: Van de Ven, A.H., Angle, H. L., & Poole, M.S. (Eds.), *Research on the management of innovation: The Minnesota studies.* New York:Oxford University Press.

Baer, M., & Frese, M.,(2003). Innovation is not enough: climates for initiatives and psychological safety, process innovations, and firm performance. *Journal of Organizational Behavior, 24*(1), 45-68.

Bagozzi, P. R. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association of Information Systems, 8*(4), 244-254.

Bagozzi, R.P. & Yi, Y. (1988). On the evaluation of structural equation models. *Academy of Marking Science, 16*, 76-94.

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

Barclay, D., Thompson, R. and Higgins, C. (1995). The Partial Least Squares (PLS) Approach to Causal Modeling: Personal Computer Adoption and Use an Illustration. *Technology Studies, 2*(2), 285-309.

Benbasat, I., & Barki, H. (2007). Quo vadis, TAM?. *Journal of the Association for Information System, 8*(4), 211-218.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*(3), 588-606.

Boomsma, A., & Hoogland, J. J. (2001). The robustness of LISREL modeling revisited. *Psychometrika, 51*, 313-325.

Brinkerhoff, J. (2006). Effects of a long-duration, professional development academy on technology skills, computer self-efficacy, and technology integration beliefs and practices. *International Society for Technology in Education, 39*(1), 22-43.

Chen, J. M., Kao, H. L., & Huang, J. C. (2008). Vocational High School Teacher's Professional Development through Innovative Teaching Strategy. Retrieved September 2, 2010 from the World Wide Web: http://www0.nttu.edu.tw/jmc/file/%E5%89%B5%E6%96%B0%E6%95%99%E5%AD%B8%E4%BF%83%E9%80%B2%E9%AB%98%E8%81%B7%E6%95%99.pdf

Chou, C. M., Shen, C. H., Hsiao, H. C., & Chen, S. C. (2010a) The Influence of Innovative Organizational Management of Technological and Vocational Schools on Innovative Performance - Using Organizational Innovative Climate as The Mediator Variable. *World Transactions on Engineering and Technology Education, 8(2), 237-242.*

Chou, C. M., Shen, C. H., & Hsiao, H. C., (2010b). An analysis of the key factors of high-quality instruction of teachers in institutes of technology. *World Transactions on Engineering and Technology Education, 8(1), 37-43.*

Chu, W. K., Chu, L. Y., & Hung, X. H. (2004). The IT teaching behavior of technical and vocational college for teachers. Retrieved September 6, 2010 from the World Wide Web: http://web.idv.nkmu.edu.tw/~khsu/main/paper/conference/2004TTF.pdf

Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly, 19*(2): 189-211.

Davis, F. D., Bagozzi, R.P., & Warshaw, P.R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science, 35*(8), 982-1002.

Davis, F. D., & Venkatesh, V. (1996). A critical assessment of potential measurement biases in the technology acceptance model: three experiments, *International Journal Human Computer Studies, 45*, 19-45.

Damanpour, F. & Wischnevsky, J. D. (2006). Research on innovation in organizations: Distinguishing innovation-generating from innovation-adopting organizations. *Journal of Engineering and Technology management, 23*, 269-291.

Dunn, S., & Mott, C. (2009). Building a climate for innovation. *Business Intelligence, Aprill*, 52-54.

Faseyitan, S., Libii, N., & Hirschbuhl, J. (1996). An in-service model for enhancing faculty computer self-efficacy. *British Journal Educational Technology, 27*, 214-226.

Gefen, D., & Straub, D. (2000) . The relative importance of perceived ease of use in IS adoption: A study of e-commerce adoption, *Journal of The Association for Information Systems*, *1*(8), 1-28.

Gumusluoglu, L. & Ilsev , A. (2009). Transformational leadership, creativity, and organizational innovation. *Journal of Business Research, 62,* 461–473.

Guriting, G., Chunwen, G., Ndu, N. N. O. (2007). Computer self-efficacy levels, perceptions and adoption of online banking. *International Journal of Services Technology and Management, 8*(1), 54-61.

Hage, J. & Aiken, M. (1970). *Social change in complex organizations.* NY: Random House.

Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2010). *Multivariate Data Analysis(7th ed.)* New Jersey: Pearson Prentice Hall.

Hair, J. F. Jr., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate Data Analysis*, (5th ed.), Englewood Cliffs: Prentice-Hall.

Hill, T., Smith, N., & Mann, M. (1987). Role of efficacy expectations in predicting the decision to use advanced technologies: The case of computers. *Journal of Applied Psychology, 72*, 307-313.

Ho, S.C. Kauffman, R. J., & Liang, T.P. (2007). A growth theory perspective on B2C e-commerce growth in Europe: An exploratory study, *Electronic Commerce Research and Applications, 6,* 237-259.

Hoffer, J. A. & Alexander, M. B. (1992). The diffusion of database machines. *Data Base, 23*(2), .13-19.

Huang, E., & Chuang, M. H. (2007). Extending the theory of planned behavior as a model to explain post-merger employee behavior of IS use. *Computers in Human Behavior, 23*(1), 240-257.

Hu, A. L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55.

Hung, S. Y., & Lian, T. P., & Chang, C. M.(2005). A meta-analysis of empirical research using TAM. *Journal of Information Management, 12*(4), 211-234.

Husua, J. & Tirrib, K. (2007). Developing whole school pedagogical values—A case of going through the ethos of ‘‘good schooling’’. *Teaching and Teacher Education, 23*, 390–401.

Hsu, M. H., Ju, T. L., Yen, C. H., & Chang, C. M. (2007). Knowledge sharing behavior in virtual communities: The relationship between trust, self-efficacy, and outcome expectations. *International Journal of Human-Computer Studies, 65*(2), 153-169.

Igbaria, M. & J. Iivari (1995). The effects of self-efficacy on computer usage. *Journal of Management Science, 23*(6), 587-605.

Iyer, G. R., LaPlaca, P. J. & Sharma, A. (2006). Innovation and new product introductions in emerging markets: Strategic recommendations for the Indian market. *Industrial Marketing Management, 35*, 373-382.

Jarvenpaa, S.L. Tractinsky, N., & Vitale, M. (2000). Consumer trust in an internet store. *Information Technology and Management, 1* (1&2), 45–71.

Karsten, R. & Roth , R. M. (1998). Computer self-efficacy: A practical indicator of student computer competency in introductory IS courses. *Informing Science, 1*(3), 61-68.

Katz, E., Blumer, J. G., & Gurevitch, M. (1974). Utilization of Mass Communication by the Individual, in J.G. Blumer & Katz, E. (eds.), *The Uses of Communications*. Beverly Hills, CA: Sage, 19-32.

King, E. B., Chemrmont, K., West, M. Dawson, J. F., & Hebl, M. R. (2007). How innovation can alleviate negative consequences of demanding work contexts: The influence of climate for innovation on organizational outcomes. *Journal of Occupational and Organizational Psychology, 80*, 631–645

Koc, M., & Bakir, N. (2010). A needs assessment survey to investigate pre-service teachers' knowledge, experiences and perceptions about preparation to using educational technologies. *The Turkish Online Journal of Educational Technology, 9*(1), 13-22.

Oliver, R. L. & Millan, M. (1992). An investigation of attribute suggestions for a stage-specific satisfaction framework. *Advance in Customer Research, 19*, 237-244.

Reuvers, M., van Engen, M. L., Vinkenburg, C. J. & Wilson-Evered, E. (2008). Transformational Leadership and Innovative Work Behavior: Exploring the Relevance of Gender Differences. *Leadership and Innovation, 17*(3), 227-244.

Vajargah, K. F. & Jahani, S. (2010). Application of ICTS in teaching and learning at university level: The case of shahid beheshti university. *The Turkish Online Journal of Educational Technology, 9*(2), 33-39.

Saade, R. G., & Kira, D. (2009). Computer anxiety in e-learning: The effect of computer self-efficacy. *Journal of Information Technology Education, 8*, 177-191.

Shulman, L.S. & Quinlan, K.M. (1996). *The comparative psychology of school subjects.* In D.C. Rerliner & R.C. Calfee(Eds.), Handbook of educational psychology (PP.399-422). NY: Simon & Schuster Macmillan.

Sorensen, E. K., Mathiasen, H., & Dalsgaard, C. (2009). E-learning concepts in higher education. 2010/9/2 from: http://person.au.dk/fil/16581526/Sorensen_Mathiasen_Dalsgaard_E-learning_concepts.pdf

Susser, B., & Ariga, T. (2006). Teaching e-commerce web page evaluation and design: a pilot study using tourism destination sites, *Computers & Education, 47*, 399-413.

Teo, T. (2009a). Modeling technology acceptance in education: A study of pre-service teachers. *Computers & Education, 52*(1), 302-312.

Teo, T. (2009b). Examining the relationship between student teachers' self-efficacy believes and their intended used of technology for teaching: A structural equation modeling approach. *The Turkish Online Journal of Educational Technology, 8*(4), 7-15.

Tung, F. C., & Chang, S. C. (2007). Exploring adolescents' intentions regarding the online learning courses in Taiwan. *Cyber psychology & Behavior, 10*(5), 729-730.

Marakas, M. 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 of research. *Information Systems Research, 9*(2), 126-163.

Martinez, M. A. & Sauleda, N. & Huber, G. H. (2001). Metaphors as blueprints of thinking about teaching and learning. *Teaching and Teacher Education, 17*(8), 965-977.

Matulich, E., Papp, R., & Haytko, D. L. (2008). Continuous improvement through teaching innovations: A requirement for today's learners. *Marketing Education Review, 18*(1), 1-7.

Mohrman, S.A., Cohen, S.G., & Mohrman, A.M., Jr. (1995). *Designing team-based organizations: New forms for knowledge work.* San Francisco: Jossey-Bass.

Neill, S., McKee, D. & Rose, G. M. (2007). Developing the organization's sensemaking capability: Precursor to an adaptive strategic marketing response. *Industrial Marketing Management, 36*, 731-744.

Weigl, T., Hartmann, E., Jahns, C., & Darkow, I. L.(2008). Inter-organizational network structures in Russia: organizational changes form institutional and social embeddings perspectives. *Human Resource Development, 11*(2), 151-165.

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.

Wu. T. J., & Yang, S. C. (2009). The Structural Equation Modeling Construction and the Sex Structure Invariance Assessment of Factors Affecting Innovative Behavior of Information Infused Instruction for Elementary School Teachers. *Bulletin of Educational Psychology, 40* (3), 385-418.

Zaman, M., Ananda rajan, M., & Dai, Q. (2010). Experiencing flow with instant messaging and its role on innovative behaviors. *Computers in Human Behavior, 26*, 1009-1018.

Appendix
List of items used in this study

	Composition of scales	Items
Scale of organizational innovative climate	**Job autonomy**	1. I will constantly ponder on innovative teaching materials and approaches. 2. I will use multiple instructional approaches to develop students' multiple wisdom and creations. 3. I can actively promote instructional innovative ideas and attempt to implement them.
	Innovative leadership	4. Supervisors of the school have unique innovative ideas. 5. Communication channels of this school are varied. 6. Supervisors of the school respect and support my creations at work.
	Resource support	7. I have sufficient equipment for creative teaching. 8. As long as I am in need, professional staff will effectively assist me with creative teaching. 9. The school provides opportunities for creative teaching. 10. The school financially supports demands for innovative R&D.
	Innovative culture	11. Most teachers of the school are willing to encounter challenges. 12. The school climate stimulates teachers' innovative thoughts. 13. Members of the school can understand and accept innovative visions and goals.
	Group cohesion	14. The teams in our unit have clear and definite goals. 15. Co-workers of the school share common consensus. 16. Co-workers of the school support and help each other.
Computer self-efficacy	**Playfulness**	17. Computer-based instruction is more interesting. 18. Digital data is more likely to attract students. 19. E-teaching is more interesting.
	Ease of use	20. For me, the computer is easy to learn. 21. I can learn how to use computers by observing others. 22. It is not difficult to master computers.
	Effectiveness	23. E-teaching is more flexible. 24. E-teaching is more likely to increase students' learning motivations. 25. E-teaching is more likely to increase students' learning outcomes.
	Usefulness	26. It is more useful to make teaching materials by computers. 27. It is easier to assist with students' after-school learning by e-teaching. 28. It is easier to deal with digital teaching materials after learning computer skills.
Continuous use of e-teaching	**Goal identification**	29. Before e-teaching, I will create teaching plans in advance. 30. Before e-teaching, I will become familiar with the contents of different units. 31. Before e-teaching, I will prepare teaching materials and tools for different units. 32. In e-teaching, I will change instructional activities to maintain students' concentration. 33. I can select proper teaching media according to instructional subjects and teaching materials.
	Job achievement	34. After e-teaching, I will grade students by multiple evaluations. 35. After e-teaching, I will have discussions with students regarding their learning results and guide their future learning. 36. After e-teaching, I will adjust instructional schedules, degree of difficulty, and methods, according to evaluation outcomes.

		37. After e-teaching, I will collect supplementary teaching materials in order to enhance teaching efficacy.
		38. After e-teaching, I will enhance the operations of teaching media in order to enhance teaching activities.
	Flow experience	39. During e-teaching processes, I can create harmonious learning atmospheres.
		40. During e-teaching processes, I will value students' demands.
		41. During e-teaching processes, I will interact with students and share experiences.
		42. During e-teaching processes, I can maintain order in the class.
		43. During e-teaching processes, I will praise and encourage students' progress.

CREATING INTERACTIVE WEB-BASED ENVIRONMENTS TO SCAFFOLD CREATIVE REASONING AND MEANINGFUL LEARNING: FROM PHYSICS TO PRODUCTS

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ABSTRACT
With the evolution of the surrounding world market, engineers have to propose innovations in products and processes. Industrial innovation frequently results from an improved understanding of basic physics. In this paper, an approach to accelerate inventive preliminary design is presented. This method combines the main advantages of CBR (Case Based Reasoning) and TRIZ (Russian acronym for Theory of Solving Inventive Problem) to transfer physics to industrial technology. Based on this synergy, interactive web-based environments are developed. These systems are intended not only to enhance students to become familiar with basic physics, but also to support students in building meaningful links between basic physics and industrial technologies.

The evaluation was conducted in a "Special Project Design" course requiring students to design a robot that could carry out several functions. Robotics, an interdisciplinary engineering subject, has been a recurring theme in engineering education. Project-based learning provides opportunities for interdisciplinary learning. With project-based learning approaches, planning activities and investigations play a critical role in the project process. Through the web-based environments, students can explore the essence of basic physics, design technologies, and the integration of mechatronics. Further, web-based reasoning and meaningful learning modules are developed to scaffold creative design and to enhance student participation, motivation, and learning effectiveness. Quantitative and qualitative methods such as questionnaires and interviews were used to evaluate the effects of the developed system. Findings showed that inquiry modules were able to facilitate investigation and planning activities in product design stages. The responses obtained were very encouraging. Students in the course were appreciative of these on-going changes and indicated that these were indeed helping them to develop their engineering thinking and design skills, increasing their motivation to study.

INTRODUCTION

In every engineering field, engineers provide solutions, knowledge, and development, to improve and develop products. Consequently, all these trends and demands increase the need for innovation and anticipation of future trends in products and processes. In response, educators have developed a variety of pedagogical tools and curriculums to increase engineering student ability and competence. Robotics, being an interdisciplinary engineering subject, plays a key role in achieving this goal. Robotic design involves the application of a wide range of physics concepts. For example, to understand mechanism technology, students should have knowledge of mechanics. One of the more difficult aspects of teaching physics is helping students develop an appreciation for physics applications.

In the field of physics education, many studies developed a variety of methods to improve students' physics achievements. The consequences of the studies range from increased awareness and appreciation of good teaching and learning principles and practices, to strategic programs for increasing student interest and participation in physics (Tobias and Birrer, 1999; McDermott, 2001; Coletta *et al.*, 2008). Many research projects have concentrated on the factors effecting students' achievements in science and physics. Reasoning ability has been established as one of the important factors in science and physics achievement (Lawson, *et al.*, 2000). In recent years, studies in physics education have concentrated on students' conceptual understandings yielding important results in physics education. One of these results is that traditional teaching does not help or improve meaningful understanding in introductory mechanics. Employing instructional strategies involving inquiry methods have proven promising in helping students construct meaningful understanding (Lawson, 2007; Lawson, 1985; Lawson, 1992; Cavallo, 1996; Enveart, *et al.*, 1980; Cohen, *et al.*, 1978; Clement, 1993; Kahle and Damnjanovic, 1994; Thijs, and Bosch, 1998; Marshall and Dorward, 2000; Ates and Cataloglu, 2007, Liu, *et al.*, 2010). The inquiry-based learning (IBL) approach engages students in exploring meaningful questions

through a process of investigation and collaboration (Thomas, 2003). In the IBL environment, students build their own knowledge through active learning, interacting with the environment as suggested by the constructivist approach, and working independently or collaborating in teams, while the teacher directs and guides and them in making a real product (Meng and Yang, 2003).

The emergence of the Internet has reformed the concept and methods of engineering education. Online learning, utilizing Web features, is increasingly important for education. In general, online learning environments have shown potential in promoting thinking skills (Saba, 2000; Isman, *et al.*, 2010). Furthermore, Dockrill (2003) found students through interactive teaching and learning facilitates acquisition of critical thinking skills. Despite the many benefits of e-learning, there is a risk of low motivation due to lack of face-to-face communication. In order to make the learning process effective, we need to motivate students in learning activities. Therefore, this study adopted a project-based learning (PBL) approach that is based on the creative problem-solving (CPS) model, to provide motivation, self-learning, and collaborative learning for students through the Web environment. The project-based learning approach engages students in exploring meaningful questions through a process of investigation and collaboration (Krajcik, *et al.*, 1999). In the PBL environment, students build their own knowledge through active learning, interacting with the environment as suggested by the constructivist approach, and working independently or collaborating in teams, while the teacher directs and guides and them in making a real product (Thomas, 2003).

DEVELOPMENT OF WEB-BASED ENVIRONMENTS FOR CREATIVE DESIGN

In this study, we propose a methodology to help students accelerate complex design and propose creative ideas. Generally, when we face a new problem, we use our early experiences and try to adapt them in order to produce a solution. This analogical reasoning is the most often used process during problem resolution. In artificial intelligence (AI), case-based reasoning (CBR) is one approach to manage knowledge. The main idea in CBR is that: similar problems have similar solutions. The CBR process uses and adapts earlier successful resolutions and solutions in order to solve new problems. This method is useful for repetitive design. For inventive design, its usefulness is more limited. In inventive design, problems are totally new and require solutions that are very distant from those already known. For this reason, CBR is coupled with the TRIZ theory (Russian acronym for Theory of Solving Inventive Problem). TRIZ is a problem solving method that increases the ability to solve creative problems. TRIZ is based on the analysis of knowledge used in technical domains. TRIZ has numerous advantages but some drawbacks. Each time one faces a new problem, to the process of resolution must be redeployed, which is time consuming. The proposed synergy eliminates this drawback by coupling TRIZ with CBR. CBR brings a way to model knowledge and accelerate the resolution. TRIZ offers the ability to eliminate barriers between technical domains and propose inventive solutions.

The model is presented in Figure 1. The central notion of the proposed model is a case. The initial step is to collect data that describes the handling problem and to fill the target problem features with specific values. After filling of the target problem features, the next step is to retrieve the case or a subset of cases, stored in the case base, that are relevant to solving the target problem. We need to adjust some features of the retrieved solution in order to answer the target problem; reused step. Next, the adapted solution is implemented, tested and repaired if necessary; the revised step. If the case base does not have any similar solved case or sufficiently similar case, the system offers inventive principles associated with general physics. One advantage of this model is its ability to learn with the incorporation of new cases in the case base; retain step. Failure like success can be stored in memory, because we also learn from failures. With this step, the system evolves, enlarging its coverage of problems and increasing its performance by extending the case base.

This system allows rapid resolution of problems through the use of past experiences in the domain of application but also in other domains through TRIZ. The transdisciplinarity between domains allows access to the best solutions, methods, and practices in all technical domains, leading to more inventive solutions. With this system, the students are not restricted to a domain, but are more open-minded.

This system is able to allow users to perform more activities online. The application tier side consists of a web server and a Java application server. A presentation tier consists of a client-side terminal that comprises the HTML, XML, and 3D web player plug-in. The client, which runs in a web browser, provides a student interface that handles input and output (displaying results and simulations). The web server performs actions and computations based on student input by using XML and JSP languages. The application server reads and writes to databases through a JavaBean. The content of the course is primarily presented with Web pages that are written in HTML. In order to move courses from one system to another, and extract and/or perform automated processing on documents, standardized definitions for course structures are necessary. To meet these

requirements, Extensible Markup Language (XML) is used to develop course structures. In order obtain cross-platform application, the JAVA language is used in programming of the interactive Web pages.

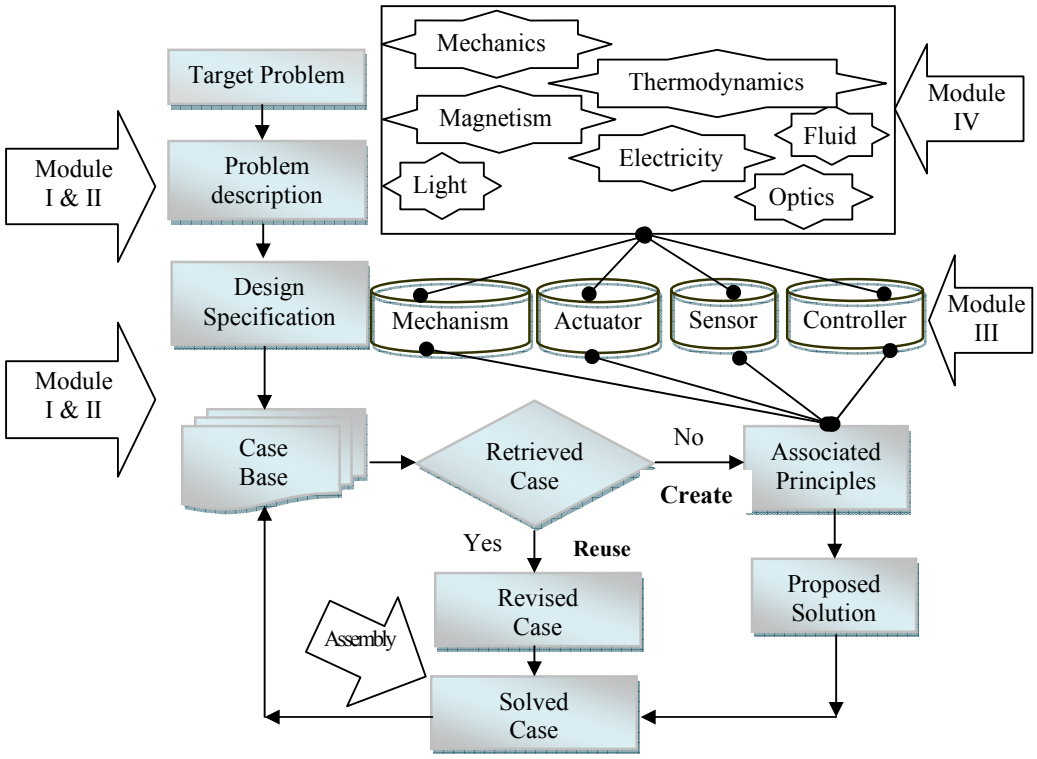

Figure 1. Elaborated framework for creative design

INSTRUCTIONAL MODEL AND METHODOLOGY

This research brings the creative problem-solving concept to develop the course model for basic physics and robotic education. The problem-based work of technology is characterized by the hierarchical knowledge structure of mechatronics, and the degree of teacher-centered planning. The problems, the guidelines, and the desired results, are provided in advance for the first type of PBL work. This type of PBL work is to intend to introduce students to relevant basic concepts of related disciplines of technologies involved in the design and fabrication of mechatronic systems. After students have gauged the interrelation between various related disciplines, they should able to explore their methods to solve the technological problems. Thus, the desired results will not be available to students in the second type of PBL work. They are only given guidelines for how to approach problems in the third type of PBL work. Students are confronted with the problems only in the last type of PBL work which is project-oriented. Students need to pursue solutions to open-ended problems by formulating questions for investigation, designing plans, collecting and analyzing information, and creating final products of their understanding.

The developed model is intended to not only enhance students to become familiar with the technical skills, but also to be able to use the skills to solve the problems given to them. The characteristics of this method give students more freedom to develop a question to investigate, devise an experimental procedure, and decide how to interpret the results. As a result, this teaching method focuses on students' skills in critical thinking and independent problem solving.

With project-based learning approaches, planning activities and investigations play a critical role. Students plan their work and create a synthesis of information retrieved from numerous resources. However, Meng and Yang (2003) pointed out that most existing search (Question and Answering) systems suffer from precision problems. Since the amount of available information is large, users waste considerable time in searching and browsing various websites to obtain the required information. Users must click and browse documents returned by keyword search to identify their desired information. When numerous documents are returned, users waste time dealing with many unsuitable documents. Studies of learner using the Web have indicated that students

frequently fail to establish task-relevant, meaningful, reflective activity (Hill and Hannafin, 1997). The root problem is that keyword searches are not an ideal method for users to present their real intentions. To solve this problem, our previous studies developed two searching methods that process problem statements in natural Chinese language (Module I) and engineering drawings (Module II) to uncover the intention of the user query (Jou, *et al*., 2010). The developed semantic inquiry module interprets a student's question (i.e., document source) to extract the semantic information. The system then contrasts the source documents with the existing engineering database through heuristic rules to retrieve useful and precise results that meet user expectations. Besides the semantic inquiry module, another inquiry module, allowing students to describe their handling problem through engineering graphics. After uploading engineering drawings (2D or 3D), this module interprets the input data and extracts the engineering information from the case base to analyze designing methods. These two modules were integrated into the developed interactive web-based environment for students to investigate robotic manipulation including mechanisms, robot motion, and path planning. Students explored the website in advance and proposed what they wished to investigate through the developed inquiry modules by using natural Chinese language or graphs. The system responded to the questions with accurate answers in the form of contextual information. Students clicked desired items and browsed detailed documents that contained text, graphics, multimedia, and interactive simulations. Furthermore, students were able to observe robot arm link inertias of motions and study trajectory generation and control.

Figure 2 show the developed modules (Module III) for students to investigate robotic manipulation including mechanisms, robot motion, and path planning. Students explored the website in advance and proposed what they wished to investigate through the developed inquiry modules by using natural Chinese language or graphs. The system responded to the questions with accurate answers in the form of contextual information. Students clicked desired items and browsed detailed documents that contained text, graphics, multimedia, and interactive simulations. Furthermore, students were able to observe robot arm link inertias of motions and study trajectory generation and control.

Another function of this system is facilitating collective learning based on information obtained from associated principles of basic physics (Figure 3, Module IV). The design and development of this system allows for collection of data concerning students' design activities. This data is then analyzed by the system to promote designing activities. The system was developed to incorporate all the modules necessary to encourage creative designs. Furthermore, this system integrates asynchronous communication tools (discussion forums), a synchronous meeting tool that allows textual discussion and application sharing, and a tool for writing reports during the project.

Finally, this study provides a platform for students to assemble mechanical parts and integrate mechatronics (i.e. sensors, actuators, and control units) in designing robots. The assembly platform can allow students to design and modify mechanical components of robots to meet the project's expected goal. The platform of mechatronics was designed to help students in learning robotic sensors, actuators, and controllers. With this platform, students can design and construct functioning models, gaining experience and insight in designing robotic mechantronics. For robotic sensors, the learning content covers proprioceptive sensors, exteroceptive sensors, sensor performance, and design criteria. For actuators, the system contains a number of motors for study. Through this platform, students confront, and learn to deal with, the realities of robotic control.

Figure 2. Design and learning platform of robotics

Figure 3. Learning of basic physics and technologies for creative design

ASSESSMENT

The participants in this study were 30 sophomore students in a special project design course during the spring semester. The aim was to design a mobile robot that could perform a specific task. The participants were required to complete the course online without face-to-face instruction, working on their designs in small groups of 4-5 participants. They were encouraged to retrieve relevant information from the developed e-learning system. Following completion of the course, each group was required to submit a final technical report detailing the design process, the engineering considerations that led to the final design, a review of the relevant engineering literature, and the group's conclusions.

This study employed a pre-experimental approach without the utilization of control groups (Creswell, 1994).

Quantitative data were collected using questionnaires, while qualitative data were collected through interviews. According to Windschitl (1998), qualitative data can capture unique phenomena of online learning. The questionnaire also measured satisfaction toward the course, perceptions of delivery method, course structure, inquiry method, interactions among participants and with materials, and participant autonomy. The questionnaires were administered to the participants before and after completion of the online course. Follow-up interviews were carried out with the participants at the end of the course.

Table 1 shows perceptions of the various features in the interactive e-learning environments. Nearly 90 percent of the students agreed that the interface design was user friendly, simple, and attractive. In addition, they found the course content to be well organized. They also felt the inquiry modules facilitated investigation and planning activities in project development stages. Furthermore, these course activities were able to enhance interest in robotics. The students believed that the interactive e-learning environments not only helped them to enhance their problem solving skills, but also their technology integration ability. However, a small number of participants felt isolated while completing the online course. This can be attributed to the lack of face-to-face interaction. Interviews revealed students felt the course was challenging, stimulating, and fun. Students also showed a positive attitude toward robotics.

Student learning effectiveness was analyzed by employing laboratory exercises in robotics (Krotkov, 1996). After revising and correcting, there are 70 multiple choice questions in the test. The mean of passing and discrimination percentage are 0.57 and 0.33, respectively. Therefore, it could be called a reasonable test with a good passing and discrimination percentage. According to the result of the reliability analysis, the Cronbach's alpha value of internal consistency is 0.786. Moreover, criterion validity is based upon the significantly positive correlation of test scores for several universities. As a result, the test has good reliability and validity.

As shown in Table 2, the mean scores for mechanism design, manufacturing, application of actuators, and selection of sensors, before and after attending the special project course with interactive e-learning environments, were satisfactory. Integration of mechatronics, shows a mean score, before attending the course, of 7.47. This score indicates a moderate level of technical skill. After the course, a mean of 7.79 shows that the level of technical skills improved to satisfactory. Construction of control systems and assembly and testing scores were between 7.37-7.89, a moderate level. Significant improvements were observed in the technical skills of mechanism design ($t(36)=-2.39$ and $p=0.022$), manufacturing ($t(36)=-2.54$ and $p=0.015$), application of actuators ($t(36)=-2.40$ and $p=0.022$), and selection of sensors ($t(36)=-2.04$ and $p=0.048$). However, there were no statistically significant increases in technical skills for construction of control systems, integration of mechatronics and assembly and testing. However, data from the interviews indicated that most students showed higher interest and motivation toward problem solving in mechatronics and testing. Although students felt the projects were difficult and challenging, they were able to use appropriate technical skills to complete them. They were able to solve the technical problems at their own pace, collaborating among themselves.

Table 3 shows responses for two items associated with satisfaction with the interactive e-learning modules. Results showed that 93.3% of the participants agreed that the interactive e-learning modules had helped them to solve problems in project developing stages. (Mean, M=4.2; Standard deviation, SD=0.551). Furthermore, 90.0% of the participants believed that the interactive e-learning modules created a conducive learning environment ($M = 4.03$, $SD = 0.615$).

CONCLUSIONS

In this paper, we propose an interactive e-learning environment supporting creative design and design of robots at a distance. The developed inquiry modules allow students to present their problems in natural Chinese language fashion and through engineering graphics. In addition, this study developed interactive web-based environments to incorporate all the modules necessary for creative designs. This study examined the various important dimensions of web-based environments. Students generally provided positive feedback on the interactive learning environments employed in the special project course. Most students were satisfied with the inquiry modules, course activities, and interactions. In fact, they believed that these factors helped in their studies. Generally, interactive web-based environments can successfully enhance students' course achievements and technical skills.

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Table 1. Perceptions of the interactive e-learning environments

Items	Responses						
	SA	A	US	DA	SDA	M	SD
The online course enhances my interests toward learning.	8	20	2	0	0	4.20	.551
It is easy to gain access to technical supports.	5	22	2	1	0	4.03	.615
I can actively involve myself in the special project.	4	18	5	2	1	3.73	.907
The course materials satisfy my learning needs.	3	17	6	3	1	3.60	.932
The interface is user friendly and attractive.	10	17	3	0	0	4.23	.626
The online course contents are well structured.	7	18	4	1	0	4.03	.718
I can obtain the materials from the e-learning system for learning.	5	19	5	1	0	.393	.691
I can complete the project assigned within the time given.	20	9	1	0	0	4.63	.556
The group size is appropriate for robotic design project.	18	12	0	0	0	4.60	.498
The inquiry modules encourage learning through questions.	12	17	1	0	0	4.37	.556
I obtain feedbacks from inquiry modules as frequent as I need.	8	21	1	0	0	4.23	.504
I could interact with the inquiry modules as frequent as I need.	10	19	1	0	0	4.30	.535
I could obtain assistance to understand the content of the robotics from e-learning systems.	5	21	3	1	0	4.00	.643
I can understand the robotic course content from e-learning systems.	7	19	3	1	0	4.07	.691
The use of materials in the e-learning systems enhances my understanding of the robotics.	3	21	4	1	1	3.80	.805
I would like to repeat the experience.	18	11	1	0	0	4.57	.568

Table 2. Dependent t-test results: Students' ability of technical skills on robotics

		M[a]	SD	t	df	p-value
Mechanism design	Pre-test Post-test	7.748 .47	0.99 0.90	-2.39	36	0.022
Manufacturing	Pre-test Post-test	7.688 .47	1.00 0.90	-2.54	36	0.015
Application of actuators	Pre-test Post-test	7.168 .05	1.211. 07	-2.40	36	0.022
Selection of sensors	Pre-test Post-test	7.167 .89	1.210. 99	-2.04	36	0.048
Construction of control system	Pre-test Post-test	7.37 7.89	0.83 0.99	-1.77	36	0.085
Integration of mechatronics	Pre-test Post-test	7.47 7.79	0.90 1.08	-0.97	36	0.336
Assembly and Testing	Pre-test Post-test	7.47 7.79	0.901. 03	-1.00	36	0.323

[a]The maximum grade for each part of the question was 10.00, and the maximum grade for the entire question was 70.00.

Table 3. Satisfaction with the interactive e-learning environments

Items	Responses						
	SA	A	US	DA	SDA	M	SD
The interactive e-learning modules help me to solve problems on project developing stages.	8	*20*	2	0	0	4.20	.551
The interactive e-learning modules provide a conducive learning environment.	5	22	2	1	0	4.03	.615

Note: SA = Strongly Agree (5), A = Agree (4), US = Unsure (3), DA = Disagree (2), and SDA= Strongly Disagree (1), M = Mean, SD = Standard Deviation

REFERENCES

Aroyo, L., Dicheva, D. (2004). The New Challenges for E-learning: The Educational Semantic Web. *Edu. Tech. Soc.*, 7(4), 59-69.

Ates, S. and Cataloglu, E. (2007). The effects of students' cognitive styles on conceptual understandings and problem solving skills in introductory mechanics. Res. Sci. Technol. Educ. 25, 167-78.

Berners-Lee, T., Hendler, J., Lassila, O. (2001). The Semantic Web. *Scientific American*, 284(5), 34-43.

Cavallo, A. M. L. (1996). Meaningful learning, reasoning ability, and students' understanding and problem solving of topics in genetics. *J. Res. Sci. Teach.* 33, 625–56.

Clement, J. (1993). Using bridging analogy and anchoring intuitions to deal with students' preconceptions in physics. *J. Res. Sci. Teach.* 30, 1241–57.

Cohen, H., Hillman, D. and Agne, R. (1978). Cognitive level and college physics achievement. *Am. J. Phys.* 46, 1026.

Coletta, V. P., Phillips, J. A, Savinainen, A. and Steinert, J. J. (2008). Comment on 'The effects of students' reasoning abilities on conceptual understanding and problem-solving skills in introductory mechanics. Eur. J. Phys. 29, L25.

Creswell, J.W. (1994). *Research design: Qualitative and Quantitative Approaches.* Sage Publication, California.

Dockrill, P. M. (2003). Facilitating Critical Thinking in First Year Community College Students. Master's thesis, St. Francis Xavier University, Canada.

Enveart, M. A., Baker, D., and Vanharlingen, D. (1980). Correlation of inductive and deductive logical reasoning to college physics achievement. *J. Res. Sci. Teach.* 17, 263–76.

Hill, J.R., Hannafin, M.J. (1997). Cognitive Strategies and Learning from the world wide web. Educ. Tech. Res. & Dev. 45(4), 37-64.

Isman, A., Isbulan, O. (2010). Usability level of distance education website. *Turkish Online Journal of Educational Technology*. 9(1), 243-258.

Jou, M., M.-J. Wu, and C.-C. Liu, "Application of Semantic Approaches and Interactive Virtual Technology to Improve Teaching Effectiveness", *Interactive Learning Environments*. (appear in 2010)

Kahle, J. B. and Damnjanovic, A. (1994). The effects of inquiry activities on elementary students' enjoyment, ease, and confidence in doing science: an analysis by sex and race. *J. Women Minorities Sci. Eng.* 1, 17–28.

Krajcik, J., Czerniak, C., Berger, C. (1999). *Teaching Science: A Project-Based Approach*. McGraw-Hill College, New York.

Krotkov, E. (1996). Robotics laboratory exercises. *IEEE Trans. on Edu.* 39(1), 94-97.

Lawson, A. E, Clark, B., Meldrum, E. C., Falconer, K. A., Sequist, J. M., and Kwon, Y. J . (2000). Development of scientific reasoning in college biology: do two levels of general hypothesis-testing skills exist? *J. Res. Sci. Teach.* 37, 81–101.

Lawson, A. E., Banks, D. L., and Logvin, M. (2007). Self-efficacy, reasoning ability, and achievement in college biology. *J. Res. Sci. Teach.* 44, 706–24.

Lawson, A. E. (1985). A review of research on formal reasoning and science teaching. *J. Res. Sci. Teach.* 22, 569–617.

Lawson, A. E. (1992). What do tests of formal reasoning actually measure? *J. Res. Sci. Teach.* 29, 965–84.

Liu, E. Z. F., and 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.

Lytras, M. D., Garcia, R. (2008). Semantic Web applications: a framework for industry and business exploitation

– What is needed for the adoption of the Semantic Web from the market and industry, *Int. J. of Knowledge and Learning.* 4(1), 93-108.
Marshall, J. A. and Dorward, J. T. (2000). Inquiry experiences as a lecture supplement for preservice elementary teachers and general education students. Am. J. Phys. 68, 27-36.
McDermott, C. L. (2001). Oersted Medal Lecture 2001: physics education research-the key to students learning. Am. J. Phys. 69, 1127–37.
Meng, I.H., Yang, W.P. (2003). An Effective Engine for Answering Questions Based upon Chinese Semantic Extraction. *Info. Mang. Scis.* 14(4), 27-48.
Panagis, Y. and Sakkopoulos, E. (2006). Optimization mechanism for web search results using topic knowledge. *Int. J. of Knowledge and Learning.* 4(1/2), 140-153.
Porta, M. (2007). E-learning and machine perception: in pursuit of human-like interaction in computer-based teaching systems. *Int. J. of Knowledge and Learning*. 3(2/3), 281-298.
Saba, F. (2000). Research in Distance Education: A Status Report. International Review of Research in Open and Distance Learning, retrieved from http://www.irrodl.org/index.php/irrodl/article/view/4/24.
Thijs, G. D. and Bosch, G. M. (1998). Cognitive effects of science experiments focusing on student's preconceptions of force: a comparison of demonstrations and small-group practicals. Int. J. Sci. Educ. 36, 526-527.
Thomas, J. W. (2003). A Review of Research on Project-based Learning. Retrieved from http://www.autodesk.com/foundation/pbl/research.
Tobias, S. and Birrer, A. J. (1999). Who will study physics, and why? Eur. J. Phys., 20, 365–72.
Vargas-Vera, M., Lytras, M. D. (2008). Exploiting semantic web and ontologies for personalized learning services: towards semantic web-enabled learning portals for real learning experiences. *Int. J. of Knowledge and Learning.* 4(1), 1-17.
Windschitl, M. (1998). The WWW and Classroom Research: What path should we ake? *Educational Researcher*, 27(1), 28-33.

DESIGNING A TECHNOLOGY-ENHANCED LEARNING ENVIRONMENT TO SUPPORT SCIENTIFIC MODELING

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ABSTRACT
Modeling of a natural phenomenon is of value in science learning and increasingly emphasized as an important component of science education. However, previous research has shown that secondary school students encounter difficulties when engaging in modeling activities and need substantial support in order to create meaningful scientific models. Therefore, the purpose of this article is to present the design of a technology-based modeling tool (Air Pollution Modeling Tool, APoMT) that supports students to engage in scientific modeling. The design of APoMT is based on theories and guidelines of scaffolding. APoMT decomposes a modeling process into manageable tasks, supports an increasingly sophisticated modeling process by integrating multiple variables into students' models, provides multiple representations to help students visualize data and relationships, and embeds expert guidance to help learners apply science content to modeling. An implementation study shows that combining APoMT with well-designed learning lessons could effectively support students' development of conceptual understandings and modeling abilities (Wu, 2010).
Keywords: technology-enhanced learning, modeling, scaffoldings

INTRODUCTION

Modeling of a natural phenomenon is of value in science learning and increasingly emphasized as an important component of science education (National Research Council, 1996). Modeling engages students in meaningful learning activities such as making a plan, identifying variables, building relationships, and testing their model (Sins, Savelsbergh, & Van Joolingen, 2005). However, secondary school students encounter a number of difficulties in creating and using models for science learning. For example, students are unable to relate their models to the phenomenon being modeled because of their limited content knowledge (de Jong & van Joolingen, 1998). Additionally, some students cannot recognize mismatches between modeled outcomes and expected behaviors of the system represented in a model (Hogan & Thomas, 2001). Previous research has shown that students need substantial support in order to create meaningful scientific models. One source of support is from a well-designed technological tool (Fretz et al., 2002). Compared to the support provided by teachers and peers, tool support is more consistent and persistent; it exists all the time and can be employed in various settings (e.g., inside and outside classroom). Therefore, the purpose of this article is to present the design of a technology-based modeling tool (Air Pollution Modeling Tool, APoMT) that supports students to engage in scientific modeling. The design guidelines are informed by theories of scaffolding (Puntambekar & Hübscher, 2005; Quintana, et al., 2004; Wood, Bruner, & Ross, 1976).

The following sections start with a description of models and modeling. Innovative features of the Air Pollution Modeling Tool (APoMT) are described. Then theories and studies about scaffolding are discussed, and a set of design guidelines is showed after the discussion. Finally, the design of APoMT is presented and how the design follows the guidelines is explained.

Models and Modeling

A model is a simplified representation of a system that focuses attention on specific aspects or components of a system, such as ideas, objects, events or processes (Gilbert, 1991). These specific aspects can be either complex or on a different scale to that which is normally perceived. Models, therefore, can reveal the hidden structures or processes that are fundamental to an understanding of a system or a phenomenon (Harrison & Treagust, 2000).

Models also integrate conceptual knowledge to explain the phenomenon and use components of the model (i.e., objects, variables, factors or relationships) to elaborate on interactions within the system (Gobert & Buckley,

2000). For example, when creating a model of water quality, students need to identify variables of related concepts, such as dissolved oxygen, conductivity, and pH value, build causal relationships among them, and test the accuracy of these relationships. Thus, constructing a scientific model involves various learning activities that could enhance students understandings of scientific concepts, and in this article, this model construction process is defined as modeling.

Innovations of a Modeling Tool

Several software tools have been designed to engage students in modeling processes. For example, Fretz et al. (2002) showed how Model-It supported students to externalize their scientific ideas and create their own models. PowerSim allowed students to create and run a model about dynamic systems (Sins, et al., 2005). However, none of these technological tools were developed based on a real scientific model. Additionally, very few modeling tools in previous research provided simulated data for students to test the accuracy of their models. Thus the technology-based modeling tool presented in this article, APoMT, contains two innovative features as follows.

The first innovation is to build a modeling tool based on a real scientific model. According to theories of situated learning (Lave & Wenger, 1991), engaging students in activities that are similar to what scientists do is a very important part of learning. A real scientific model provides a context for students to participate in authentic science and gives students access to experts' knowledge base. Because APoMT focuses on a topic of air quality, integrating a model used by atmospheric scientists into APoMT could help students understand the transport and dispersion of air pollutants in the ambient air. One of the professional models commonly used by atmospheric scientists is AERMOD (http://www.epa.gov/scram001/dispersion_prefrec.htm). AERMOD can simulate the flow of air pollution in the atmosphere and estimate the concentration of air pollutant, but it does not have an interface for high school students to visualize and manipulate the simulations. Thus APoMT was designed based on AERMOD, includes major variables for students to manipulate and test, and contains interfaces to run, generate and visualize simulations.

Secondly, very few modeling tools provide real or simulated data to help students evaluate the accuracy of their models. For example, in Model-It (Fretz, et al., 2002), students could create as many irrelevant variables or relationship as they want, and the tool provided no data for students to test their modeled results. To improve the accuracy of students' models, therefore, it is necessary to provide students with simulated data. Rather than retrieving ready-made data from a database, APoMT directly runs the equations and simulations provided by AERMOD. This innovation could support students to build accurate relationships between variables and create a better model. Students could also use this feature to compare the simulated results to their predictions.

In summary, APoMT is a modeling tool with innovative features. By using APoMT, students could visualize a phenomenon (e.g., how pollutants disperse in the air), pose questions that take them beyond the original phenomenon (e.g., how topographical factors, weather conditions, and atmospheric stability affect the transport and dispersion of air pollutants), and develop explanations for these questions based on simulated results. Consequently, APoMT transforms modeling into a process that affords students the opportunities to engage in meaningful learning and allows them to transform their understandings of a phenomenon into objects, variables and a series of relationships between variables (Fretz, et al., 2002).

Theories and Design Principles of Scaffolding

Although modeling is important for science learning and allows students to participate in desirable learning activities, several studies showed that secondary school students encounter difficulties when creating and using models (de Jong & van Joolingen, 1998; Hogan & Thomas, 2001). To design effective support for modeling, our research team draws on theories of scaffolding (Wood, Bruner, & Ross, 1976), and defines scaffolding as a process of providing decreasing amounts of support to help students "bridge the gap between their current abilities and the intended goal of instruction" (Rosenshine & Meister, 1992, p. 26) that allows students "to participate at ever-increasing levels of competence" (Palincsar & Brown, 1984, p. 122). Scaffolding is referred to as support provided within a learner's zone of proximal development (Vygotsky, 1978) that is the vital developmental area between what a student could do alone, and what he or she could do with the assistance of a more capable other.

Scaffolding can be provided by a variety of sources and appear in many forms ranging from print-based materials to modeling behaviors enacted by the teacher. These scaffolding materials or procedures often begin with simple exercises that allow learners to participate in difficult tasks or activities early on in their inquiry. Through a series of closely monitored steps, difficulty is gradually increased as students become more involved

with their learning, and finally the support by the teacher is withdrawn (Wood, et al., 1976). The scaffolding instruction allows students to gain appropriate experiences and skills to increase their cognitive capabilities toward the task.

Software tools can also have supports or functions that play a role of scaffolding. Through inductive and theory-based analyses, Quintana et al. (2004) proposed a scaffolding design framework for science learning and synthesized previous research on learning technologies into a set of guidelines. Among the seven guidelines, four of them are very relevant to designing scaffolding in a modeling tool: (1) use representations and language that bridge learners' understanding, (2) organize tools and artifacts around the semantics of the discipline, (3) use representations that learners can inspect in different ways to reveal important properties of underlying data, and (4) provide structure for complex tasks and functionality (p. 345). For example, based on the third guideline, a modeling tool can provide multiple representations to help students visualize data and relationships between variables. According to the fourth guideline, a tool can offer representations or visuals that demonstrate structures or sequences of modeling so that students can easily organize their modeling process. The following section describes how the design of APoMT follows the guidelines.

Design of APoMT

APoMT decomposes the modeling processes into four modes: Build (Figure 1), Test (Figures 2 and 3), Apply, and Case (Figure 4). Two common features are embedded in every mode: Tool Bar and Help. Students could move back and forth among the modes by clicking on the buttons in the "Tool Bar" at the top of the window. The Tool Bar also provides a visual organizer that allows students to have access to functionality (Guideline 1). In addition of the Tool Bar, another common feature across different modes is "Help." This embedded feature serves a role of expert guidance to help learners use the tool, understand the purposes of each mode, and apply science content to modeling (Guideline 1).

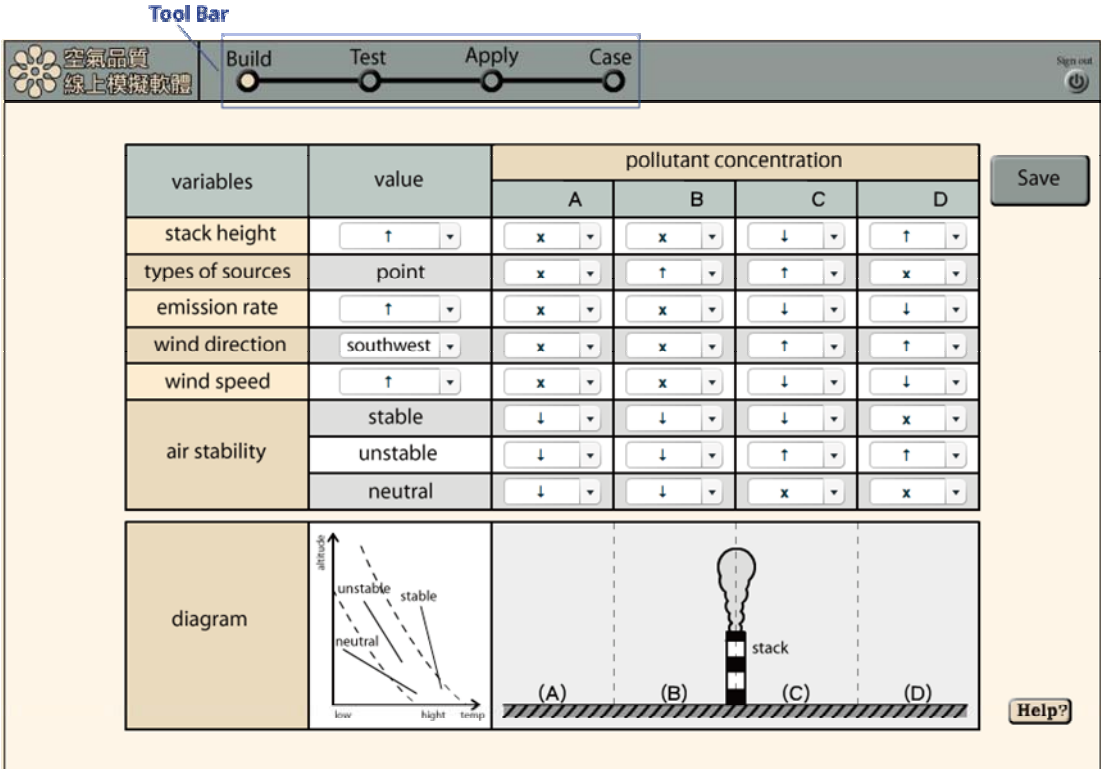

Figure 1. Interface of Build mode in APoMT

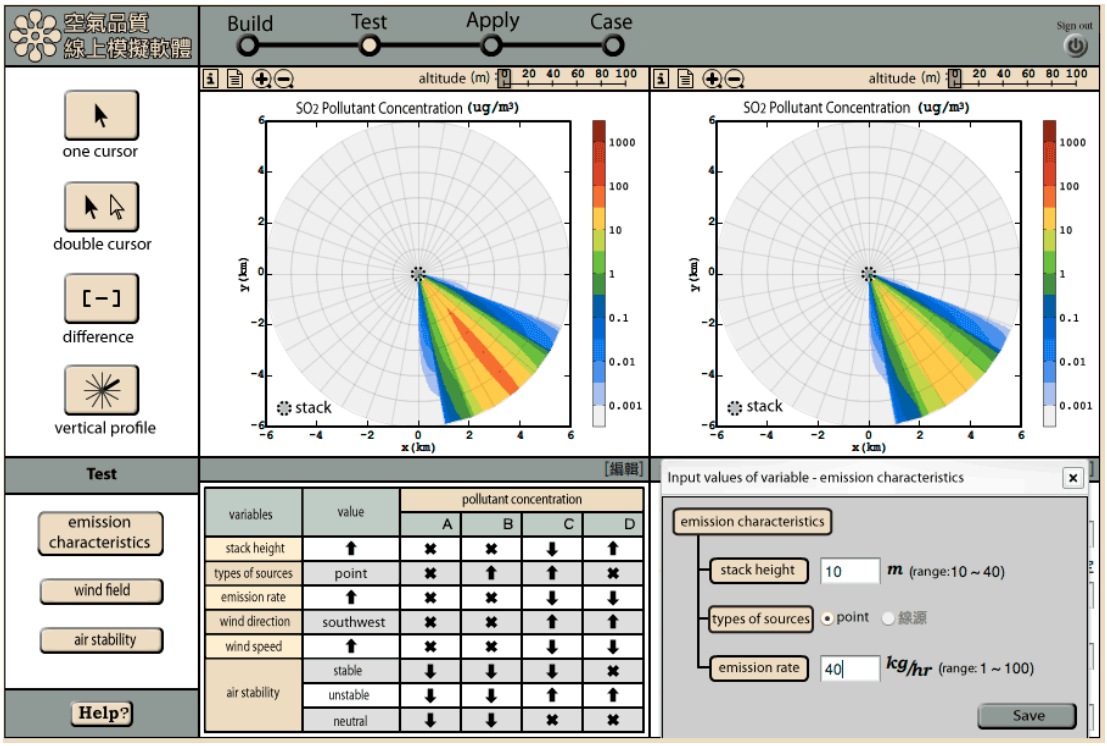

Figure 2. Interface of Test mode in APoMT

Table 1 Design Guidelines of Scaffolding and APoMT Features

Design Guideline	APoMT Features
(1) Use representations and language that bridge learners' understanding	• Provide a visual organizer that allows students to have access to functionality (Tool Bar). • Embed expert guidance to help learners use the tool, understand the purposes of each mode, and apply science content to modeling (Help).
(2) Organize tools and artifacts around the semantics of the discipline	• Organize the tool modes around a possible sequence of how scientists construct a model (Four modes). • Make a modeling process accessible and explicit to students (Four modes).
(3) Use representations that learners can inspect in different ways to reveal important properties of underlying data	• Offer a representation that can be inspected to reveal relationships among variables and underlying properties of data (Variable Table in Build mode). • Allow students to directly manipulate different representations (Test, Apply, Case modes). • Provide multiple representations to help students visualize data and relationships (Test, Apply, Case modes).
(4) Provide structure for complex tasks and functionality	• Constrain the space of activities that makes a complex modeling process more feasible and manageable (Four modes). • Restrict a complex task by allowing students to test only one variable each time (Test mode). • Support an increasingly sophisticated modeling process by using ordered task decompositions (Test, Apply, Case modes)

The four modes are organized around a possible sequence of how scientists construct a model (Guideline 2); the sequence makes a scientific modeling process accessible and explicit to students and guide students to plan their investigations of pollutant dispersions for model construction (Guideline 2). Additionally, each mode constrains the space of activities that makes a complex modeling process more feasible and manageable (Guideline 4). Table 1 outlines the design guidelines of scaffolding and APoMT features that are designed based on the guidelines.

In Build mode, the tool provides a Variable Table (Figure 1) that is designed to help students identify major variables and predict how the variables affect the pollutant concentration in different locations. For example, for a variable of the stack height, students could choose a "up arrow" which means "when the stack height increases" and then decide whether the pollutant concentration in location A, B, C, or D would increase (↑), decrease (↓) or not change (×). Build mode allows students to make prediction about relationships between variables and reveals students' own models before they collect simulated results. Following the third guideline, the design of this mode includes a representation (Variable Table) that can be inspected to reveal relationships among variables and underlying properties of data.

After making predictions, in Test mode (Figures 2 and 3), students could examine their models and test their hypotheses about how a variable might affect air pollution dispersion. To restrict the complexity of the task (Guideline 4), this mode allows students to manipulate only one variable from the variable list while other variables are controlled. Students can input a variable value in a pop-up window and run a simulation. Students can test different values with the same variable and observe how changes to variable values affect the pollutant dispersion patterns. The simulated results are generated by a professional modeling system, AERMOD, and shown by color-coded displays (Figure 3). The colors indicate estimated concentrations of an air pollutant (SO_2) at different altitudes (0-100 meters). Students can also visualize the dispersion of the pollutant from a different perspective; the Vertical Profile shows a cross-section of how a flow of pollutants moves from the stack to several kilometers away. After running simulations, students conclude their observations in the Data Explanation box and compare their conclusions with prediction early made in the Variable Table. The simulations are malleable representations that allow students to directly manipulate different variables and to have multiple views of how variables have impact on the pollutant concentrations (Guideline 3). Additionally, this mode provides multiple representations to help students compare differences and visualize data and relationships (Guideline 3).

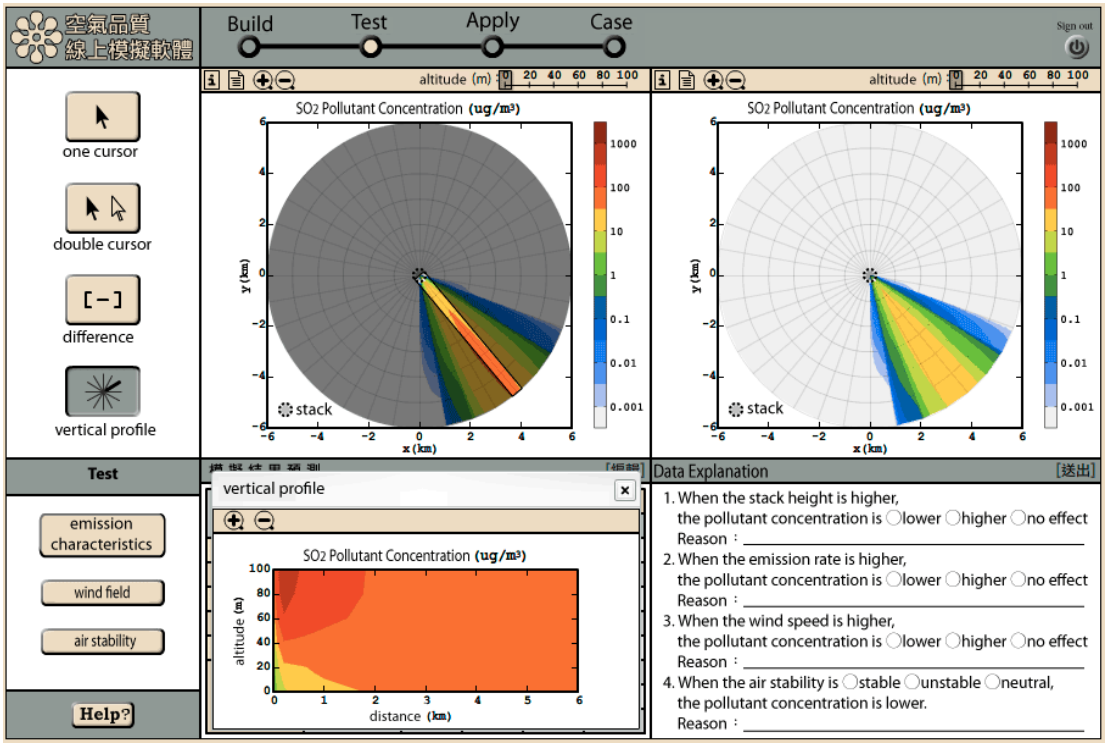

Figure 3. Interface of Test mode in APoMT

Apply mode is also designed for students to manipulate variables, to visualize simulated results, and to describe their findings. However, different from Test mode in which students could change only one variable each time, Apply mode allows students to manipulate all variables at once and is designed to support a more sophisticated modeling process. The transition from Test to Apply mode could make model testing become a more feasible and manageable task to students (Guideline 4). In this mode, students could integrate what they learned about

the effects of individual variables in Test mode, manipulate multiple variables at the same time, and observe possible interactions among variables. Additionally, this mode allows students to visualize how the pollutant concentration changes within 48 hours (Guideline 4) and to answer open-ended questions in the Data Explanation box.

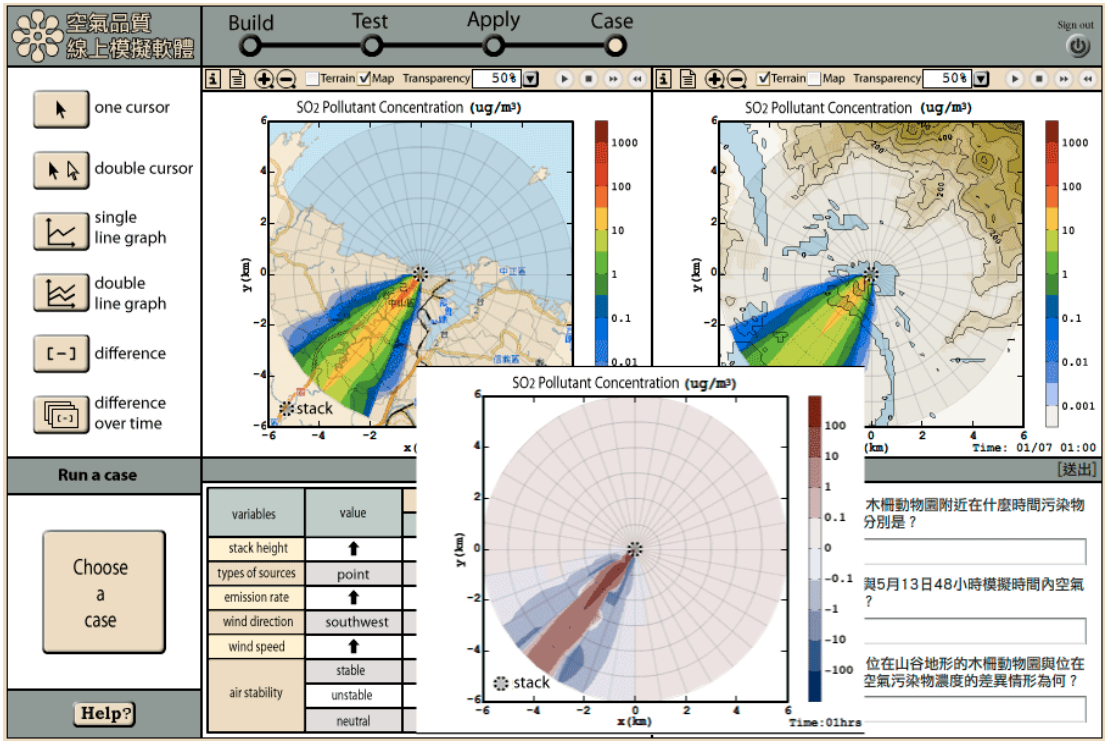

Figure 4. Interface of Case mode in APoMT

To further support students' modeling processes, six cases are provided in Case mode. Each case includes a location and relevant information (e.g., data of different variables, weather conditions, topographical situations, and maps) about the location. In this mode, students are asked to generalize their conclusions, apply their models and concepts learned to different cases, make prediction about the pollutant dispersion in different locations, and decide where would be the best location to build a thermal power plant. Students could choose a case, employ their models to make predictions about the case, run simulations, and compare the simulated results to their predictions (Figure 4). To support an increasingly sophisticated modeling process, one more variable, topography, is included in this mode (Guideline 4). Students could choose a Terrain view or a Map view to see whether the location is near large cities, whether pollutants would move into an urban or rural area, and whether any mountain or hill close to the location would cause an increase in the pollutant concentration. Additionally, line graphs and graphical illustrations (Figure 4) are provided for students to compare the pollutant concentrations in different locations and to visualize how the pollutant concentration changes over time (Guideline 3).

CONCLUSION

Modeling is one of the important ways for scientists to construct scientific knowledge (Dunbar, 1998). Although several modeling tools were built, very few of them have been developed based on a real scientific model and provided simulated data for students to test the accuracy of their models. Therefore, this article presents the design of APoMT that follows design guidelines of scaffolding. The tool decomposes a modeling process into manageable tasks, supports an increasingly sophisticated modeling process by integrating multiple variables into students' models, and provides multiple representations to help students visualize data and relationships. In the past year, an implementation study was conducted and shows positive results (Wu, 2010). In the study, we designed five learning lessons with the use of APoMT and examined students' conceptual understandings and modeling abilities after the lessons. The results indicated a significant improvement in conceptual understandings. In addition, students performed better on modeling abilities, such as planning, identifying variables, and testing models. These findings suggest that combining APoMT with well-designed

learning lessons could effectively support students' development of conceptual understandings and modeling abilities.

REFERENCES

de Jong, T., & van Joolingen, W. R. (1998). Scientific discovery learning with computer simulations of conceptual domains. *Review of Educational Research, 68*(2), 179-201.

Fretz, E. B., Wu, H.-K., Zhang, B., Krajcik, J. S., Davis, E. A., & Soloway, E. (2002). An investigation of software scaffolds supporting modeling practices. *Research in Science Education, 32*(4), 567-589.

Gilbert, S. W. (1991). Model building and a definition of science. *Journal of Research in Science Teaching, 28*(1), 73-79.

Gobert, J. D., & Buckley, B. C. (2000). Introduction to model-based teaching and learning in science education. *International Journal of Science Education, 22*(9), 891-894.

Harrison, A. G., & Treagust, D. F. (2000). A typology of school science models. *International Journal of Science Education, 22*(9), 1011-1026.

Hogan, K., & Thomas, D. (2001). Cognitive comparisons of students' systems modeling in ecology. *Journal of Science Education and Technology, 10*(4), 319-345.

National Research Council (1996). *National Science Education Standards*. Washington, DC: National Academies Press.

Palincsar, A. M., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1*(2), 117-175.

Puntambekar, S., & Hübscher, R. (2005). Tools for scaffolding students in a complex learning environment: What have we gained and what have we missed? *Educational Psychologist, 40*(1), 1-12.

Quintana, C., Reiser, B. J., Davis, E. A., Krajcik, J., Fretz, E. B., 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.

Rosenshine, B., & Meister, C. (1992). The use of scaffolds for teaching higher-level cognitive strategies. *Educational Leadership, 49*(7), 26-33.

Sins, P. H. M., Savelsbergh, E. R., & Van Joolingen, W. R. (2005). The difficult process of scientific modelling: An analysis of novices' reasoning during computer-based modelling. *International Journal of Science Education, 27*(14), 1695-1721.

Suthers, D. D., & Hundhausen, C. D. (2003). An experimental study of the effects of representational guidance on collaborative learning processes. *Journal of the Learning Sciences, 12*(2), 183-218.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wood, D. J., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17*, 89-100.

Wu, H.-K. (2010). Modeling a complex system: Using novice-expert analysis for developing an effective technology-enhanced learning environment. *International Journal of Science Education, 32*(2), 195-219.

EXEMPLARY SOCIAL STUDIES TEACHERS USE OF COMPUTER-SUPPORTED INSTRUCTION IN THE CLASSROOM

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ABSTRACT
Educators increasingly support the use of computer-supported instruction in social studies education. However, few studies have been conducted to study teacher use of computer-supported instruction in social studies education. This study was therefore designed to examine the use of exemplary social studies teachers' computer-supported instruction in the classroom. Case study methodological approach was used for this study. Four exemplary social studies teachers who use computer-supported instruction in their teaching practices were selected as participants. The data were collected from interviews and classroom observations. The data analysis indicated that all of the participants agreed that the computer is a powerful research tool which facilitates students' work and makes the work faster and easier for the students. The participants used various types of computer-supported instruction in their classrooms. The use of the Internet and software programs such as Microsoft Power Point, Word, and Excel were the most common use of computer-supported instruction in the classrooms observed.
Keywords: Computer-supported instruction, Social studies, In-service teachers

INTRODUCTION

Major developments in computer and Internet technologies have increased the availability of computer and Internet access in schools. According to data from the National Center for Education Statistics (NCES, 2003), computers have been widely introduced into schools in recent years. In 2002, the average public school contained 131 instructional computers, and 99% of schools had access to the Internet in the United States. Like other disciplines, these developments in computer hardware and software in the last decades have increased computer integration in social studies education (Açıkalın & Duru, 2005; Berson & Balyta, 2004; Nickell, Field, & Roach, 2001; Rose & Fernlund, 1997; VanHover, Berson, Mason-Bolick, & Owings-Swan, 2004; White, 1997; Whitworth & Berson, 2003).

These substantial developments in computer and Internet technologies and the growing availability of computer and Internet access in schools have brought such terms as "Computer-Based Training" (CBT), "Computer-Based Instruction" (CBI), and Computer-Assisted/Aided Instruction" (CAI) (see Kausar, Choudhry, & Gujjar, 2008;Yusuf & Afolabi, 2010) into the field of education. These terms are frequently used interchangeably to refer to virtually any kind of computer use for training and instruction (see Freedman, 2001, p. 116, 171; Margolis, 1999, p. 77-78). Nevertheless, there are important differences between these terms that should be maintained. The phrase "Computer-Based" refers to the computer as a central part of instruction, which I believe is far beyond the utility of the computer in education. On the other hand, "Computer-Assisted/Aided Instruction (CAI)" is almost exclusively associated with computer programs such as drills and practice, tutorials, and simulations (see Jonassen, 2000, p. 4; Kleinedler et al., 2001, p. 39; Plaffenberger, 2001, p. 86) that limit the scope of computer utilization in education. I therefore have preferred to use the term "Computer-Supported Instruction (CSI)" as a reference to all aspects of computer use in the instructional context in order to help teach any kind of knowledge and skills to individuals. This includes the uses of any types of software (i.e. MS Word, Excel, PowerPoint), games, simulations, Internet searches, any sorts of online communications (i.e. e-mail exchanges, blogs, forums), virtual field trips and Webpage developments for instructional purposes.

LITERATURE REVIEW / PURPOSE OF THE STUDY

Social studies is the integrated study of the social sciences such as history, geography, economy, sociology, anthropology, psychology, philosophy, political science, law, and civic education (Milli Eğitim Bakanlığı Talim Terbiye Kurulu Başkanlığı [TTKB] 2009a, 2009b; National Council for Social Studies [NCSS], 1994). Many scholars point out that the disciplines of social studies are intended to develop effective citizens who possess critical thinking, problem-solving, and decision-making skills (Berson, 1996; Engle & Ochoa, 1988; Newmann, 1991; VanSickle & Hoge, 1991).

Likewise, many researchers in the field of social studies education highlight the role of computers in engaging students in critical thinking, problem-solving, and decision-making (see Açıkalın & Duru, 2005; Bennett & Pye, 1999; Berson, 1996; Berson & Balyta, 2004; Casutto, 2000; Dils, 2000; Fontana, 1997; Hicks, Tlou, Lee, Parry, & Doolittle, 2002; Larson, 1999; Rice & Wilson, 1999; Rose & Ferlund, 1997; Saye & Brush, 1999; Whitworth

& Berson, 2003; Zukas, 2000). According to Berson (1996), "Computer-based learning has the potential to facilitate development of students' decision-making and problem-solving skills, data-processing skills, and communication capabilities. By using the computer, students can gain access to expansive knowledge links and broaden their exposure to diverse people and perspectives" (p. 486). Likewise, educational organizations such as the National Council for Social Studies, the College and University Faculty Assembly (CUFA), and the International Society for Technology Information (ISTE) recognize the potential of computer integration to transform learning in social studies (Hicks, Doolittle, & Lee, 2004; NCSS, 1994; Mason et al., 2000; VanHover et al., 2004).

While the computer integration in social studies education has been increasing, not much research has been done about the level of use of computer-supported instruction in the social studies classroom. Prior studies indicated that word processing, simulation, drill and practice and tutorials were listed as the most common computer applications used by social studies teachers (Northup & Rooze, 1990; Pye & Sullivan, 2001). On the other hand, database, problem-solving were less common strategies compared to the previous four categories (Northup & Rooze, 1990; Pye & Sullivan, 2001).
Nevertheless, a number of studies showed that "Internet use" and "accessing information from the Web" have become the most common use of computers in social studies education (Whitworth & Berson, 2003; see also Pye & Sullivan, 2001; Vanfossen, 2000, 2001). This change might be explained by the rapid new developments and innovations in computer and Internet technologies. However, the common findings of these studies were that social studies teachers use the Internet for personal purposes, and to gather background information for planning rather than for teaching and learning activities in the classroom (Gibson & Nocente, 1999; Keiper, Harwood, & Larson, 2000; Sunal, Smith, Sunal, & Britt, 1998; Vanfossen, 2000, 2001).

On the other hand, there are increasing body of research emphasize the crucial role of the Internet in providing information to students about multiple perspectives, cultures, and real-world issues (see Bennett & Pye, 1999; Cassutto, 2000; Dils, 2000; Hicks et al., 2002; Hicks & Ewing, 2003; Larson, 1999; Risinger, 1996, 1998, 2000, 2001, 2003; Shiveley & VanFossen, 1999; Zukas, 2000).

Despite the increasing availability of the computer and Internet access in schools (NCES, 2003), there are still common barriers keeping social studies teachers from employing computer-supported instruction more frequently. The most extensively cited barriers are (a) lack of availability of computers and problems with Internet access (Gibson & Nocente, 1999; Keiper et al., 2000; Sunal et al., 1998; VanFossen, 2000, 2001); (b) lack of training in how to apply the computer- and Internet-supported instruction in the classroom (Rice, Wilson, & Bagley, 2001; VanFossen, 2000, 2001); (c) lack of time (Sunal et al., 1998; Rice et al., 2001); and (d) lack of funding (Rice et al., 2001).

In summary, the review of the literature reveals, few studies have been conducted to study teacher use of computer-supported instruction in the social studies classroom. However, despite the extensive support for integrating computers into the social studies curriculum, further research regarding the effectiveness of computer integration and its impact on student learning and classroom environment in social studies education is still needed (Berson & Balyta, 2004; Diem, 2000; Martorella, 1999; Nickell et al., 2001; Shaver, 1999; Whitworth & Berson, 2003). Therefore, there is a need to examine the use of computer-supported instruction in the social studies classroom. Nevertheless, it is also important to investigate the exemplary use of computer-supported instruction in the social studies classroom in order to reveal the current and good examples of the uses of computer-supported instruction. Thus, this study may provide valuable views and ideas for social studies teachers and educators about the use of computer-supported instruction and may inspire them to apply this sort of instruction in their classrooms. In order to investigate the exemplary teachers use of computer-supported instruction in the social studies classroom, the following research questions were generated for this research:

1. How do exemplary social studies teachers view the computer as an instructional tool?
2. What are the current computer-supported instructional applications used by the exemplary teachers in their classrooms?
3. How do exemplary social studies teachers use computer-supported instruction in their classrooms?

This study was designed with the intention of analyzing the exemplary use of computer-supported instruction in social studies education so that the findings from the study may be helpful for the discussion and new directions about the more effective computer use in social studies education.

METHODOLOGY

Design of the Study: Qualitative Case Studies

Case study design (Bogdan & Biklen, 1998; Merriam, 1998) is employed for this study to gain an in-depth description, understanding and interpretation of a situation. Moreover, in order to collect data from different perspectives and be able to compare the findings from different settings, I preferred to use a "Multi-case studies" approach that involved more than one subject and setting in the research process (Bogdan & Biklen, 1998; Merriam, 1998; Yin, 2003).

Settings and Participants

Participants and sites were selected based on a "purposeful sampling" approach in which "researchers intentionally select individuals and sites to learn or understand the central phenomenon" (Creswell, 2005, p. 204; see also Ritchie, Lewis, & Elam, 2003). In this approach, samples are chosen based on a set of criteria because they have particular features or characteristics that enable detailed exploration and understanding of a central phenomenon or puzzle which the researcher wishes to study (Ritchie et al., 2003). Thus, the following criteria were developed for the selection of the participant teachers. The participant teachers should be (a) experienced secondary social studies teachers; (b) knowledgeable in computer-supported instruction; (c) using computer-supported instruction frequently.

Along with these criteria, "heterogeneous samples" (Ritchie et al., 2003) or "maximum variation sampling" (Patton, 2002) method was taken under consideration for this study to ensure diversity among the participants and the settings so that participants' perspectives, ideas, and classroom practices can be compared within the various contexts.

According to these criteria, four participants were located by means of a nomination process. Two of the participants (Mike: Pseudonym, David: Pseudonym) were nominated by the social studies education faculty from a Midwestern University in the U. S. Initially I had planned to work with four participants so that I continued to search for social studies teachers who met my selection criteria. As result of this search process, I was able to locate two more social studies teachers. One of them was nominated by a parent who was a doctoral students in the field education at that time (Bill: Pseudonym) and the other participant (Kate: Pseudonym) was nominated by one of the district administrators in her school district. Therefore, the nomination process was completed by means of three different sources for the study: the social studies education faculty, one school administrator, and one parent.

As can be seen from Table 1, two of the selected participant teachers were White males, one of them was an African American male, and the other was a White female. This variety in the teacher's gender and race provided different perspectives and ideas about the use of computer-supported instruction in the social studies classroom. Also, one of the teachers was teaching in a private school whereas the other three were teaching in public schools which contributed to heterogeneous sampling and provided diverse data about private and public school settings. In addition to that, as Table 1 shows all participant teachers were very experienced. Most of them had more than 20 years of experience. Another important factor about the participant was their academic backgrounds. As can be seen from Table 1, the variety in academic background of the participants was also a contributing factor to the heterogeneity of the sample.

Table 1: Demographic information of the participants.

Name (Pseudonym)	Age	Race	Gender	Years of Teaching	Educational Background	Major	School Context
David	47	White	Male	25	B.S., M.A. and Ph.D. work	Social Studies	Public Middle
Bill	52	White	Male	22	B.A., M.A. and Ph.D. work	Social Studies	Private Middle
Mike	43	African American	Male	19	B.A.	Social Studies	Public High
Kate	46	White	Female	24	B.A., M.Ed.	History	Public Middle

Data Collection

Interviews

The four participants were interviewed twice during the data collection period. The first interviews were done in one-on-one and in-depth (unstructured) form (Creswell, 2005).The first set of interviews served exploratory purposes to understand the participants computer use in the classroom. The second set of interviews was

conducted in a structured format and the interview questions were developed by the researcher after analyzing the transcriptions of the first interviews. All interview sessions were audio taped and transcribed.

Table 2: Interview chart.

Name (Pseudonym)	Interview Date−Time	Duration	Place
David	Nov. 10, 05−3:45 pm	46 minutes	In school
Bill	Dec. 06, 05−12:30 pm	33 minutes	In school
Mike	Dec. 14, 05−11:25 am	20 minutes	In school
Bill	Jan. 12, 06−12:45 pm	26 minutes	In school
Mike	Jan. 19, 06−9:30 am	10 minutes	In school
David	Jan. 24, 06−3:10 pm	39 minutes	In school
Kate	Jan. 30, 06−8: 00 am	13 minutes	In school
Kate	Feb. 15, 06−10:30 am	24 minutes	In school

Classroom Observations

The purpose of observation sessions was to monitor the way the participant teachers employ computer-supported instruction and to explore some hints and evidences about the influence of computer-supported instruction on student learning. Therefore, field notes were taken during the classroom observations. Many things were recorded during classroom observations such as the time of students worked on the computers; the names of computer-supported instructional applications or software were used; and even sometimes the Web sites visited by the students. The notes of informal discussions with teachers during these visits were also taken. These conversations were not audio taped rather the summary of them were written after the classroom observations.

Although initially it had been planned to observe each classroom at least for five sessions, the total number of actual classroom observations was around one hundred. As Charmaz (2000) pointed out, the researcher should keep collecting data until the saturation point is reached. Therefore, I increased the number of classroom observation until finding the same data pattern in each individual case. The numbers of classroom observations ranged from 7 to 31 based on the participant's frequency of computer use and the length of instructional units in which the computer was integrated.

Data Analysis

All audio taped interview sessions were transcribed and classroom observation notes typed as word documents. Using NVivo (QSR International, 2002) software program, the data were coded and the codes were grouped similar codes to construct general themes that represent the pattern of the data.

As multi-case studies approach (Bogdan & Biklen, 1998; Merriam, 1998; Yin, 2003) was used for this study, every single case was comprehensively analyzed independently. Once within-case analysis is complete, cross-case analysis begins. In a cross-case analysis, the researcher attempts "to build a general explanation that fits each of the individual cases, even though the cases will vary in their details" (Yin, 2003, p. 121). Therefore, after the contextual variables and data findings for each single case are individually described, I will apply the technique of cross-case analysis and compare all cases to find some patterns and build abstractions that apply across all the cases (Merriam, 1998).

FINDINGS

Case # 1: David (Pseudonym)

Background Information about David and the School Setting

David is a 47 year old White male social studies teacher with 25 years of teaching experience. He completed his bachelor's degree at a Midwestern University in the field of secondary social studies education. He also earned a Master of Arts degree in the field of social studies from a large Midwestern University, and at the time of the study he was a doctoral candidate in the social studies program at the same institution.

The school was a suburban middle school in a Midwestern state. The class was a seventh grade social studies with 12 boys and 8 girls all of whom were White. There were three desktop computers in the classroom for instructional purposes. There was one computer lab in the school building consisting of 30 Macintosh desktop computers and a laser printer. Also there was one mobile lab station with 25 Macintosh laptop computers and one printer. The class was observed by the researcher for 31 class periods. David complained about computer availability and inadequacy of the software programs in his school.

David's Use of Computer-supported Instruction

David believed that the computer was a great instructional tool which enabled easier and faster access to different perspectives and provided opportunities for students to improve their work. While David acknowledged the great benefits of computer technologies, he did not differentiate the computer from any other instructional tools in the classroom. He used the computer when it provided "a faster and deeper connection" (Nov. 10, 05) to information and points of views could not be found in traditional library or text materials. This next excerpt summarized David's view about the computer "… Is it [computer] a panacea to everything? 'No'. Is it another helpful tool? 'Yeah'" (Nov. 10, 05). According to David, there were three main ways to use computer technology in the classroom: (a) information gathering; (b) use in the classroom (presentation tool); and (c) manipulated by students (use of students) (Informal discussion: Nov 28, 05).

The interviews and classroom observations indicated that David integrated the computer in his teaching or "… have the kids working directly on a computer as a part of the class … five or six times a month" (Nov. 10, 05). David used a wide range of computer-supported instruction in his teaching. When he was asked about the most commonly used instructional applications in his classroom he replied "The most common use for me would be the Internet, word processing. It would be for research. It is the vast majority how I use the computer" (Nov. 10, 05). Furthermore, he cited Database development, Web Page development and use of software programs such as Microsoft Excel and Power Point, and Hyperstudio as other sorts of computer-supported instructions in his classroom. In addition, he mentioned a tele-collaboration activity he had been involved in which his students got connected with their counterparts in Ukraine, Poland, and Russia. Although David had experiences with a broad range of computer-supported instructional strategies, only some of them were observed during the classroom observations within "The Historical Figure" project. In the next section, the project and the observed computer-supported instructional activities will be discussed.

The historical figure project

In this project students were to do research on a historical figure and discover three positive character traits they have in common. The requirements were to have at least two Internet sources and one print source to complete the research. Another source of information was the personal interviews. In order to complete the assignment, the students were supposed to write an essay in which they compared themselves to the historical figures. Another part of the assignment was to present their findings in a secondary way beyond the essay. For this part, students created projects in which they compared themselves to the historical figures. The type of project was optional. Students were given a choice of doing either a computer-supported project or other traditional types of project.

The students used the computer lab for Internet search and the school library for print resources in order to find information for their essays and projects. Students used the computer lab for 8 class periods and spent a total of 12 class periods to complete the project.

Internet search

The interviews and classroom observations showed that Internet search was the most common use of the computer in David's classroom. He used the Internet mostly for its reference materials as presenting students with different points of view and ideas. The following excerpt shows how David viewed the role of the Internet in terms of having students involved with diverse perspectives.

> It's [Internet] nice reference area and a good way to look at different points of view and to look at different ideas and I want them to have enough sources that messes their whole idea up because they're going to find sources disagree with one another. (Jan. 24, 06)

During the classroom observations students used the Internet for a minimum of eight class periods for this project. The Google search engine was the most common search engine used among the students. Students found text resources about historical figures that they had chosen. They used that information to write their essay as well as create their project. Many of the students searched on the Internet for pictures of their historical figure. As David pointed out during the Internet search, students encountered many resources that provided different points of view about the historical figures they had chosen.

Word processing

During the classroom observation Microsoft Word was used extensively among the students. Many students used the program during Internet searches. The Word program was used by students as a notebook for note taking. Most of students used copy and paste features of the program when they got information from Internet resources. Even URL's were copied on Word documents by some students. They used those documents like a "scratch

paper" while searching and finding information from the Internet. They put any information relevant to their projects on these Word documents. Then, they read, filtered, and edited the information before they wrote their essays and create their projects.

Students also typed their reference lists for this project using Microsoft Word. They were supposed to create a reference list for the project and David was very strict about the format they were using. He gave them a sheet that showed how references were supposed to be written on the reference list and cited in papers. Students had to use the editing features of the program many times as they corrected their reference lists.

Computer as a presentation tool
David rarely used the computer for presentation purposes during the classroom observations. He usually preferred to use the overhead projector with transparencies for that purpose. However, one time he used the computer for a presentation for this project. He used the computer in order to show the students how to write a reference list based on the format he had given them. He used one of the student's reference list as an example and projected it onto the wall. It was a Microsoft Word document and he corrected the mistakes on the paper using the computer and this software program so that students could see the proper format for the references. Although in the interview he mentioned that he used "it [computer] for instruction through PowerPoint presentations" (Nov. 10, 05) he did not use it with PowerPoint during the classroom observations.

PowerPoint
PowerPoint was another software program used in David's classroom. Almost half of the students preferred to do PowerPoint presentation for this project. The presentations were mostly 4 to 6 slides. The first slide was the title page. The second and third slide were about the historical figures they studied and the following slide was about themselves. The next slide was a comparison of themselves with the historical figures, and the final slide was the bibliography which had been created based on the format given them by David. When students created the slides they used the information they had gathered through Internet searches, print sources, and the personal interviews. Most of them used the notes they took on Microsoft Word documents from Internet searches.

Case # 2: Bill (Pseudonym)
Background Information about Bill and the School Setting
Bill is a 52 years old White male social studies teacher with 22 years teaching experience. He completed his Bachelor's and Master of Arts degrees at a large Midwestern University in the field of social studies education. The school was a private school located in a large city in a Midwestern state. The class was a seventh grade American History class with a population of 10 boys and 9 girls. There were 12 White and seven African American students.

There were four desktops computers in the classroom for the use of the students. Also there was one laptop computer connected to the Smart Board for the instructional purposes. There was one DVD player which connected to the Smart Board. Also, there were 20 PC desktop computers in the computer lab. This class was observed by the researcher for 28 class periods. According to Bill, computers and software programs are sufficient in his school. But it would be better if they are improved.

Bill's Use of Computer-supported Instruction
Bill considered the computer as one of the instructional tools that could be used in the classroom. In both interviews he pointed out this view a number of times. Yet, he acknowledged the great benefits of using computer in the classroom in terms of gathering information and reviewing different resources. He stated that

> I use the computer as a tool. A tool that enables to the students … okay … to become more responsible for gathering information for themselves … rather than, myself, being the sole source of information for the students and rather than the textbook being the sole source of information …okay? the computer opens up whole new world of resources. (Dec. 06, 05)

He also highlighted the advantages of using computers as contributing to the students' project and helping them to work more effectively and easily to accomplish their tasks. He stated that "… projects are made okay much more effective or are … frankly made much easier by using the computer" (Dec. 06, 05). According to Bill, "the computer allows to kids to do so much" and create more opportunities for them through the information accessed to be able construct knowledge.

Although Bill recognized the effectiveness of computer use in the classroom in terms of helping students to create and construct, he clearly drew a line between computer use and the purpose of tasks or projects that

students were assigned to do. On the one hand, he acknowledged the extreme importance of computer use in the classroom; on the other hand, he definitely did not put the computer in the center of his instruction. This statement from the first interview showed his view about the computer as an instructional tool.

> … the computer is not the center of what I do. The computer is just a means … for accomplishing the task. So, the role of the computers… again it's extremely important because it allows so much … to be done. But, the other side of it is I would do the same thing, if I did not have a computer. (Dec. 06, 05)

The classroom observations and the interview sessions indicated that Bill used computers very frequently in his teaching. He stated that

> In one from or another I use the computer everyday. So… whether it is in a from of project such as the kids have just completed or whether simply to put … notes on…the Smart Board, the computer is used everyday in my class. (Dec. 06, 05)

As he reported, the most commonly used instructional applications in Bill's classroom were the Smart Board, Internet search, and use of software programs such as Microsoft Word and PowerPoint. However, during the classroom observation periods, there was not an assignment that required a PowerPoint presentation. Yet, the other computer-supported instructional applications were observed in Bill's classroom through "The Colonial Newspaper Project."

The colonial newspaper project

In this project, students were supposed to produce a newspaper that was set in the colonial period just prior to the American Revolution. The newspaper had to have following sections: an editorial page, classified section, international news section, entertainment section, and at least one cartoon. Students were given a handout that explained the project through the whole process. In this handout, it was highlighted that students were supposed to give "clear expression of the viewpoints of both Patriots and Loyalist". The second handout about the project was the list of events that had to be covered in the newspaper. Another handout given by Bill was a list of some Internet sources about the Colonial Era. The project was a set up as a group project and students were assigned to the groups by Bill.

Smart Board as a presentation tool

As Bill pointed out, using the Smart Board as a presentation tool was the most common use of the computer in his classroom. The next excerpt shows how Bill utilized the Smart Board in his classroom. "Using the computer as a means of activating the Smart Board, placing… information notes onto the Smart Board which are then saved … and are downloaded to a Web site that the students can access later" (Dec. 06, 05).

The classroom observations also showed that Bill used the Smart Board in a variety of ways such as introducing students to the project, and showing them some useful Web sites and sources from the Internet. During the classroom observations, another use of the Smart Board was to use its screen to show students some documentary films. Bill showed the students a set of documentary films about the American Revolution for 10 class periods. The film set was in DVD format and therefore sound and visual effects of the films were at a very high quality.

Internet search

The interviews and the classroom observations indicated that Internet search was one of the most common computer-supported instruction were used in Bill's classroom. During the classroom observations, students were sent to the computer lab to do Internet searches at least for 10 class periods to find resources and information for their newspapers.

While Bill considered the Internet as another important source of information, he did not completely rely on it, and wanted his students to seek other sources of information as well such as textbooks or other print materials. Bill also underlined the validity of the information gathered through the Internet sources. He stated that "... we constantly have to remind them [students] … that simply because it is there, it doesn't mean that it is valid in itself" (Dec. 06, 05). In order to make sure his students check the validity of the information that they gathered from the Internet, Bill suggested that using multiple sources of information. Bill stated that

What we need to do though is to constantly remind them that they need to be able to find multiple sources. They have to confirm information from more than one source before they can begin to consider whether or not is valid. (Jan. 12, 06)

During the colonial newspaper project Bill reminded students several times to check the validity of the information. He asked them to confirm what they have with other sources on the Internet as well as print sources such as their textbooks.

Word processing
Some of the conventional software programs such as Microsoft Word were also among the frequently used programs in Bill's classroom. In the first interview Bill pointed out that writing papers was another common use of the computer in his classroom. He stated that "… Actually the students would write papers … as a part of it as well. … But I have my students… Sixth and seventh grade type most of the formal papers that they do for me" (Dec. 06, 05).

Also the classroom observation notes showed that students used the computer extensively to type their articles and other sections for the newspaper project. Students used several features of the program such as copying and pasting information from the Internet to the Word documents. In the documents students were able to edit the information, rewrite their sections, and use various types of fonts and colors that resembled an authentic Colonial Era newspaper.

Case # 3: Mike (Pseudonym)
Background Information about Mike and the School Setting
Mike is a 43 year old African American male social studies teacher with 19 years of teaching experience. He completed his bachelor's degree in a Midwestern University in the field of social studies education. The school was a suburban high school in a Midwestern state. Mike's two different classes were observed in the same classroom. The first class was 12th grade American Government and the second one was 10th grade American History. There were 12 boys and 12 girls (21 White and three African American) in the American Government class. This class was observed for by the researcher for 19 class periods. There were 12 boys and 11 girls (18 White, four African American, and one Hispanic) in the American History class and it was observed for 11 class periods.

There were 6 desktop and 12 laptop computers in the classroom for Mike and students to use. During the classroom observations either of the classes did not use the computer lab in the school. Although the number of computers seemed to be adequate, students complained about the availability of computers during the classroom observation on a couple occasions. When each student wanted to work individually on the computer, some of the students could not find an available computer to them because the number of computers is less than the number of the students in both classes. Likewise, Mike complained about the inadequacy of the computers and lack of software programs.

Mike's Use of Computer-supported Instruction
Mike believed that "the computer just another tool that allows students to go in depth with their learning; allowing students to be in charge of their own learning; allowing them to experiment and to be more creative" (Dec. 14, 05). While Mike believed that the computer use in the classroom promoted the creativity of the students, he also mentioned that sometimes the computer makes it easier to "…. reach students … especially students who are … visual learners" (Dec. 14, 05).

Mike also mentioned another great advantage of computer technology over traditional methods. According to Mike, computer technology provided students with the ability to edit and read not only textual information but also visual and audio features of their projects. However, it would not be possible for them to edit and read their work if they used traditional types of materials. According to Mike, this feature of computer technology allowed students to do a better job on their projects.

Mike integrated the computer in his teaching frequently. He pointed out that he used the computer on average three times a week. His most common uses of computer-supported instructional applications can be listed as Internet search, Web Page development and use of software programs such as Microsoft Word, PowerPoint and Movie Maker (Microsoft Corporation, 2004). During the classroom observation most of these software programs were used extensively by the students, especially, PowerPoint presentation and Movie Maker which allowed students to create their own videos through the student projects in the both classes. As Mike's two different classes were observed, there were two different projects in which computer-supported instruction had been used.

The projects
The first project was "The City Planning" project (12th grade America Government). This was a group project. Each group consisted of three to five students and students were free to select their group members. Every group was supposed to create a city on their own. One part of the project was to submit a written report about the city including history, landmarks, maps, zoning (laws), economics, schools, and other public buildings. The second part was creating a ten-minute video that introduced the city. Students were allowed to use Internet sources not only to gather information for the written part, but also to find appropriate sound and visual effects for their videos.

The second project was "The World War I Project" (10th grade American History). There were three options for this project: writing a diary, creating a newspaper, or creating a PowerPoint presentation. Except for the newspaper projects, students worked individually. Students or groups were assigned to topics related to WWI by Mike. Students were allowed to use the Internet sources not only to gather information, but also to find appropriate sound and visual effects and even historical videos for their projects.

Internet search
The Internet was being used in Mike's classroom primarily for finding information. While he used the Internet to find primary sources and Web sites for students, he also had the students search on the Internet to find text and visual materials such as images and videos for their projects. Mike gave special attention to the visual and audio materials on the Internet as he believed, "the American public are mostly visual learners" (Jan. 19, 06). Therefore, he would like to have his students use more visual materials in the classroom. All projects in this class were created based on the information acquired from the Internet.

Computer as a presentation tool
The interviews and classroom observation indicated that Mike used the computer as a presentation tool. He usually used Web sites and reflected them on the wall to support his lectures. He stated that

> … Not only can students listen to what I am saying but also they can actually see an example of what I am talking about. If I were talking about a general in World War I, then I'd try to find a visual of that person. (Dec. 14, 05)

During the classroom observations, Mike used the computer as a presentation tool for a number of times especially in the 12th grade American Government class. He reflected on the wall the official Web site of the county, city, and their school districts to show students how the local government works and to introduce the city and county officials such as mayors, governors, or other official figures such as board members of their school districts.

Software─multimedia
Utilizing multimedia types of software was one of the most common instructional strategies used in Mike's classroom. He cited a number of times that his major focus was on multimedia related software programs. He stated that

> I think right now, my most common use of multimedia is bringing video in the classroom and integrating it with a lesson enhancing a lecture. This type of presentation is working because kids today are more visual learners because they're of the TV generation. (Dec. 14, 05)

As indicated in the quotation, the reason why Mike used multimedia types of software in his teaching was his belief that the contemporary American students were mostly visual learners. Movie Maker program was used for the "The City Planning Project" in the American Government class during the classroom observations. Students used Movie Maker software program to edit, add sounds, and other visual effects to their introductory movies about their cities after they had filmed them around town.

Word processing─excel
Microsoft Word and Excel were the most common software programs were used in Mike's classroom. The Word program mostly was used for note taking purposes during Internet searches. In both classes Internet searches were a big part of the projects. Students did Internet searches in both classes and while they found sources, they copied and pasted information on Microsoft Word documents. Then, they processed the information and used it for their projects. In both classes, students typed necessary parts of the projects on the Word documents.

In the American Government class, along with the Word program, Microsoft Excel was also commonly used for projects. In order to complete the written part of the "City Planning" project students were supposed to come up with some statistics about the city such as population, religions, and economics for the city. Therefore, this program was used frequently among the groups in order to create bar charts or pie charts that represented the city statistics.

PowerPoint
PowerPoint was another frequently used software program in Mike's classroom. In the American History class, eight students did PowerPoint projects as they had an option to choose the format of the project. There were a wide variety of topics such as "WWI Tanks", "WWI Weapons", "WWI Personalities" and "Battles of WWI". Students used information and images they had found from Internet resources. There were many images in the presentations such as tanks, weapons and aircraft that had been used in the war. The student added sound and texts to the video which made it stand up for itself. Most of the PowerPoint projects were high quality and met Mike's expectation.

Case 4: Kate (Pseudonym)
Background Information about Kate and the School Setting
Kate is s a 46 year old, White, female social studies teacher with 24 years of teaching experience. She completed her bachelor's degree in a Midwestern University in K-8 teacher education program. She received a Master of Education degree in field of Curriculum & Instruction with emphasis on social studies education from another Midwestern University.

The school was a suburban middle school in a Midwestern state. The class was the eighth grade American History class with 10 boys and 11 girls (19 White and two African American). There were four desktop computers in the classroom for the use of the students and one for the use of Kate. There were three laptop stations in the school for classroom use. Each station consisted of 25 laptop computers and one printer. Kate complained about unavailability of these stations. The class was observed by the researcher for seven class periods. Fewer classroom observations were conducted in Kate's classroom due to limited computer availability in her school. She was only allowed to use computers in her classroom five days a month

Kate's Use of Computer-supported Instruction
Kate considered the computer as an aid for instruction. Kate thought that the computer was a powerful tool that helped gain access to a lot of information. According to her, text materials cannot cover entire topics thoroughly and provide information on many issues related to course of study. She stated that "I just think it is the only way to really get a lot of information. … the Internet is important on getting some expanded knowledge for the students. So, you have to have that" (Feb. 15, 06). She believed that computer technologies gave students alternative "opportunities to go as wide as and as deep as they want to go" (Feb. 15, 06). Along with that, Kate pointed out the importance of computer technologies in providing more advanced presentation tools for students.

Kate's computer integration was less frequent compared to other participants due to the computer unavailability. She stated that "I try to use them [computers] once a nine week in terms of some sort of research" (Jan. 30, 06). Her main computer use with the students was to utilize the computer as a research tool. She also used the computer herself to update school WebPage with student homework and grades. Internet searches and PowerPoint presentations were the most common uses among the students in her classroom. Likewise, students used these two software programs when they created their projects which are explained in the next section.

The "War of 1812" project
During the classroom observation periods, students were working on the "War of 1812 Project". The project was designed as a group project and each group consisted of two-three students. There were 12 topics ─usually individual battles─ about the War of 1812 stated by Kate in the project handout. Students were assigned to the topics based on their choices. Students were supposed to do Internet searches to find information for their projects and create a project either computer-supported such as PowerPoint or traditional type of project such as poster presentation.

Internet search
Internet search was the most common use of computer in Kate's classroom. The following excerpt was a summary of how she used the Internet in the classroom. "… like "the war 1812" each had a topic. They would go in detail about their topic and find not only just information but pictures that would represent that time period any primary sources…" (Jan. 30, 06).

As Kate pointed out during the "the War of 1812" project, students searched the Internet to find information about their projects. They were looking for not only textual information but also for pictures and images that could be used for their projects. Student used search engines ─mostly Goggle search engine─ and type keywords related to their project to find relevant sources of information. So, the Internet was used by students to cerate a base of information for their projects.

Kate preferred to use primary resources from the Internet rather than go and spend time on opinion resources. Therefore, she usually limited students with specific Web sites which consisted of primary sources such as, The Smithsonian or The National Archives. She stated that "…I try to keep with those more than getting into an opinion kind of thing" (Feb. 15, 06).

Word processing
The Microsoft Word program was the second most common computer use in Kate's classroom. During the project, students used this program every day. Most of the students were using the copy and paste features of the program in order to take notes for their project. They were copying and pasting some texts they had found from the Internet and also some pictures and images of the people that they were searching about.

Students who did PowerPoint projects usually used the Word program to edit and adjust the textual information on the documents before transferring their work to a PowerPoint file. Yet, students who did not have computer-supported projects also used the program for note taking, and print functions in order to put them on poster board.

Computer as a presentation tool
Kate used the computer as a presentation tool in the classroom. She used a number of features of the presentation system such as connecting it to the Internet and showed the whole class Web sites rather than have them search information by themselves. Another feature she used was presenting information through this device such as handouts or other type of documents concerning the instructional unit. She highlighted that it was a great feature of computer technology to allow all students to follow lessons. She stated that "It's kind of a nice way to for everybody to be on the same page, so to speak. You know which is pretty big in the middle school because they don't always want to be on the same page" (Feb. 15, 06).

PowerPoint
Although PowerPoint software program was not Kate's favorite program, it was used a lot by her students. According to Kate, mostly students cut textual information from the Internet and tended to put long text on the PowerPoint presentation without editing the information (Informal discussion: Feb. 16, 06). Yet, PowerPoint seemed to be students' favorite software. Kate stated that

> … They [students] love doing PowerPoint. I think it's because it is easy. 'Cut and paste; next screen; cut paste; put a figure in.' … I don't think they utilize much … creativity. I mean you can pick the slide you want; you type your title; you type you know. (Feb. 15, 06)

As Kate pointed out many students used PowerPoint for their projects during the class classroom observations. The problem she indicated was visible on most PowerPoint presentations. Students usually used long textual information on the slides. Even some of the text was not legible. It was clear that they did not do much editing on the information they had retrieved from the Internet. On the other hand, there were a couple of projects that were designed very well. One of them was a recreation of a battle, and the students who did the project added sound and animated images to simulate the battle strategy.

CROSS-CASE ANALYSIS AND DISCUSSIONS OF RESEARCH QUESTIONS

R.Q. 1: How do exemplary social studies teachers view the computer as an instructional tool?

The data analysis indicated that all participants viewed the computer as an instructional tool that facilitates teaching and learning in multiple ways. David mentioned that the computer was a great instructional tool which enabled easier and faster access to different perspectives and provided opportunities for students to improve their work. Bill considered the computer as one of the instructional tools that could be used in the classroom. Mike stressed that the computer just another tool that can promote the creativity of the students. Kate considered the computer as an aid for instruction. Kate thought that the computer was a powerful tool that helped gain access to a lot of information.

While all participants saw computer as another instructional tool and acknowledged its great benefits, especially David and Bill were specifically cited that they do not put the computer in the center of their instruction. They

were aware that it is only another tool and they only used when it is necessary for their instructional design. David stated that he only used the computer when he "could not teach a unit in any other way" (Nov. 10, 05).

As the computer is seen any other instructional tool by the participants, all of them agreed that it is a valuable research tool can provide wide variety of sources and information for the students to help them improve their works. The classroom observations also indicated that students used the computer as a research tool extensively to complete their projects. The students searched on the Internet for visual and textual sources to build various parts of their projects.

R.Q. 2: What are the current computer-supported instructional activities used by the exemplary teachers in their classrooms?

The interviews and classroom observations showed that the participant teachers used a number of computer-supported instructional applications in their classrooms. As table 3 shows, use of the Internet and of software programs such as Microsoft Power Point, Word, and Excel were the most common type of computer-supported instruction in the classrooms observed. In addition, computers were used as presentation tools frequently in these classrooms. Multimedia software was used by only one teacher during the classroom observations. Other strategies listed in the table were not observed during the data collection period, although the participant teachers reported they had had experiences with these applications.

Table 3: Self-reported use of computer-supported instruction by the participants in their classrooms.

	David	Bill	Mike	Kate
Internet	X	X	X	X
Presentation Tool	X	X	X	X
PowerPoint	X	X	X	X
MS Word Excel	X	X	X	X
Multimedia Software	X		X	
Games Simulations				X
Databases	X			
Web Quest				
Web Page Development	X		X	
Tele-collaboration	X			
Virtual Field Trip		X		

The Internet was the most common computer use in the observed classrooms. All participants used the Internet because it provided fast and easy access to a vast amount of resources and information. Along with its fast and easy access to information, most of the participant teachers valued the Internet for its ability to provide global and multiple perspectives to students.

The computer was also frequently used as a presentation tool in the observed classrooms, either by students or by the teachers. All participant teachers used the computer to show Web sites and handouts related to student's projects during the classroom observations. Another form of computer use was to present students' projects. All participant teachers stated that computers were frequently used in their classes for student presentations. There were many PowerPoint projects presented during the classroom observations in all classrooms observed.

Although computers were used as presentation tools frequently by both teachers and students, not much has been written in the literature on this subject. Nevertheless, it seems that there are a number of benefits of using computers as presentation tools. The data showed that when a computer was used as a presentation tool, it not only improved the quality of the presentation's visuals and sound, it also gave the teachers flexibility to use other types of tools with the computer, such as connecting to the Internet or to a DVD player. Clearly, it is not possible to have such flexibility and ease in transferring to another presentation tool with a traditional overhead projector.

Another common type of computer use by the participant teachers was the use of software programs. Only conventional software programs such as Microsoft Word, Excel, and PowerPoint were commonly used in the observed classrooms. However, the data in this study showed that newly developed software programs were rarely used in the observed classrooms. There are a number of reasons for that situation.

The data indicated that a number of factors influenced social studies teachers' computer use in their classrooms. The first factor was the lack of computer and software availability in the schools. The data showed that in the three of the observed schools, computer availability was a factor that kept the teachers from integrating computers more with their teaching, even though the data from the National Center for Education Statistics

(NCES, 2003) showed a rapid increase in the number of instructional computers (an average of 131 instructional computers per school) in American schools.

In addition, the lack of software was a problem in some of the observed classrooms, and it kept at least one participant from using computer-supported instruction more frequently. Nevertheless, most of the participant teachers were not seeking new computer software programs that could be used in the social studies classroom. In fact, due to administrative processes, the teachers did not have much responsibility for choosing software programs or even much effect on which programs were chosen. Another factor influencing social studies teachers' use of computers in their classrooms could be related to lack of time due to curriculum requirements. Two of the participant teachers complained about the time limit and curriculum requirements.

In conclusion, the lack of computers and software, and time issues related to the curriculum seem to be the major problems that prevent the participant teachers from using computer-supported instruction more frequently.

R. Q. 3: How do exemplary social studies teachers use computer-supported instruction in their classrooms?

The study revealed that all four participants cited Internet search among the most common strategies they used in their classrooms. In the interviews all participants stated a number of times how frequently they used the Internet as a research tool. The classroom observations also showed that using the Internet for research was the most common strategy in the classrooms observed. Generally, the teachers had students use the Internet as a research tool to find textual and visual information for their projects.

Teachers' focuses within the strategy of using the Internet for research varied to some degree, yet most of them acknowledged the crucial role of the Internet in terms of providing information to students about multiple perspectives, cultures, and real-world issues. Only, Kate wanted to keep her students from sources that represented opinions; rather, she preferred to use sources that represent "facts and events."

All participant teachers used computers as presentation tools in their classrooms, although how and how often they used them varied. Among all participants, Bill used the computer for presentation purposes most frequently. He cited the Smart Board as the most common use of computers in his classroom. On the other hand, David rarely used the computer for presentation purposes. He generally preferred to use an overhead projector.

Computers were also used to present students' projects. All participant teachers stated that computers were used frequently in their classes for student presentations. Most of these presentations were made with Microsoft PowerPoint. It was one of the most frequently used programs in the classrooms observed. There were not many differences between classrooms in how this software program was used. Students did Internet searches and copied information from the Internet to Word documents so that they could evaluate information, analyze it, and edit it before creating their final PowerPoint projects. Many PowerPoint projects were presented during the classroom observations in all classrooms observed.

In addition, Microsoft Word was one of the most common software programs used in all classrooms. In all classrooms, students used Word documents to type their papers and also as "scratch paper" to take notes, evaluate and analyze information, and edit the information before they created their final projects. The editing feature of the software program was cited by all participant teachers as a great advantage for the students as it prevented them from needing to retype, consequently saving time and thereby helping to improve students' work. According to Mike, this feature of the computer technology allowed students to do better work on their projects. He stated that "The computer allows students to correct … those mistakes; to retype a paragraph; to go back and look at their work … so what is you get is better work from students." (Jan. 19, 06)

In addition, Microsoft Excel was also used by the students in the classrooms observed. Although it was not used as frequently as Microsoft Word or PowerPoint, students used Excel to create databases, tables, and charts for their projects. The data indicated that other software programs were rarely used in the classroom. Mike was the only teacher who used a software program different from those just mentioned. He had students create videos using Windows Movie Maker.

CONCLUSION AND DISCUSSION

The analysis of the data indicated that all participants had similar views about the computer as they did not differentiae it from any other instructional tool. Nevertheless, all of them agreed that the computer is a powerful research tool that facilitates students work and make the work faster and easier for the students.

The participants used the computer in their classroom in many ways and integrated the computer-supported instruction to the units they taught. The use of the Internet for research purposes was the most common type of computer-supported instruction in the classrooms observed. This finding is consistent with the recent literature. A number of studies showed that "Internet use" and "accessing information from the Web" were the most common use of computers in social studies education (Whitworth & Berson, 2003; see also Pye & Sullivan, 2001; Vanfossen, 2000, 2001). Most of the participant teachers valued the Internet for its ability to provide global and multiple perspectives to students. This finding also is consistent with the current literature in the field. A number of studies emphasize the crucial role of the Internet in providing information to students about multiple perspectives, cultures, and real-world issues (see Bennett & Pye, 1999; Cassutto, 2000; Dils, 2000; Hicks et al., 2002; Hicks & Ewing, 2003; Larson, 1999; Risinger, 1996, 1998, 2000, 2001, 2003; Shiveley & VanFossen, 1999, Zukas, 2000).

The computer was also frequently used as a presentation tool in the observed classrooms, either by students or by the teachers. All participant teachers used the computer to show Web sites and handouts related to student's projects during the classroom observations. Another form of computer use was to present students' projects. All participant teachers stated that computers were frequently used in their classes for student presentations. There were many PowerPoint projects presented during the classroom observations in all classrooms observed. Although computers were used as presentation tools frequently by both teachers and students, not much has been written in the literature on this subject. The research focuses on the effectiveness of PowerPoint presentations in undergraduate courses (DenBeste, 2003; see also Bartsch & Cobern, 2003; Frey & Birnbaum, 2002; Susskind, 2005) rather than in K-12 educational settings. Therefore, it is clear that there is a need for more empirical research to investigate the role and effectiveness of computer as a presentation tool and the use of PowerPoint in the social studies classroom.

The use of software programs such as Microsoft Word, and Excel were the other common type of computer-supported instruction in the classrooms observed. In all classrooms, students used Word documents to type their papers and also as "scratch paper" to take notes, evaluate and analyze information, and edit the information before creating their final projects. In addition, Microsoft Excel was also used by the students in the classrooms observed. Although it was not used as frequently as Microsoft Word or PowerPoint, students used Excel to create databases, tables, and charts for their projects. However, there is not much research in the literature about the use of these applications in the classroom. There are few studies on the effectiveness of computer-supported writing activities in social studies (see Berson, 1996). Therefore, it is clear that there is a need for more empirical research to investigate the role of Microsoft Word in preparing student projects in the social studies classroom.

Multimedia software was used by only one teacher during the classroom observations. The data in this study showed that software programs other than Microsoft Word, Excel, and Power Point were rarely used in the observed classrooms. As the data showed there are a number of reasons for that including the lack of computer and software programs, curriculum requirements, and administrative issues. Likewise, the current literature indicated the following barriers which are keeping teachers from not using computer-supported instruction: (a) lack of availability of computers and problems with Internet access; (b) lack of training in how to apply the computer- and Internet-supported instruction in the classroom; (c) lack of time; and (d) lack of funding (Gibson & Nocente, 1999; Keiper et al., 2000; Sunal et al., 1998; VanFossen, 2000, 2001).

It is also important to investigate the influences of outside classroom aspects on computer integration in the social studies classroom. Administrative issues regarding computer and software use in schools can have significant influences on teachers' use of computer-supported instruction. It is very crucial whether school and district administrators support the use of computer-supported instruction in the classroom. Thus, further studies could be done to investigate the school and district administrators' views and attitudes toward computer integration in the classroom.

Finally, both qualitative and quantitative studies could be done to examine effectiveness of a particular computer-supported instructional application such as Web Quest, PowerPoint, or the use of another type of software. I believe that focusing on a particular computer-supported instructional application would provide more in-depth findings to help to examine the effectiveness of these strategies individually. Of course, the findings from that type of research would be more valuable if students were active participants in those studies.

REFERENCES

Açıkalın, M., & Duru, E. (2005). The use of computer technologies in the social studies classroom. *Turkish Online Journal of Educational Technology, 4*(2), 18-26. Retrieved July 26, 2010 from http://www.tojet.net/volumes/v4i2.pdf

Bartsch, R. A., & Cobern, K. M. (2003). Effectiveness of PowerPoint presentations in lectures [Electronic version]. *Computers & Education, 41*, 77-86.

Bennett, L., & Pye, J. (1999). Instructional technology as a medium for learning world history. *International Journal of Social Education, 14*(1), 111-117.

Berson, M. J. (1996). Effectiveness of computer technology in the social studies: A review of the literature. *Journal of Research on Computing in Education, 2*(4), 486-499.

Berson, M. J., & Balyta, P. (2004). Technological thinking and practice in the social studies: Transcending the tumultuous adolescence of reform. *Journal of Computing in Teacher Education, 20*(4), 141-150.

Bogdan, R. C., & Biklen, S. K. (1998). *Qualitative research for education: An introductory to theory and methods* (3rd ed.). Boston: Allyn and Bacon.

Cassutto, G. (2000). Social studies and the World Wide Web. *International Journal of Social Education, 15*(1), 94-101.

Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In N. K. Denzin & Y. N. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 509-535). Thousand Oaks, CA: Sage.

Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2nd ed.). Upper Saddle River, NJ: Merrill.

DenBeste, M. (2003). PowerPoint, technology and the web: More than just an overhead projector for the new century? [Electronic version]. *The History Teacher, 36*(4), 491-504.

Diem, R. A. (2000). Can it make difference? Technology and the social studies. *Theory and Research in Social Education, 28*(4), 493-501.

Dils, A. K. (2000). Using technology in a middle school social studies classroom. *International Journal of Social Education, 15*(1), 102-112.

Freedman, A. (Ed.). (2001). *Computer desktop encyclopedia* (9th ed.) San Francisco: Osborne/McGraw-Hill.

Engle, S. H., & Ochoa, A. S. (1988). *Education for democratic citizenship: Decision making in the social studies*. New York: Teachers College Press.

Fontana, L. A. (1997). Online learning communities: Implications for the social studies. In P. H. Martorella (Ed.), *Interactive Technologies and the Social Studies* (pp. 1-25). Albany, NY: State University of New York Press.

Frey, B. A., & Birnbaum, D. J. (2002). *Learners' perceptions on the value of PowerPoint in lectures.* Pittsburgh: University Pittsburgh (ERIC Document Reproduction Service No. ED 467192).

Gibson, S., & Nocente, N. (1999). Computers in social studies education: A report of teachers' perspectives and students' attitudes. *Computers in the Schools, 15*(2), 73-81.

Hicks, D., Doolittle, P., & Lee, J. K. (2004). Social studies teachers' use of classroom-based and web-based historical primary sources. *Theory and Research in Social Education, 32*(2), 213-247.

Hicks, D., Ewing, E. T. (2003). Bringing the World into the classroom with online global newspaper. *Social Education, 67*(3), 134-139.

Hicks, D., Tlou, J., Lee. J. K., Parry, L., & Doolittle, P. (2002). Global connections: Using the Internet to support citizenship education. *International Journal of Social Education, 17*(1), 93-102.

Jonassen, D. H. (2000). *Computers as mindtools for schools: Engaging critical thinking* (2nd ed.). Upper Saddle River, NJ: Prentice-Hall.

Kausar, T., Choudhry, B. N., & Gujjar, A. A. (2008). A comparative study to evaluate the effectiveness of computer assisted instruction (cai) versus class room lecture (crl) for computer science at ics level. *Turkish Online Journal of Educational Technology , 7*(4), 19-29. Retrieved July 26, 2010 from http://www.tojet.net/volumes/v7i4.pdf

Keiper, T., Harwood, A., Larson, B. E. (2000). Preservice teachers' perceptions of infusing computer technology into social studies instruction. *Theory and Research in Social Education, 28*(4), 566-579.

Kleinedler, S., et al. (Eds.) (2001). *Dictionary of computer and Internet words*. Boston: Houghton Mifflin.

Larson, B. E. (1999). Current events and the Internet: Connecting "headline news" to perennial issues. *Social Studies and the Young Learner, 12*(1), 25-28.

Martorella, P. H. (1999). Technology and the social studies-or which way to the sleeping giant? *Theory and Research in Social Education, 25*(4), 511-514.

Margolis, P. E. (Ed.). (1999). *Random House Webster's computer and Internet dictionary* (3rd ed.). New York: Random House.

Mason, C., Berson, M., Diem, R., Hicks, D., Lee, J., & Dralle, T. (2000). Guidelines for using technology to prepare social studies teachers. *Contemporary Issues in Technology and Teacher Education* [Online

serial], *1* (1). Retrieved October 28, 2004 from http://www.citejournal.org/vol1/iss1/currentissues/socialstudies/article1.htm

Merriam, S. B. (1998). *Qualitative research and case study applications in education: Revised and expanded from case study research in education.* San Francisco: Jossey-Bass.

Milli Eğitim Bakanlığı Talim Terbiye Kurulu Başkanlığı [TTKB]. 2009a. *Sosyal bilgiler 4. - 5. sınıf programı [Social studies curriculum: Grades 4-5]*. Ankara: author. Retrieved November 12, 2009 from http://ttkb.meb.gov.tr/ogretmen/modules.php?name=Downloads&d_op=viewdownload&cid=74&min=10&orderby=titleA&show=10

Milli Eğitim Bakanlığı Talim Terbiye Kurulu Başkanlığı [TTKB]. 2009b. *Sosyal bilgiler 6. - 7. sınıf programı [Social studies curriculum: Grades 6-7]*. Ankara: author. Retrieved November 12, 2009 from http://ttkb.meb.gov.tr/ogretmen/modules.php?name=Downloads&d_op=viewdownload&cid=74&min=20&orderby=titleA&show=10

National Center for Educational Statistics. (2003). *Digest of education statistics*. Washington DC: U.S. Department of Education , Retrieved 14 September, 2005, from http://nces.ed.gov/programs/digest/d03/ch_7.asp

National Council for the Social Studies. (1994). *Expectations of excellence: Curriculum standards for social studies*. Washington D.C.: National Council for the Social Studies.

Newmann. F. M. (1991). Promoting higher order thinking in social studies: Overview of a study of 16 high school departments. *Theory and Research in Social Education, 19*(4), 324-340.

Nickell, P., Field, S. L., & Roach, P. (2001). Trends, issues, and gaps, in technology for elementary social studies. *International Journal of Social Education, 15*(2), 76-91.

Northup, T., & Rooze, G. E. (1990). Are social studies teachers using computers?: A national survey. *Social Education 54*(4), 212-214.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Plaffenberger, B. (2001). *Webster's new world computer dictionary* (9th ed.). New York: Hungry Minds.

Pye, J., & Sullivan, J. (2001). Use of computer-based instruction in teaching middle school social studies. *The International Journal of Social Education, 15*(2), 92-102.

QSR International (2002). NVivo (Version 2.0) [Computer Software]. Doncaster, Victoria, Australia: Author.

Rice, M. L., & Wilson, E. K. (1999). How technology aids constructivism in the social studies classroom. *The Social Studies, 90*(1), 28-33.

Rice, M. L., Wilson, E. K., & Bagley, W. (2001). Transforming learning with technology: Lessons from field. *Journal of Technology and Teacher Education, 9*(2), 211-230.

Risinger, C. F. (1996). Global and international education on the World Wide Web. *Social Education, 60*(7), 447-448.

Risinger, C. F. (1998). Global education and the World Wide Web. *Social Education, 62*(5), 276-277.

Risinger, C. F. (2000). Teaching social issues using the Internet. *Social Education, 64*(7), 455-457.

Risinger, C. F. (2001). Teaching about terrorism, Islam, and tolerance with the Internet. *Social Education, 65*(7), 26-427.

Risinger, C. F. (2003). Teaching about war and peace with the Internet. *Social Education, 67*(3), 175-176.

Ritchie, J., Lewis, J., & Elam, G. (2003). Designing and selecting samples. In J. Ritchie & J. Lewis (Eds.), *Qualitative research practice: A guide for social science students and researchers* (pp.77-108). Thousands Oaks, CA: Sage.

Rose, S. A., & Fernlund, P. M. (1997). Using technology for powerful social studies learning. *Social Education 61*(3), 160-166.

Saye, J. W., & Brush, T. (1999). Student engagement with social issues in a multimedia supported learning environment. *Theory and Research in Social Education, 27*(4), 472-504.

Shaver, J. P. (1999). Electronic technologies and the future of social studies in elementary and secondary schools. *Journal of Education, 181*(3), 13-40.

Shiveley, J. M., & VanFossen, P. J. (1999). Critical thinking and the Internet: Opportunities for the social studies classroom. *The Social Studies, 90*(1), 42-46.

Sunal, C. S., Smith, C., Sunal, D. W., & Britt, J. (1998).Using the Internet to create meaningful instruction. *The Social Studies, 89*(1), 13-17.

Susskind, J. E. (2005). PowerPoint's power in the classroom: Enhancing students' self efficacy and attitudes [Electronic version]. *Computer & Education, 45,* 203-215.

VanFossen, P. J. (2000). An analysis of the use of the Internet and world wide web by secondary social studies teachers in Indiana. *International Journal of Social Education, 14*(2), 89-109.

VanFossen, P. J. (2001). Degree of Internet/www use and barriers to use among secondary social studies teachers [Electronic Version], *International Journal of Instructional Media, 28*(1), 57-74.

VanHover, S. D., Berson, M. J., Mason-Bolick, C., & Owings-Swan, K. (2004). Implications of ubiquitous computing for the social studies curriculum. *Journal of Computing in Teacher Education, 20*(3), 107-111.

VanSickle, R. L., & Hoge, J. D. (1991). Higher cognitive thinking skills in social studies: Concepts and Critiques. *Theory and Research in Social Education, 19*(2), 152-172.

White, C. (1997). Technology and social studies: An Introduction. *Social Education 61*, 147-148.

Whitworth, S., & Berson, M. J. (2003). Computer technology in the social studies: An examination of the effectiveness literature (1996- 2001). *Contemporary Issues in Technology and Teacher Education, 2*(4), 472-509.

Yin, R. K. (2003). *Case study research: Design and Methods* (3rd ed.). Thousand Oaks, CA: Sage.

Yusuf, M. O., & Afolabi, A. O. (2010). Effects of computer assisted instruction (cai) on secondary school students' performance in biology. *Turkish Online Journal of Educational Technology, 9*(1), 62-69. Retrieved July 26, 2010 from http://www.tojet.net/volumes/v9i1.pdf

Zukas, A. (2000). Active learning, world history, and the Internet: Creating knowledge in the classroom. *International Journal of Social Education, 15*(1), 62-79.

HYPOTHESIZED LEARNERS' TECHNOLOGY PREFERENCES BASED ON LEARNING STYLE DIMENSIONS

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ABSTRACT
If students are demotivated, confused and look tired in class, one solution is to use new teaching styles in your class to overcome such problems. This is because learners learn in different ways such as hearing, seeing, taking notes, imagining and visualizing, among many others. The paper reports firstly, the impact of teaching and learning style preferences and their match or mismatch on learners' achievement and secondly, the proposed technology preferences for learners based on learning styles dimension. To obtain the data, the Index of Learning Styles was used together with observations and interviews to collect data. The participants were 4 lecturers and 310 students in an English major program in Iran. The findings from this study suggest that it is crucial for teachers to have knowledge about learner preferences in their classes to consider in their teaching design. The students show a positive response and higher achievement when their learning preferences and needs are accommodated by their lecturers. Based on findings, it is hypothesized that the different learning styles dimensions have their own preferences in terms of technology usage.
Key words: Learning styles, teaching styles, match, mismatch, achievement, technology

INTRODUCTION

Have you ever faced the situation that the students are bored in your class? They are demotivated, confused and look tired. If so, it is time to look for the solution in the form of a new teaching style in your class. Learners learn in different ways such as hearing, seeing, taking notes, imagining and visualizing among many others. These ways or tactics are called learning styles. Much research has been done on learning styles in recent years (Armstrong & Mahmud, 2008; Coffield, Moseley, Hall, & Ecclestone, 2004; Demirbas & Demirkan, 2007; Garcia, Amandi, Schiaffino, & Campo, 2007; Herbert & Stenfors, 2007; Hyde, 2007; Kayes, 2007; Li, Chen, & Tsai, 2008; Reynolds & Vince, 2007; Welsh, Dehler, & Murray, 2007; Sievers, 2007). What is the impact of each of these learning styles on university students' learning? This basic question opens our vision to the vast area of learning style research. A sizable body of empirical research suggests that students learn best when they are taught in ways that match their way of learning (Lovelace, 2005; Mahlios, 2001; Ogden, 2003; Stanberry & Azria, 2001). Does this mean that we should adapt our teaching to fit student learning styles? The sample in this study consists of 310 English Major Students (EMSs) and four lecturers teaching in a faculty of foreign languages. The Index of Learning Styles (Felder & Soloman, 2006), scheduled interview and observation were used as the instruments. This research aimed at investigating the impact of teaching and learning style preferences and their match and mismatch impact on learners' achievements and also this study tries to hypothesize the technology preferences for each learning styles dimension.

Findings of studies done in the realm of the language learning indicated that a) students do learn differently from one another; b) learner's performance in different subject is related to their learning styles c) when students are taught with their preferred techniques or styles in learning their achievement is increased (DeBello, 1985; Dunn et al., 1986).

Learning Styles Preferences and Educational Technology

There are different nature for learning concept in majority of educational environment, traditional learning and learning influenced by technology. In traditional learning, the teacher delivers the pre-determined lesson to students. This kind of delivery is done under different forms,

a. Lectures; teacher explains the knowledge to the students.

b. Exercises; learners apply the new learned items via some controlled tests. c. Feedback/Assessment; it will inform the students how proper they have used the acquired knowledge.

The end product of this kind of learning is the development of some of the skills such as social skills that is a necessary pillar for all members of the society. Opposed to this traditional learning, there is another kind of learning which is learning influenced by technology. Conducting the learning merged with technology is considered as a new trend in the educational environment. Pudichery (2003) believed that technology or in other words World Wide Web has been playing the important role in education world during the last decades. It is true that technology/net offers huge amount of information, it also "resemble an untamed jungle for those seeking knowledge on a particular subject".

Society is facing the rapid transform as the technology is progressing in our life; however, education is not a process which ends when we graduate high school or university. Instead we are all required to practice lifelong learning to be update with the technology changes and improvements. Therefore it is considerable to use the technology in field such as education to facilitate the student's learning. Akpinar, Bayramoglu.(2008) stated that "Technology based teaching and learning materials became more common in educational settings. To provide an information source for teachers, administrators, students and parents." Considering the fact mentioned by Akpinar, Bayramoglu (2008), still in some of the countries the traditional learning and instruction is practiced. However, researches indicated that the E-learning concept regarding the learner's preferences consideration is in infancy stage in most of the educational setting.

In a study done by Yaghoubi, Mohammadi, Iravani, Attaran and Gheidi (2008), it is indicated that technology in education considered as the new concept in Iran and only few educational institutional have introduced these techniques. They stated that technology concept in Iran is 5 to 6 years old. This system has been introduced /provided by both private and governmental bodies in some of the universities in Iran (Yaghoubi et al., 2008).

White (2007) believed that internet is considered as the primary source used by the students to obtain the information. He also found out that the learners used the websites such as Google and Wikipedia excessively. However, accessibility of the different tool of the technologies such as high band, wireless and other devices has developed the E-learning implementation possibilities in different educational setting (Sharples, 2000).

One of the important key points is to evaluate how appropriate/suitable the technologies meet the needs of the learners. Technology infusion, the context and classroom quality are the sub categories of the huge learning issue merged with technology. Having knowledge about learners' need and learning concept are important factors in order to choose the proper technology to nourish their need in educational field. The most proper and successful learning settings are those that are up to date with the 21 century development and are aligning with the information age. There are ways and suggestions for improving the learning in the classroom environment whether in a traditional or an E-learning classroom environment. (One of the ways that sounds practical is to design system, program or lesson plan that consider the learner's preferences.) McKenzie (2001) suggested that the schools and universities must consider learners preferences when designing the curriculum and also focus on activities that support technology merged with the education. Some studies have looked at the learning styles preferences among the technology graduate students (Hogan, 2009) to investigate the preferences of the students in order to empower the learning. Felder, Felder, and Dietz (2002) believed that mismatch between the instructions and learning preferences is one of the causes for low performance and student demotivation.

Match and Mismatch?

Finding of studies on English language learning indicated that in order to be effective ESL/EFL teachers, one should have knowledge about the learners' learning needs, individual differences in learning, the required teaching methods, learners' preferences as well as the necessary teaching materials required to meet learners' needs in the educational setting (Bain, 2004; Beck, 2001; Bull & Ma, 2001; Felder & Spurlin, 2005; Li et al., 2008; Rayneri, Gerber, & Wiley, 2006; Woolfolk Hoy & Murphy, 2001; Zhang, 2006).

More specifically, recently, emphasis has also been paid to teaching and learning styles. Most of the research on teaching and learning styles has been cross-sectional in nature; many deal with the learning styles of students in higher institutions of learning. Frequently the studies focus on how demographic variables such as gender, age, university major, and personality influence learning styles (Brew, 2002; Li et al., 2008). The learning style concept must be studied in depth for three main reasons. Firstly, based on many studies, it is clear that learners have their own preferences regarding learning, and, in some cases, certain types of psychological characteristics are associated in certain "types" of individual (Smith, 2002; Stevenson & Dunn, 2001). Secondly, there is evidence showing that the attempt to provide different learning styles may help learners achieve better results (Bull & Ma, 2001; Rayneri et al., 2006). Finally, teachers should know how to develop a classroom methodology that is based on students' learning style preferences. There have also been studies on the matching and mismatching of teaching and learning styles (Beck, 2001; Zhenhui, 2001).

Research on learning styles in particular on L2 learning is still very much limited (Peacock, 2001). Research on learning and teaching styles and specifically the match or otherwise between them is still very much under-researched in ESL and EFL. The findings of some studies propose that mismatches often occur and have bad effects on students' learning and attitudes (Jones, 1997; Littlewood, Liu, & Yu, 1996). The findings of past studies explained that a learner's achievement in any class is determined by factors such as native ability, and the level of congruence between learners' learning styles and teachers' teaching styles.

Many studies (Bull & Ma, 2001; Rayneri et al., 2006) have been done to investigate the relationship between learning style and academic achievement. Matching and mismatching between teaching and learning styles exist in any academic setting, at least to a certain extent. Some studies have also found that congruence (matching) between teaching and learning styles has a positive impact on achievement and satisfaction (Felder, Felder, & Dietz, 2002). A mismatch is said to occur when students' preferred methods of processing information are not aligned with the teachers' preferred styles of teaching. Felder and Spurlin (2005, p. 2) stated:

> When mismatches exist between learning styles of most students in a class and the teaching style of the professor, the students may become bored and inattentive, do poorly on tests, get discouraged about the courses, the curriculum, and themselves, and in some cases change to other curricula or drop out of school. (p. 2)

Universities in Iran are also places in which English is taught in a range of independent fields of study, such as English language and literature, teaching English as a second /foreign language and English translation. The students in these fields are referred to as English Major Students (EMSs). A majority of EMSs in Iran have a certain degree of capability in the use of the English language but there are some students who have low proficiency. Every EMS goes through two years of training that covers general English, which is about the four main skills of reading, listening, writing and speaking. In the next two years, the students focus on their specialized course of study. Some of the learners have problems in grasping the contents and concepts of the course given in English and this seems to be one of the problems that EFL students face in Iranian universities. One possible reason for this is the inability or weaknesses of the students in English language basics. As such, the students may not do well academically. However, even if the students pass their courses, it is not an indication that they have attained an acceptable level of proficiency in English. According to Farhady, Jafarpur, and Birjandi (1994), after passing their core courses and graduating, Iranian EFL graduates are found to be still wanting in English language use and its components. The teaching of English is growing so fast in Iran that there is a need to understand the mechanics involved in the teaching and learning of English in Iran. Currently there is a lack of research in this direction; in particular, there is a dearth of research with regard to teaching and learning styles of EFL learners and almost none on the match or mismatch of teaching and learning styles and their impact on achievement.

Many learning style specialists (Sarasin, 1999; as cited in Klein, 2003; and Ford & Chen, 2001; Peacock, 2001; Woolhouse & Blaire, 2003; Zhang, 2006) confirmed the theory that students will learn more and will enjoy the class experience and environment when they can use their preferred learning styles. In some cases, students are blamed when the classroom activity is not compatible with their way of learning. In a very recent study, Mulalic et al. (2009) suggested that:

> Teaching and learning styles should become one of the greatest interests of the educators particularly their relationship. However, one of the weaknesses of the research into LS is the lack of the investigation into the matching of teaching and learning styles. Theoretically, many variables exist in the educational literature but few researches dealt with the matching of teaching styles and learning styles (p. 102).

Bonham (1989) cited in Ruhnau (2006) proposed a solution for this situation, that is by selecting the teaching approach which will "match" different learning styles. Even though this approach sounds practical in theory, considering the diversity of student learning styles in the "real world" it is not practical within the classroom. Another solution is to identify the learners' learning styles preferences and then assist them to widen their learning styles and develop their "learning comfort factor" (Bonham, 1989, cited in Ruhnau, 2006).

OBJECTIVES AND RESEARCH QUESTIONS

The objective of this study was to explore the impact of teaching and learning style preferences and their match or mismatch on learners' achievement in Azad University, Iran. The study is based on the belief that appropriate

teaching styles that are aligned with students' learning preferences can improve student achievement. On the minor scale, previous studies on teaching styles/ learning styles have been reviewed in order to explain the link which may exist between the two variables and its relationship with technology preferences in classroom setting. This study attempted to answer the following questions:

R1

a. What are the teaching style preferences of EMSs lecturers and learning style preferences of EMSs learners in a university classroom setting in Iran?
b. Does the match or mismatch of teaching and learning styles impact on the achievement of EMSs learners in a university classroom setting in Iran?

R2

a. What are the hypothesized students technology preferences based on their learning styles preferences?

METHOD

The research method used for this study is the mixed method approach to look at the impact of the congruence and incongruence between the teaching styles and learning styles in the classroom setting and the level of its impact on learner achievement. This study also hypothesized the technology preferences for each preferred learning style dimension. The objective of this study is to explore and investigate the outcome of the congruence and incongruence between the teaching and learning styles on EMSs learners' achievements in Iranian universities. The independent variables of this research are teachers' teaching styles and learners' learning styles that were measured through the ILS (Index of Learning Styles) developed by Felder and Silverman (1988), interview and observation. The dependent variable is student achievement, which is measured through their final exam marks. In the first round of research the researcher used the survey to obtain the variety of the students' learning styles and their teachers' teaching styles. In the second round, the researcher used interview and observation to provide the necessary information for the related research questions and also to strengthen the results obtained in the first round of data collection.

Instruments

Three instruments were used in this study: First is the Index of Learning Styles (ILS) (Felder & Silverman, 1988) for identifying the student's and teacher's learning styles. The survey instrument used was the Learning Styles Index (LSI) developed by Felder and Soloman (2006). Felder and Spurlin (2005) reported a reliability score of .77 using the Cronbach's alpha statistical technique for this instrument. In another unpublished study, Felder and Spurlin (2005) and Livesay et al. (2002) that was conducted on 584 learners at North Carolina State University, the reported Cronbach's alpha coefficient for the index of learning styles was .76 . Second is observation as a technique to complement a dominant technique. Third is the iInterview schedule for semi-structured interviews in order to obtain the necessary information about the preferences concerning the instruction and learning styles. To ensure the plausibility of the interview, the interview responses were checked back and identified to the participants.

Sample

The sample consisted of 310 EFL learners and 4 lecturers from one of the universities in Iran, where the education system requires students to learn English as one of the foreign languages. The learners were selected randomly from the various courses conducted in English. Four lecturers from the courses were also involved in the study. The lecturers were selected based on their willingness to participate in the study. All the students were native speakers of Persian, all of whom intend to be teachers/translators/linguists/ of English at the different levels or enter a field where expert use of the English language is required. The final score of that particular subject in the class was observed and considered as the scale for the student's achievement level. As the survey method advances, the attention is drawn to proper sampling techniques and analysis. Since this study involves 310 students and 4 teachers, the questionnaire survey is the best data collection method available for describing and analyzing the number of participants who are considered a group which is too large for direct observation.

Data Analysis

All responses from the questionnaires survey will be statistically analyzed and organized to offer answers to the research questions. Descriptive and inferential analysis of the quantitative data will be examined using the Statistical Package for the Social Sciences (SPSS).

Descriptive statistics such as means, standard deviations, frequencies, and percentages will be analyzed for variables including gender, age, learning styles and teaching styles. Several types of statistical testing will be conducted using the SPSS for inferential analysis. Pearson correlation will be conducted to measure the extent of correlation between ILS and teaching style preference results. The chi-square tests will be used to determine

whether two variables, for example learning style preference and age, were independent of each other. Analysis of variance (ANOVA) will be adopted to test for significant differences between means in order to compare and analyze variables. The main aim of these analyses is to investigate the issues in relation to student learning style preferences among EMSs learners as well as their teachers. Relationship between age, gender, parents' educational background and learning style preferences, relationship between learning style and teaching style preference will be explored.

As mentioned earlier, the findings of this study will determine the effective teaching based on individual differences among the EFL students in Iran. Literature review on learning styles recommends that there are two approaches regarding the matching of learning styles and teaching styles. The results of many studies implied that students learn more effectively when they are taught according to their learning style preferences and therefore, it is more practical to identify the learners' learning styles. According to Kaur (2003), when there is a lack of a relationship between the learners' preferred learning style(s) and the teachers' style(s), the class may not be useful for the students.

The following studies discussed the match and mismatch between the learning styles and teaching styles: Kovacic (2008), Peacock (2001), Demirel (2004) and many more believed that learning is more effective when there is a match. On the other hand, Glass (1967) and Montgomery (1972) discussed that effective learning can be achieved only when there is mismatch between learning styles and teaching styles. This study will also look at the level of the match and mismatch between the teaching styles and learning style and the impact of this match on student achievement. Learning style is considered as a general pattern while teaching style is considered as more specific for the language teachers.

RESULTS

Students Learning Style Preferences and Comparison in Achievement Scores between Matched Teaching-Learning Styles with Mismatched Teaching-Learning Styles were analyzed across all four dimensions of the Learning Style Pairs (LSP) in the Learning Styles Index. There are four dimensions in the learning styles index which are (a) Active/Reflective (LSP1) (b) Sensing /Intuition (LSP2) (c) Visual/Verbal (LSP3) and (d) Global/Sequential (LSP4). The results of the study showed that the dominant learning styles of EMS students in Azad University for the LSPs respectively are Active, Sensing, Visual and Global. In order to determine the impact of match and mismatch of teaching and learning styles on student achievement, learners were categorized into five groups. The recoded variable was called Match. For learners whose learning styles matched their teachers' teaching styles across all four LSPs, Match = 4, indicating that their learning styles had a perfect match with their teacher's teaching styles across all the four LSPs. Similarly, if a learner matched his or her teachers' learning style in three of the four LSPs, the learner was categorized into Match group 3, indicating that the learner matched his or her teacher's teaching style in three of the four LSPs. If there was complete mismatch between learners's learning style and his or her teacher's teaching style across all four LSPs, the learner was categorized into Match group 0. Based on the categorization above, there were five groups under the variable Match. A one-way analysis of variance (ANOVA) was performed to determine if there were significant differences between the groups in the achievement scores. Table 1 shows the results of the Tukey HSD post-hoc multiple comparisons.

Comparison in Achievement Scores Between Matched Teaching-Learning Styles With Mismatched Teaching-Learning Styles Across All Four Dimensions Of The Learning Style Pairs (LSP) In LSI

The means and standard deviations of the achievement scores for the five groups are as shown in Table 1. Table 2 shows the results of the one-way ANOVA. Table 3 shows the results of the Tukey HSD post-hoc multiple comparisons.

Table- 1: Means and Standard Deviations of Achievement Scores for the Match Groups

Dependent Variable	Match Group				
	0	1	2	3	4
Achievement Scores	13.47	14.00	14.78	16.79	17.57
Mean	2.69	3.06	3.35	2.16	1.97
S.D.	18	27	61	136	68
N					

Table- 2: One-way Analysis of Variance on Achievement Scores for the Match Groups

Dependent Variable	Source	Sum of Squares	df	Mean Square	*F*	*p*
Achievement Scores	Between gps	562.04	4	140.51	22.22	.00*
	Within gps	1928.41	305	6.32		
	Total	2490.45	309			

*significant at $p < .05$

As can be seen from Table 1, the mean achievement scores for Match Groups 0, 1, 2, 3 and 4 are 13.47, 14.00, 14.78, 16.79 and 17.57 respectively. The results of the one-way analysis of variance, as can be seen from Table 2, showed a significant difference in the means, $F(4,305)=22.22$, $MSE = 6.32$, $p = .00$. Post-hoc multiple comparisons using the Tukey HSD tests showed significant differences between Match Group 0 with Match Groups 3 and 4, *MD* (Mean Difference)=-3.32, $p = .00$ and *MD*= -4.10, $p = .00$ respectively. Significant differences were also recorded for Match Groups 1 and 2 with both Match Groups 3 and 4. However, no significant differences in achievement were found amongst Match Groups 0, 1 and 2 or between Match Groups 3 and 4. The results indicate that Match Groups 3 and 4 outperformed the other Match Groups in achievement scores but their performance did not differ from each other. In short, the results imply that generally if teaching styles are matched to learning styles, achievement of students will be significantly better perhaps up to a point. The results in this study are consistent with those in past studies (for example, Ester, 1994; Felder, 1988; Goodwin, 1995; McDonald, 1996) where it was found that when teaching and learning styles are matched for individual LSPs, performance would be much better than if they were not. The results of this study revealed that connecting learning styles and teaching styles in EFL classes in Azad University plays an important role in student achievement. The results of the observation and interview support the results of the first part of the study which stated the fact that when there is a match between the learning styles and teaching styles in the classroom environment, it will optimize the learning task.

Table- 3: Tukey post-hoc Comparisons on Achievement Scores for the Match Groups

Dependent Variable	(I) GROUP	(J) GROUP	Mean Difference (MD) (I-J)	*p*
Achievement Scores	Match Group 0	Match Group 1	-0.53	.96
		Match Group 2	-1.31	.30
		Match Group 3	-3.32	.00*
		Match Group 4	-4.10	.00*
	Match Group 1	Match Group 2	-0.78	.66
		Match Group 3	-2.79	.00*
		Match Group 4	-3.57	.00*
	Match Group 2	Match Group 3	-2.01	.00*
		Match Group 4	-2.79	.00*
	Match Group 3	Match Group 4	-0.78	.23

*significant at $p < .05$

The results in this study are also consistent with those of other studies (Felder & Spurlin, 2005; Peacock, 2001; and Bonham, 1989, cited in Ruhnau, 2006) where it was found that when teaching and learning styles are matched for individual LSPs, performance would be much better than if they were not. Based on the findings above the technology preferences of the students were listed. Table 4 display the hypothesized technology preferences of Iranian students based on their dominant learning styles.

Table- 4: Hypothesized Technology Preferences of Based on Learning Styles Preferences

LS Dimensions	LS dominant in Iran	Learning styles characteristics (Felder and Soloman)	Suggested technology preferences for Iranian learners based on their LS dimension
Active/Réflective	Active	-Hands on practice. - Finding the quick solutions to the problem.	-Design online project which deals more with group work -Providing the program which gives the students the chance for designing
Sensing/Intuitive	Sensing	-Like learning facts -Interested in discovering the possibilities and relationship -Innovative -Tend to be practical -Like to be test on things that have not been covered in class -Do not like the subjects that have no connection to the real world -Like solving problems using well-established methods; -Enjoy courses that have connections to the real world	-Program that visualize real life problem (Connecting information to real life) -E -Portfolio -Program which needs evaluation -Concept Mapping -Designing or improving blogs -Program which help them to have a mind map -Guidelines styles
Visual/Verbal	Visual	-Using books and workbooks -Prefer reading than listening -Remember information by looking at them -Like color on the page, they learn better by using different colors -Like Creative text (fancy) -Like to work in silence or quiet place -They must visualize the information in their mind therefore they can retrieve them faster -Love to take notes while reading	-Pictures, Illustration and Diagrams -Posters, Cartoons, Slideshow, Animation , -Films and Videos Collages,Flowcharts,Coloring Text -Graphs and Charts, Maps -Electronic Flash Cards -Computer interfaces -Film -Video -Audio lesson
Sequential/Global	Global	- Feel comfortable with large jumps -Quick problem solver -Skimming through the entire chapter to get an overview before starting to study specific information -Relating the subject to things already known - Like to see big picture before detail - Large jump, context of the subject - Come up with the bigger picture - Provide all the possible solution	-Build products -Ambiguous situation

RECOMMENDATIONS AND IMPLICATIONS

Based on the findings of this study, the following recommendations can be drawn:

1. If better learning style inventory test and better data collection instruments can be developed, the research performed in this study should be replicated to determine if the lack of significance seen in this study was a true representation of the current relationship between learning styles and teaching styles and its impact on student achievement, or if the lack of significance seen was the result of errors in the design or procedures of the study.

2. If the future researches find a positive correlation between the teaching styles and learning styles and student achievement in class, it will only answer half of the question. The other half is the issue of teacher acceptance and willingness toward this. Further research should be pursued to determine whether the level of benefit derived from matching the learning styles and teaching styles and its impact on student achievement within a university classroom setting compensates for the increased burden on the teachers.

3. It is not the intention of this study to argue that Iranian EFL lecturers should strive for completely one to one lecture style or individualized instruction which sounds impractical due to the classroom size they teach. However, it does suggest that educators at all levels can and should adapt their teaching to better meet the learning style preferences of the majority of their students.

4. Friedman and Alley (1984) recommend that students can identify and utilize their preferred learning styles and take advantage of those preferences under their teacher's guidance. Grasha (1972) suggests that when the teacher is sharing the versatility of learning styles by picturing those styles in their teaching styles, it may assist the learners in fulfilling their tertiary education demands. Furthermore, considering the fact that one of the crucial goals of instruction is to assist the learners in identifying and evaluating their learning styles, the idea of conducting action research besides considering the students' learning styles as one of the teaching program major components sounds practical and beneficial. This will give teachers the chance to see the benefit of using the different teaching styles in their class and its impact on student learning.

In brief, many studies have discussed learning styles and teaching styles and a growing body of literature addresses and evaluates learning styles. Based on the results of this study, the first implication is the possibility of academic success growth by addressing the learner's needs in the teaching plan. The second implication is the importance of the congruence between the learning styles and teaching styles in the classroom in facilitating the student's educational growth. Considering the fact that technology is developing very fast and that it influences all aspects of life especially education, it is advisable for the teachers and policy makers to consider facilitating the learners' need in the E- learning environment. It is predictable that in future the majority of classrooms will turn into e-learning environments; therefore it is advisable to consider the learners' needs and preferences in lesson design in order to let learners get the most from the classroom.

REFERENCES

Akpinar, Y., & Bayramoglu, Y. (2008). Promoting teachers' positive attitude towards web use: A study in web sitedevelopment. *The Turkish Online Journal of Educational Technology*, 7(3).

Armstrong, S., & Mahmud, A. (2008). Experiential Learning and the acquisition of managerial tacit knowledge. *Academy of Management Journal*, 7(2), 189-208.

Bain, K. (2004). *What the best college teachers do*. Cambridge, MA: Harvard University Press.

Barbe, W. B., & Milone, M. N., Jr. (1980). Modality. *Instructor*, 89(6), 44-46.

Beck, C. R. (2001). Matching teaching strategies to learning style preferences. *Teacher Educator*, 37(10), 1-15.

Bonham, L. A. (1989). Using learning style information, too. In E. Hayes (Ed.), *Effective teaching styles* (pp. 29-40). San Francisco, CA: Jossey-Bass.

Brew, C. R. (2002). Kolb's learning style instrument: Sensitive to gender. *Educational and Psychological Measurement*, 62(2), 373-90.

Bull, S., & Ma, X. (2001). Raising learner awareness of language learning strategies in situations of limited resources. *Interactive Learning Environments*, 9(2), 171-200.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review. Retrieved from http://www.lsda.org.uk/files/PDF/1543.pdf

DeBello, T. (1985). A critical analysis of the achievement and attitude effects of administrative assignments to social studies writing instruction based on identified eighth grade students' learning style preferences for learning alone, with peers, or with teachers. *Dissertation Abstracts International*, 47, 68A.

Demirbas, O. O., & Demirkan, H. (2007). Learning styles of Design students and the relationship of academic performance and gender in Design education. *Learning and Instruction*, 17, 345-359.

Demirel, Y. (2004). Effective teaching and active learning of engineering courses with workbook strategy. In *Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition*. Retrieved from http://www.uwe.ac.uk/bbs/trr/Issue3/Is3-1_5.htm

Dunn, R., Della Valle, J., Dunn, K., Geisert, G., Sinatra, R., & Zenhausern, R. (1986). The effects of matching and mismatching students' mobility preferences on recognition and memory tasks. *Journal of Educational Research*, 79(5), 267-272.

Ester, D. P. (1994). CAL, lecture, and student learning style: The differential effects of instructional method. *Journal of Research on Computing in Education*, 27(2), 129-140.

Farhady, H., Jafarpur, A., & Birjandi, P. (1994). *Language skills testing: From theory to practice*. Teheran: SAMT Publications.

Felder, R., & Soloman, B. (2006). Index of Learning Styles (ILS). http://www2.ncsu.edu/unity/lockers/users/f/felder/public/ILSpage.html

Felder, R. M. (1988). How students learn: Adapting teaching styles to learning styles. In *Proceedings, Frontiers in Education Conference*, ASEE/IEEE, 489. Santa Barbara, CA.

Felder, R. M., Felder, G.N., & Dietz, E.J. (2002). The effects of personality type on engineering student performance and attitude. *Journal of Engineering Education*, 91, 3-17.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering Education*, 78(7), 674-681 with author's preface - June 2002. http://www.ncsu.edu/felder-public/Papers/LS-1988.pdf

Felder, R. M., & Spurlin, J. E. (2005). Applications, reliability and validity of the Index of Learning Styles. *International Journal of Engineering Education*, 21(1), 103-112.

Ford, N., & Chen, S. Y. (2001). Matching/mismatching revisited: An empirical study of learning and teaching styles. *British Journal of Educational Technology*, 32(1), 5-22.

Friedman, P., & Alley, R. (1984). Learning/teaching styles: Applying the principles. *Theory into Practice*, 23, 77-81.

Garcia, P., Amandi, A., Schiaffino, S., & Campo, M. (2007). Evaluating Bayesian Networks' precision for detecting students' learning styles. *Computers & Education*, 49, 794-808.

Glass, G. G. (1967). Rate of reading: A correlation and treatment study. *Journal of Reading 11*,168-178.

Goodwin, D. D. (1995). Effects of matching student and instructor learning style preferences on academic achievement in English. Unpublished doctoral dissertation, University of Arkansas, United States of America. *Dissertation Abstracts International*, 57(03), 997A.

Grasha, A. F. (1972). Observations on relating teaching goals to student response styles and classroom methods. *American Psychologist*, 27, 144-147.

Herbert, A., & Stenfors, S. (2007). Choosing experiential methods for management education: The fit of Action Learning and Problem-Based Learning.

Hogan, R. L. (2009, January-March).Assessment of Technology Graduate Students' Learning Preference Styles Utilizing the Myers-Briggs Type Indicator. *Journal of Industrial Technology*, 25(1).

Hyde, P. (2007). Integrating experiential learning through live projects. In M. Reynolds & R. Vince (Eds.), *The handbook of experiential learning & management education*. Oxford, UK: Oxford UP.

Jones, N. B. (1997). *Applying learning styles research to improve writing instruction*. Paper presented at RELC Seminar on Learners and Language Learning, Singapore.

Kayes, D. C. (2007). Institutional barriers to experiential learning revisited. In M. Reynolds & R. Vince (Eds.), *The handbook of experiential learning & management education*. Oxford, UK: Oxford UP.

Klein, P. (2003). Rethinking the multiplicity of cognitive resources and curricular representations: Alternatives to 'learning styles' and 'multiple intelligences'. *Journal of Curriculum Studies*, 35(1). Retrieved from Academic Search Elite database.

Kovacic, Z. (2008). Learning styles and adaptive ICT based learning environment. In C. V. Slyke (Ed.), *Information communication technologies: Concepts, methodologies, tools, and applications* (pp. 413-429). Hershey: Information Science Reference.

Li, Y. S, Chen, P. S., & Tsai, S. J. (2008). A comparison of the learning styles among different nursing programs in Taiwan: Implications for nursing education. *Nurse Education Today*, 28, 70-76.

Littlewood, W., Liu, N. F., & Yu, C. (1996). Hong Kong tertiary students' attitudes and proficiency in spoken English. *RELC Journal*, 27(1), 70-88.

Livesay, G. A., Dee, K. C., Nauman, E. A., & Hites, L. S., Jr. (2002). Engineering students learning styles: A statistical analysis using Felder's Index of Learning Styles. Presented at the 2002 ASEE Conference and Exposition, Montreal, Quebec.

Lovelace, M. K. (2005). Meta-analysis of experimental research based on the Dunn and Dunn model. *The Journal of Educational Research*, 98, 176-183.

Mahlios, M. C. (2001). Matching teaching methods to learning styles. In B. H. Stanford & K. Yamamoto (Eds.), *Children and stress: Understanding and helping*. (pp. 65-73). Olney, MD: Association for Childhood Education International.

McDonald, M. (1996). The impact of multimedia instruction upon student attitude and achievement and relationship with learning styles. (Unpublished doctoral thesis, University of Nebraska-Lincoln). *Dissertation Abstracts International*, 57(08), 3466.

McKenzie, J. (2001). *Head of the class*. Retrieved from http://www.electronic-school.com/

Montgomery, S. M. (1995). Addressing diverse learning styles through the use of multimedia. In Engineering Education for the 21st Century: Proceedings of the 25th Annual Frontiers in Education Conference.

Mulalic, A., Mohd Shah, P., & Ahmad, F. (2009). Perceptual learning styles of ESL students. *European Journal of Social Sciences*, 7(3) pp. 101-113.

Ogden, W. R. (2003). Reaching all the students: The feedback lecture. *Journal of Instructional Psychology*, 30(1), 22-27.

Peacock, M. (2001). Match or mismatch? Learning styles and teaching styles in EFL. *International Journal of Applied Linguistics*, *11*. ERIC Document Reproduction Service No. EJ628089.

Pudichery, J. (2003).The Role of Web Technology in Education. In *Proceedings of the Academy of Educational Leadership*, 8(2). Las Vegas, USA.

Rayneri, L. J., Gerber, B. L., & Wiley, L. P. (2006). The relationship between classroom environment and the learning style preferences of gifted middle school students and the impact on levels of performance. *Gifted Child Quarterly*, 50(2), 104-118.

Reynolds, M., & Vince, R. (Eds.)(2007), *The handbook of experiential learning & management education*. Oxford, UK: Oxford UP.

Ruhnau, K. (2006). *An analysis of learning outcomes of adult students: Learning styles versus teaching styles*. Unpublished master's thesis. The Graduate School University of Wisconsin-Stout, Menomonie, WI.

Sarasin, L. S. (1999). *Learning style perspectives: Impact in the classroom*. Madison, WI: Atwood.

Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers and Education*, *34,* 177-193.

Sievers, B. (2007). Pictures from below the surface of the university: The Social Photo-matrix as a method for understanding organizations in depth. In M. Reynolds & R.Vince (Eds.), *The handbook of experiential learning & management education*. Oxford, UK: Oxford UP.

Smith, M. K. (2002). Howard Gardner and Multiple Intelligences. The Encyclopedia of Informal Education. Retrieved from http://www.infed.org/thinkers/gardner.htm

Stanberry, A. M., & Azria, E. M. (2001). Perspectives in teaching gerontology: Matching strategies with purpose and context. *Educational Gerontology*, 27(8), 639-656.

Stevenson, J., & Dunn, R. (2001). Knowledge management and learning styles: Prescriptions for future teachers. *College Student Journal*, 35(4), 483-490.

Welsh, M. A., Dehler, G. E. & Murray, D. L. (2007). Learning about and through aesthetic experience: Understanding the power of experience-based education. In M. Reynolds & R.Vince (Eds.), *The handbook of experiential learning & management education*. Oxford, UK: Oxford UP.

White, D. (2007). Results and analysis of the web 2.0 services survey undertaken by the SPIRE project. Retrieved from: http://www.jisc.ac.uk/media /documents/programmes/digitalrepositories/spiresurvey.pdf

Woolfolk Hoy, A., & Murphy, P. K. (2001). Teaching educational psychology to the implicit mind: Understanding and teaching the intuitive mind. *Student and Teacher Learning*, pp. 145-86.

Woolhouse, M., & Blaire, T. (2003). Learning styles and retention and achievement on a two-year A-level programme in a further education college. *Journal of Further and Higher Education*, 27(3), 257-269.

Yaghoubi, J., Mohammadi, I., Iravani, H., Attaran, M., & Gheidi, A. (2008). Virtual students' perceptions of E-Learning in Iran. *The Turkish Online Journal of Educational Technology*, *7*(3).

Zhang, L-F. (2006). Does student-teacher thinking style match/mismatch matter in students' achievement? *Educational Psychology*, 26(3), pp. 395-409.

Zhenhui, R. (2001). Matching teaching styles with learning styles in East Asian contexts. *The Internet TESL Journal*, 7(7). Retrieved from http://iteslj.org/Techniques/Zhenhui-Teaching.

INTERNET AS A SOURCE OF MISCONCEPTION: "RADIATION AND RADIOACTIVITY"

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ABSTRACT
The purpose of this study is to examine students' usage styles of the Internet for seeking information and to investigate whether information obtained from the Internet is a source of misconceptions. For this reason, a two-stage study was conducted. At the first stage, a questionnaire was developed to get information about students' Internet usage styles. In the light of the questionnaire results, the first 200 websites were scanned and analysed by 3 experts to determine the probable incorrect information about "Radiation" and "Radioactivity" concepts at the second stage. It was found that a good number of websites contain incorrect and inadequate knowledge about radiation and radioactivity, which can cause various misconceptions.
Keywords: Misconception, Radiation, Radioactivity, Seeking Internet, Students' Internet usage

INTRODUCTION

The use of information technologies has shown a very rapid growth during the last decade in almost every country in the world. Increasing computer ownership and access to the Internet have changed the lives of people who get online on a daily basis at home, at school, and at work. With the ever increasing use of the internet in daily life , individuals have begun to use the internet for various reasons such as "seeking information", "using e-mail" and "downloading music and video", "chatting" and "playing games" (Kuhlemeier, 2007; Wishart, 2007). Internet has also been used in education. Several studies have been carried out about the connection between the Internet and education (Dybek, 2002; Fischer, Troendle, & Mandi, 2003; O'Hanlon, 2002; Shaver, 1999; Usun, 2002; Wilson & Hord, 2000).

Researches on the use of the Internet in education indicate that seeking information on the Internet has become the first choice option for many people, especially for students (Cole, Suman, Schramm, Lunn, & Aquino, 2003; Lawrence & Giles, 1999; Pew Lawrence & Giles, 1998). The results of these studies have shown that students use the internet activities (facilities) especially for seeking homework and their projects by using search engines. Major Web search engines, such as Google, Yahoo!, MSN Search and AltaVista are one of the most frequently used tools to get information from the Web (Nielsen/NetRatings, 2004), but Google alone claims to handle more than 250 million search queries a day (Sullivan, 2003).

However, researches indicate that students do not have enough ability and knowledge to search for information on the web (Wallace & Kupperman, 1997), which ends up obtaining a large amount of irrelevant information about their studies. They pay little attention to what the information *is* (e.g., the source, date, and reliability) focusing instead on what it *says*. This strategy is similar to the "copy-paste" strategy described by Bereiter and Scardamalia in novice writers (Bereiter & Scardamalia, 1989). In accord with this conception, most of these students accepted what they found on the Web as true, with no consideration of the source or purpose of the information. This brings about some important and interesting issues with it

1. Students don't explore much.
2. Students tend to seek answers rather than understanding the topic.
3. Students' use of academic resources is little.
4. Students find it difficult to pinpoint information and resources.

This proves that students do not know how to use the Internet especially when seeking information on the web. Students do their homework or assignments with the "copy-paste" method without worrying about the reliability of the internet sources. Students' misuse (mishandling) of the Internet can create incorrect learning and misconceptions in this way. The research on students' misconceptions has become a key issue in science education for the past two decades because they are presumed to be deeply rooted, instruction-resistant obstacles to the acquisition of scientific concepts (Lawson, 1988). Skelly and Hall (1993) defined a misconception as a mental representation of a concept, which does not correspond to currently hold scientific theory. They divided

misconceptions into two categories: experiential and instructional. The experiential misconceptions are also referred to as alternative, intuitive or native conceptions. Experiential misconceptions can be described a concept that has been understood, at least to some extent, through everyday experience and interaction with the phenomenon involved (Skelly & Hall, 1993). The internet usage can provokes to create misconceptions as experiential. Misconceptions adversely influence construction of knowledge and so learning process (Ben-Zvi, Eylon & Silbertein, 1986; Bodner, 1986; Brown, 1992; Jonassen, 1991). As mentioned by Şahin, Balta & Ercan (2010), research on internet usage have indicated that there is a strong relationship between internet use trends and educational performance, and wrong use of the Internet can cause a major decrease in students' academic performance. They investigated the diversity, accessibility and reliability of the internet resources used by the inexperienced university students during literature review and found that the more useful reliable information can be gathered using less accessible and more secure internet resources. The also indicated that using highly accessible internet sites may give fast results but the reliability of those results can not be ensured. Chen & Peng (2008), examined the basic relationship between the internet use of university students and their academic performance, interpersonal relationships, psychosocial adjustment and self-evaluations. The results show that non-heavy internet users have better relationship with administrative staff, academic grades and learning satisfaction than heavy users. They claimed that the heavy internet users were likely than non-heavy users to be depressed. This study provoked us to search the raising trends in use trap sites among university students.

As mentioned above, students use Internet for their academic researches, and they acquire knowledge related to many school subjects. Radiation and radioactivity have strong links with the content of science, chemistry and physics and they have many areas of application in today's society. Therefore, students can find a lot of information about this subject on Internet. Most science education research linked to radioactivity and radiation has shown that students have difficulties in understanding these subjects and so they have lots of misconceptions (Eijkelhof, 1986; Henriksen & Jorde, 2001; Huestis, 2002; Millar et al, 1990; Millar, 1994; Mubeen et all., 2008; Nakiboglu & Tekin, 2006; Prather, 2005).

Purpose of the Study

Students generally use the Internet for their studies without formal help or training. This situation has important implications for the quality of work that students are able to produce based on their Internet use. Students need accurate knowledge, but if they are faced with inaccurate or misleading information, they lack the ability to distinguish this information from more reliable sources; they could not learn effectively (Metzger, Flanagin, & Zwarun, 2003). For this reason, in this study, the subject of radiation and radioactivity was selected and it was aimed to investigate whether information obtained from Internet is a source misconception about these subjects. To enhance the aim the following research questions were investigated,

1. How do students get information from the Internet?
2. Do Internet resources cause misconceptions about "Radiation and Radioactivity"?

METHODS AND FINDINGS

This study is composed of two stages as described below.

The First Stage

A questionnaire was developed to get more information about students' internet usage styles. This questionnaire includes three questions as follows;

1. "What do you use the internet for ?"
2. "Which search engines do you prefer while looking for information on the web? "
3. "If you want to get information about "Radiation and Radioactivity" on the Internet, which keywords do you use?"

The questionnaire was carried on 567 pre-service teachers from science, physics and chemistry education departments. In the data analysis, the content analysis method was applied and the percentages of the responses were determined.

The answers given by the students to the first question *"What do you use the internet for?"* can be seen in Table 1

Table 1: The percentage of the students responses to "*Why do you use the internet?* "

	Students affairs (%)	Seeking their homeworks or projects (%)	Using e-mail (%)	Downloading or listening music and video (%)	Playing Games and Entertainment (%)	Chatting (%)	Other (%)
Science Pre-service Teachers	**6.9**	**65.3**	**37.1**	**28.6**	**7.1**	**35.2**	**6.3**
Physics Pre-service Teachers	**12.7**	**62.7**	**25.7**	**32.0**	**8.7**	**47.0**	**3.2**
Chemistry Pre-service Teachers	**9.0**	**68.5**	**27.8**	**39.3**	**12.0**	**42.9**	**2.5**

According to the results, it was found that over 60% of the students use (the) Internet for their homework or projects. They also use the Internet especially for checking their e-mails, downloading music and video and chatting.

The answers given by the students to the second question *"Which search engines do you prefer while looking for information on the web? "* can be seen in Table 2

Table 2: The percentage of the students responses to "W*hich search engines do you prefer for seeking information?* "

	AltaVista-Search (%)	Yahoo (%)	Google (%)	ScholarGoogle (%)	MSN Search (%)	Other (%)
Science Pre-service Teachers	**5.1**	**11.3**	**72.8**	**3.1**	**1.1**	**1.8**
Physics Pre-service Teachers	**8.5**	**23.2**	**87.1**	**17.0**	**2.5**	**3.3**
Chemistry Pre-service Teachers	**4.1**	**17.8**	**81.5**	**11.2**	**1.0**	**4.3**

As shown in Table 2, all pre-service teachers from science, physics and chemistry education departments stated that "the mostly preferred search engine is **"*Google*"** with 72.8%, 87.1% and 81.5% respectively.

The answers given by the students surveyed to the third question "*If you want to get information about "Radiation and Radioactivity" on the Internet, which keywords do you use?"* can be seen in Table 3.

Table 3: The percentage of the students responses to "*If you want to get information about "Radiation and Radioactivity" on the Internet, which keywords do you use?* "

	Radiation and Radioactivity (%)	Electromagnetic Radiation (%)	Nuclear Reactions (%)	Fission and Fusion (%)	Radioactive Decay (%)	Other (%)
Science Pre-service Teachers	**82.8**	**33.9**	**27.3**	**13.2**	**8.0**	**5.9**
Physics Pre-service Teachers	**97.1**	**48.3**	**12.4**	**8.1**	**11.3**	**6.3**
Chemistry Pre-service Teachers	**63.4**	**41.2**	**18.9**	**4.4**	**3.2**	**8.2**

When the answers given to the third question "*If you want to get information about "Radiation and Radioactivity" on the Internet, which keywords do you use?* " were analysed, it was found that students use "Radiation" and "Radioactivity" keywords to seek these subjects at the highest percentage. Considering the results, it can be said that;

- Students take the advantage of the internet while doing their homework or projects at very high rates.
- A large majority of the students prefer to use "Google" as a search engine.
- Students use short titles of the subjects as keywords generally.

- Students used "radiation" and "radioactivity" as keywords to search for "Radiation and Radioactivity" issues.

The Second Stage

In the qualitative part of this study, scanning mode was used. To investigate the second research question of the study, the websites were analysed. In the light of the questionnaire results, it was found that students prefer "Radiation" and "Radioactivity" terms as a keyword and they use Google as a search engine with higher percentages. Therefore, "Radiation" and "Radioactivity" were selected as keywords in this study and used Google search engine. The contents of the first 200 websites were scanned by 3 experts to determine probable incorrect information. According to research results it was found that a lot of websites contain incorrect and inadequate knowledge about radiation and radioactivity, which can cause various misconceptions. The classification of incorrect and inadequate knowledge and their recurrence percentages in the Internet sources can be seen in Table 4.

Table 4: The percentage of *"Radiation and Radioactivity"* in the first 200 web sites' by using "Google" search engine.

Incorrect or Inadequate Knowledge	Percentage %
If the neutron numbers are higher than proton numbers in any nucleus, the nucleus has unstable structure, the neutrons in the nucleus emits alpha, beta and gamma-rays.	**26.3**
Radiation is a kind of energy which is emitted by energy package called as wave, particle and photon.	**17.9**
While Some kind of radiations, such as natural sources and medical applications are helpful, some kind of radiations, such as irradiation and nuclear wastes are harmful.	**30.1**
Temperature effects radioactivity. Decay rates of any radioactive substance decrease as temperature increases.	**11.3**
The most common radioactive isotopes are potassium-40 and carbon-14 isotopes in the human body. Other radioactive isotopes' half-lifes are enough long and they can not cause a damage to human. A cell can not be alive for long term as half-lives potassium-40. It means that radiation can not occur.	**19.7**
If an object is exposed to ionising radiation, it becomes radioactive.	**24.3**
Ionising radiation is not natural and it is always harmful. There are many sources of ionisation radiation producing. The mobile phone, radio, television, electronic devices, X-ray for medical applications are the most commonly encountered.	**38.1**
Others	**32.3**

Considering the results in the Table 4, it is seen that websites are full of many incorrect concepts about "Radiation and Radioactivity". They are commonly related to *radiation, unstable nuclei, half-life, ionising and non-ionising radiation* and *electromagnetic radiation.* The widely used incorrect knowledge is ***"Ionising radiation is not natural and it is always harmful. There are many sources which may cause radiation. The mobile phone, the radio, the television, electronic devices, X-ray for medical are the most commonly encountered "*** with 38.1 % . It is also found that some expressions like ***"While Some kind of radiations, such as natural sources and medical applications are helpful, some kind of radiations , such as irradiation and nuclear wastes are harmful "*** are with 30.1 %, ***" If the neutron numbers are higher than proton numbers in any nucleus, the nucleus has unstable structure, the neutrons in the nucleus emits alpha, beta and gamma-rays "*** is at 26.3 % ,***" If an object is exposed to ionising radiation, it becomes radioactive "*** is at 24.3 %.

DISCUSSION AND CONCLUSION

The purpose of this research is to investigate whether information obtained from the Internet is a source of misconceptions. For this reason, a two-stage study was conducted. To enhance the purpose, it was aimed to determine the reason of the students' Internet usage and the way of their seeking information about "Radiation" and "Radioactivity" in the first stage. In the light of these results, "Radiation" and "Radioactivity" were identified as keywords and 3 experts analysed the contents of 200 websites on Google search engine in the second stage. According to the findings, a good deal of incorrect information about "Radiation" and "Radioactivity" subjects was identified in several websites. In coherent with literature, the incorrect information can cause misconceptions. For instance, it was found that the sentence of ***"Ionising radiation is not natural and it is always harmful. There are many sources of ionising radiation sources. The mobile phone, radio, television, electronic devices, X-ray for medical applications devices are the most commonly encountered"*** was repeated in the 80 out of 200 websites. These sentences are scientifically incorrect, because ionising radiation can be natural such as ultraviolet, cosmic rays, gamma-rays and X-rays. These radiations can be

harmful according to their energies and wavelengths. It means they are not "**always"** harmful. "*The mobile phone, radio, television, electronic devices, X-ray for medical applications"* is not ionising radiation sources. Electronic devices produce non-ionising radiation and they cannot account with X-rays. X-rays are electromagnetic radiation and their effects depend on the amount of radiation dose. It is clear that when students read and use this information, they cannot distinguish between *ionising radiation, non-ionising radiation* and *electromagnetic radiation.* It can be a resource of misconception which has been mentioned in the literature (Lijnse et al., 1990; Millar, Eijkelhof, & Eijkelhof, 1990). The other incorrect information found on the websites as ***"While some kind of radiations, such as natural sources and medical applications are helpful, some kind of radiations, such as irradiation and nuclear wastes are harmful"*** is also another misconception determined by Mubeen, Abbas, & Nisar (2008) and Klaassen (1995). As explained above, effects of radiation depend on the amount of radiation. If the amount of radiation dose is excessive, it is harmful, it has got nothing to do with. Another source of misconceptions determined by Prather (2005) as **"If the neutron numbers are higher than proton numbers in any nucleus, the nucleus has unstable structure, the neutrons in the nucleus emits alpha, beta and gamma-rays"** was found in the websites. Scientifically, if a nucleus has unstable structure, the nucleus emits particles such as alpha, beta and gamma-rays instead of neutrons. The neutron is a nucleon like proton. The nucleus can also emit neutrons. **"The most common radioactive isotopes such as potassium-40 and carbon-14 isotopes are in the human body. Other radioactive isotopes' half-lifes are quite-long and they cannot cause any damage to the human body. A cell cannot be alive for a long period of time like half-lifes of potassium-40. It means that radiation cannot occurs"** is another incorrect information. When students read this, they can think that potassium-40 and carbon-14 isotopes are dangerous and they should not drink milk, water and eat banana as mentioned by researches (Eijkelhof & Eijkelhof, 1990). Another incorrect conception is related to "half-life" in this paragraph. It was written that ***"radiation cannot occurs before half life"*** *but* half life is a time for decay of nucleus. In this process, the mass of the nucleus is reduced to half and radiation can occur (Nakiboglu & Tekin, 2006). Another misconception found in the websites is **"Temperature effects radioactivity. Decay rates of Radioactivity decrease as the temperature increases"** (Nakiboglu & Tekin, 2006). Radioactivity has nothing to do with the temperature. Radioactivity does not depend on the temperature but on the type of the matter. The state of **"If an object is exposed to ionising radiation, it becomes radioactive"** is also the other incorrect information. If an object is exposed to ionising radiation, it becomes irradiated not radioactive. For a while, it can be at excited level then it backs to stable level. It is clear that this information can cause some misconceptions on *irradiation-contamination* (Henriksen & Jorde, 2000; Millar & Gill, 1996) and *ionising-non ionising radiation* (Millar, Eijkelhof, & Eijkelhof, 1990; Mubeen et all., 2008).

In conclusion the results of this study indicate that there is a good deal of deficient and incorrect knowledge about the subjects of "Radiation and Radioactivity" on the websites. Considering Internet to be a the first choice of students looking for information for their studies, it can be said that this incorrect information can cause misconceptions not only for these subjects but also for the other science concepts. The Internet has become a waste of knowledge throughout the time, because most of the information available on the web is not prepared by experts and the incorrect information is copied some other websites. Anybody can create websites without checking up the accuracy of the knowledge. While there have been a lot of studies that identify the positive aspects of internet usage in education, negative aspects have not underlined in the literature. Therefore it is clear that this study will make important contribution to the literature. In view of the results of this study, it is suggested that websites should be examined, students should be informed about internet use and be directed to appropriate websites by teachers.

REFERENCES

Bereiter, C., & Scardamalia, M. (1989). Intentional learning as a goal of instruction. In L. B. Resnick (Ed.), Knowing Learning and Instruction: Essays in Honor of Robert Glaser, (pp. 361-392). Hillsdale, NJ: Lawrence Erlbaum.

Ben-Zvi, R., Eylon, B., & Silberstein, J. (1987). Students' visualization of a chemical reaction. Education in Chemistry, 24, 117–120.

Bodner, G. (1986). Constructivism: A theory of knowledge. Journal of Chemical Education, 63, 873 –878.

Brown, D. E. (1992). Using examples and analogies to remediate misconceptions in physics: Factors influencing conceptual change. Journal of Research in Science Teaching, 29, 17–34.

Chen, Y. F. & Peng, S. S. (2008). University students' Internet use and its relationships with academic performance, interpersonal relationships, psychosocial adjustment, and self-evaluation. Cyberpsychology & Behavior, 11, 467-469

Cole, J.I., Suman, M., Schramm, P., Lunn, R., & Aquino, J.S. (2003). The UCLA Internet report surveying the digital future year three. <http://www.digitalcenter.org/pdf/InternetReportYearThree.pdf> Accessed 20.03.2010

Dybek, A. (2002). How Students Use the Internet for Education. <http://www.newswise.com/articles/view/31165> Accessed 20.03.2010.
Eijkelhof, H. (1986). "Dealing with acceptable risk in science education: the case of ionizingradiation." In Frazer, M. J. & Kornhauser, A. (eds.) Ethics and Social Responsibility in Science Education. Oxford: Pergamon, pp189-199.
Fischer, F., Troendle, P.,& Mandi, H. (2003). Using the Internet to Improve University Education: Problem-Oriented Web-Based Learning with MUNICS. Interactive Learning Environments, 11, 193-244.
Henriksen E. K. & Jorde D. (2001)., High School Students' Understanding of Radiation and the Environment: Can Museums Play a Role? Science Education, 85, 189–206.
Huestis S.P. (2002) Understanding the Origin and Meaning of the Radioactive Decay Equation. Journal of Geoscience Education, 50, 524-527.
Jonassen, D. H. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? Education Technology Research and Development, 39, 5-14.
Klaassen, C. W. J. M. (1995). A problem-posing approach to teaching the topic of radioactivity. Doctoral thesis, University of Utrecht.
Kuhlemeier, H. (2007), The impact of computer use at home on students' Internet skills, Computers & Education, 49, 460–480.
Lawrence, S., & Giles, C.L. (1998). Searching the World Wide Web. Science, 280, 98–100.
Lawrence, S., & Giles, C.L. (1999). Accessibility of information on the Web. Nature, 400, 107–109.
Lawson, A. E. (1988). The acquisition of biological knowledge during childhood: Cognitive conflict or tabula rasa. Journal of Research in Science Teaching, 25, 185-199.
Lijnse, P. L., Eijkelhof, H. M. C., Klaassen, C. W. J. M., & Scholte, R. L. J. (1990). Pupils' and mass media ideas about radioactivity. International Journal of Science Education, 12, 67–78.
Metzger M.J., Flanagin, A. J., & Zwarun, L. (2003). "College student Web use, perceptions of information credibility, and verification behavior.", Computers & Education, 41, 271–290.
Millar R., (1994). Students' understanding of key ideas radioactivity and ionizing radiation, Public Understanding of Science, 3, 53-30.
Millar R., & Gill J. S. (1996). School students' understanding of processes involving radioactive substances and ionizing radiation, Physics Education, 31, 27-33.
Millar R., Eijkelhof, K. K., & Eijkelhof H. (1990) Teaching about Radioactivity and Ionising Radiation : An Alternative Approach. Physics Education, 25, 338-342.
Mubeen, S. M., Abbas, Q, & Nisar, N. (2008) Knowledge about ionising and non-ionising radiation among medical students, J Ayub Med Coll Abbottabad ,20, 118-121.
Nakiboğlu, C. & Tekin, B.B. (2006). Identifying students' misconceptions about nuclear chemistry: A study of Turkish high school students. Journal of Chemical Education, 83, 1712-1718.
Nielsen/NetRatings. (2004). "One in three Americans use a search engine, according to Nielsen/Netratings". <http://www.nielsen-netratings.com/pr/pr_040223_us.pdf>. Accessed 20.03.2010.
O'Hanlon, N. (2002) Net knowledge: Performance of new college students on an Internet skills proficiency test. Internet and Higher Education, 5, 55–66
Prather E. (2005) Students' Beliefs About the Role of Atoms in Radioactive Decay and Half-life, Journal of Geoscience Education, 53, 345-354.
Şahin, Y. G, Balta, S. & Ercan, T. (2010), The Use of Internet Resources by University Students During Their Course Projects Elicitation: A Case Study, The Turkish Online Journal of Educational Technology, 9, 2 , 234-244
Shaver, J. P. (1999). "Electronic Technology and the Future of Social Studies". Journal of Education, 181,13-40.
Skelly, K. M. & Hall, D. (1993). The development and validation of a categorization of sources of misconceptions in chemistry. Paper presented at the Third International Seminar on Misconceptions and Educational Strategies in science and Mathematics (Ithaca, August).
Stavy, R. (1991). Children's Ideas About Matter. School Science and Mathematics, 91, 240-244.
Sullivan, D. (2006). "Searches per day". In SearchEngineWatch.com. < http://searchenginewatch.com/reports/article.php/2156461> Accessed 14.03.2010.
Usun, S. (2003). Educational Uses Of Internet In The World and Turkey (A Comparative Review). Turkish Online Journal of Distance Education, 4, 3.
Wallace, R., & Kupperman, J. (1997,). On-line search in the science classroom: Benefits and possibilities. Paper presented at the AERA, Chicago, 1997.
Wilson, Thomas, P., & Hord, N. (2000). Internet-Based Education: Information on Resources from the Michigan State University Experience. Top Clin Nutr, 15, 35-43.
Wishart, J. M. (2007). Using online role play to teach internet safety awareness, Computers & Education, 48, 460–473.

Zevos N. (2002) Radioactivity, Radiation, and the Chemistry of Nuclear Waste. Journal of Chemical Education, 79, 692-696.

MAKING ENGLISH A "HABIT": INCREASING CONFIDENCE, MOTIVATION, AND ABILITY OF EFL STUDENTS THROUGH CROSS-CULTURAL, COMPUTER-ASSISTED INTERACTION

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ABSTRACT
This study examines the relationships among the three essential language-related components -- motivation, confidence, and ability -- following a series of live videoconference interactions between Taiwanese EFL students and a native speaker. 227 students enrolled in the five advanced conversation classes at a private technical university in central Taiwan participated in this study. Based on quantitative evaluation of student perceptions, the major findings were (1) motivation, confidence, and ability correlated directly, but motivation of the students increased the most as a result of strong videoconference instructional design; and (2) confidence in interacting with native speakers was the best predictor of students' perceived ability. All data supported the benefits of EFL classroom teachers providing their students authentic experiences interacting with native speakers, and the value of Internet videoconferencing for this interaction. These findings provide a valuable framework for instructors in any foreign language to build a global, cross-cultural classroom.
Keywords: videoconferencing; E-learning; integrative motivation; instrumental motivation; scaffolding; authentic learning environment; perceived ability; self-perceptions

INTRODUCTION

In the 21st Century, English has become the common international language, the language most frequently used to communicate when two people are not native speakers of the same language. As a result, instruction of English as a Foreign Language (EFL) is a priority around the globe. But instructional methodologies have not always kept pace with these changing realities. In countries where there is not a surrounding population of active English speakers, the language is still often taught as a traditional classroom subject, similar to math or geography. Technology, however, now offers opportunities for authentic interaction with people from other cultures that can be incorporated into the classroom (Chang & Lehman, 2002).

This paper reports on the use of technology to allow pedagogically sound interaction between students in an EFL class in Taiwan and a native English speaker in the United States via an instructional design that could be used in any foreign language classroom in any country. The first author is a Taiwanese female faculty member teaching at the subject university in Taiwan. She holds master and doctoral degrees from American universities, where she was a doctoral classmate with the second researcher, a native-born American, who is now a faculty member at a liberal arts college in the upper Midwest of the United States. Both the Taiwanese and American faculty members employ learner centered instruction and active learning, deemphasizing traditional lecture, memorization, drill, and passive learning, which are still employed frequently by many EFL instructors in Taiwan. The authors collaborated on a project in which the American researcher spoke repeatedly via Internet videoconference to English conversation classes taught by the Taiwanese researcher.

LITERATURE REVIEW

The availability or lack of a surrounding community of English speakers outside the classroom affects learning and teaching of English as a foreign language. When there are no English speakers easily available outside the classroom, it makes EFL learning and quality teaching more challenging (Parker, Heitzman, Fjerstad, Babbs, & Cohen, 1995). Because of this, the most successful EFL pedagogies attempt to replicate the target language's environment, usually through technology-assisted teaching, bilingual curricula, and immersion programs (Lapkin, Swain, & Shapson, 1990).

Videoconferencing for language instruction

Many researchers have studied use of technology to improve EFL learning (Chung, 1991; Guthrie & Richardson, 1995; Liou, 1997; Scardamalia & Bereiter, 1991; Van Aacken, 1999). Studies have generated a wealth of data supporting the use of videoconferencing for distance language education (Wang, 2004) concluding that the present generation of Internet based desktop videoconferencing tools can be a cost-effective solution to the problem of lack of oral visual interaction in distance language learning, and that videoconferencing was

extremely well received by the distance participants. As a result, many scholars see emerging Internet technologies as having potential in the classroom (Bottino, 2004; Howard-Kennedy, 2004). Over a decade ago, Fox (1998) foresaw that the Internet had the potential to offer EFL students what is missing from their environment: "practical real life language experience, providing students with functional communicative experiences that serve the learners' needs as well as motivate them to use English in their daily lives" (p. 1). Videoconferencing, once requiring dedicated circuits with high price tags, is now within the range of home consumers, using such free or low cost technologies as Skype or Netmeeting, and E-learning is considered to be particularly well-suited to move learners from passivity into active, highly motivated learning (Dantas & Kemm, 2008).

But in spite of this potential, developing these E-learning opportunities for EFL poses an important and difficult challenge (Wu & Bright, 2006). In American education, videoconferencing technology has been available since 1975, and online collaborative learning has become increasingly common and valuable (Juell, Brekke, & Vetteri, 1996; Tiene & Ingram, 2001; Wheeler, Valacich, Alavi, & Vogel, 1999). Educators acknowledge, however, that the learning outcomes that result from online synchronous learning, such as Internet videoconferencing, are the direct product of the quality of the instructional design (Hastie, Chen, & Kuo, 2007). Without careful consideration of the instructional design, videoconference instruction tends to default to long-distance lecture with little interaction. As a result, students tend to be passive, as if they were watching television (Gillies, 2008).

Past efforts to use videoconferencing as part of foreign-language instruction have received criticism because they often have not been integrated into a comprehensive pedagogic structure (O'Dowd, 2005). In addition, trepidation on the part of the instructors has been one of the biggest problems associated with attempts to use videoconferencing for language instruction, due to low comfort levels using the technology (Ramirez, 1998). Technical problems, such as unexpected failures of sound or video, can undermine the learning value of a videoconference (Gillies, 2008). Therefore, instructors must "normalize" their use of the technology so that it is routine.

Motivating EFL students with Internet technology

E-learning has been found to be particularly well-suited to move learners out of passive learning modes into highly motivated, engaged learning (Dantas & Kemm, 2008). Motivation improves or declines as the consequence of positive or negative learning experiences that motivate or demotivate the students (Sakai & Kikuchi, 2009). For EFL students, this means that their experiences using English, both in and out of the classroom, drive their levels of motivation.

The work of Zoltan Dörnyei helps shed light on how E-Learning and Internet videoconferencing can impact student motivation. Dörnyei's process model of motivation (Dörnyei, 2000, 2001) and his theory of the motivational self-system (Dörnyei, 2005) provides a framework that stresses the importance of the self-concept of the language learner and suggests that motivation stems from the desire to lessen the dichotomy between one's actual self, and the self one wishes to become. In addition, Dörnyei (2005) presented a complex vision of motivation in which the idealized English-speaking self is partially based on real-life encounters (or lack thereof) with speakers of the target language and partly on the way the students imagine themselves functioning in a cosmopolitan international society, not necessarily interacting only with representatives of native English speaking cultures. One role of EFL instruction, therefore, is to help shape the student's idea of what the self ought to be. Furthermore, it would appear that successful Internet videoconferencing between EFL students and a native speaker could also serve this mission of helping students imagine themselves interacting successfully with people of different cultural backgrounds in this international society.

Motivation, confidence, and ability as learning dimensions

Motivation, confidence, and ability are often treated as distinct but related learning dimensions (Butler & Lumpe, 2008; Clèment & Kruidenier, 1985; Hirschfeld, Lawson, & Mossholder, 2004; Phillips & Lindsay, 2006; Tavani & Losh, 2003). The literature widely holds that motivation, confidence, and ability are directly related and impact each other and that if one of the factors increases or decreases, the other two will follow in a direct relationship. All three learning dimensions are the result of the cumulative experiences of the student, both in and out of the classroom. All three dimensions improve or decline as the consequence of positive or negative experiences.

Scaffolding to promote active learning

In designing a curriculum incorporating authentic online interaction, the use of scaffolding can make the difference between a successful experience that improves motivation and an unsuccessful interaction that depresses motivation. Scaffolding is a teaching and learning model for classroom interaction in which the

teacher initially gives a high level of support to the student, such as availability to translate during interaction in the foreign language, with support slowly withdrawn to help the student become more independent (Beed, Hawkins, & Roller, 1991). Scaffolding, therefore, uses a social constructivist philosophy in which student collaboration and student/teacher interaction leads learners to evolve their own knowledge foundations. The social interaction is the central concept behind scaffolding. It depends on the building of positive relationships among students and between students and instructors. Scaffolding fosters collaboration, respect for one's own and others' ideas, and a growing ability to construct meaning from previous experience (Lee, 2003). In the context of videoconferences between EFL learners and native speakers, this means teachers need to initially provide high levels of support, including assistance with vocabulary, pronunciation, and listening comprehension, slowly withdrawing that support over time to encourage the students to achieve higher levels of proficiency.

Importance of student perceptions

In order to analyze the effectiveness of videoconferencing for EFL instruction, researchers need to either use the self-perceptions of study participants, or external measurements. Some academic literature has criticized self-report methodology, but many scholars contend that students above high school levels have both the cognitive and meta-cognitive capacity to comprehend and report their own characteristics, such as motivation (Gottfried, 1985; Linnenbrink & Pintrich, 2002). There is abundant research showing that student perceptions of their own motivation, confidence, and ability accurately predict a variety of learning factors, including goal orientation, self-efficacy and actual outcomes (Bandura, 1989; Hardré & Sullivan, 2008; Kaplan & Midgley, 1997; Leach, Queirolo, DeVoe & Chemers, 2003; Noels, Pelltier, Clément & Vallerand, 2003; Ryan and Deci, 2000; Wolters & Pintrich, 1996). In this framework of performance versus learning orientations, positive self-perception, and self-efficacy correlates with adaptive, beneficial goals for learning, leading to productive outcomes. In particular, a "learning orientation", in which individuals are concerned about developing their ability and their focus is on gaining understanding, insight, and skill, is linked to integrative motivation and thus positive outcomes (Brunin, Schraw, & Ronning, 1999). This social-psychological understanding of the student, encompassing self-efficacy versus anxiety and based on experiences in and outside the classroom, has been found to be particularly valuable in describing the EFL classroom dynamic (Clément, Dörnyei, & Noels, 1994). Thus while the student perception of ability, motivation, or confidence may not tally with an external evaluation of the same factors, it is the student's perception that largely predicts the level of effort the student will invest in studying, which can be argued to translate into the actual ability outcome.

Purpose of the study

This review of the literature suggested that further empirical research was needed into how videoconferencing can be employed in the EFL classroom and into the resulting reactions of students, in order to provide more information and guidance to educators who wish to use student centered methodology to improve learning. The main goals of this empirical study were to determine (1) which learning dimensions (motivation, confidence, and ability) changed the most in student perceptions due to the videoconferencing; (2) the relationships among the three learning dimensions; and (3) which dimension best predicted English ability as perceived by students. This final goal is particularly important, from the practical perspective of educators. Students who best improve their ability during a semester or during their entire university careers are often defined as the most successful. This status, validated through threshold GEPT (General English Proficiency Test) scores required for graduation in all majors throughout the universities in Taiwan, is the practical objective of EFL programs. Therefore, it is the focus of EFL programs and instructors to help the students build their ability.

Instructional Design

This study employed a series of planned videoconferencing sessions between non-English majors at one technology university in Taiwan and an American liberal arts college faculty member. The Taiwanese colleague was seen by students as knowledgeable and enthusiastic about America. The American colleague teaches in a college Mass Communication program and is experienced at being "on camera" in broadcasting settings.

Six videoconference sessions were held during the fall and the spring semesters in five English conversation classes taught by the Taiwanese researcher. The same students were in the class in both semesters. During each videoconference, the American researcher presented a topic drawn from American culture and American customs, followed by a period of student interaction with the American. The researchers then collected both quantitative and qualitative data from the 227 participating students.

Videoconference methods

The development of the presentations involved two major steps. Table 1 contains a detailed sequence of the steps required for each lesson, including preparation, conduct of the videoconferences, and follow-up.

The first major step was an assessment of the technical environment. For the presentations in this study, the collaborating teachers selected the consumer system SKYPE (skype.com). Due to time zone differences, the American and the Taiwanese classes would be 13 to 14 hours apart in their local times, so the American made provisions to connect to the videoconferences from home, because the classes fell in mid-evening, in the middle of the night, or in the early morning hours United States time. The Taiwanese classes met in an on-campus computer lab. The teacher's computer in the lab made the connection to the American and the screen of the teacher's computer was reproduced on a large projected display, as well as on the individual student computers in the lab. Wall-mounted speakers and a common microphone allowed for all students to hear the American and for the Taiwanese teacher to control the flow of the conversation and assure equal opportunity for students to participate.

During the second step of development, the two faculty members collaborated to plan the overall strategy of the videoconferences and the individual lessons carefully. The American developed a presentation of 20-30 minutes for each round of teleconferences, with feedback from the Taiwanese teacher. The subject of each presentation was specifically tailored to interest young adults and highlighted American culture, traditions, and vocabulary. Specific issues and topics covered in the curriculum included major American holidays, American National Parks and travel preferences, Western food and table manners, and American dress and decorum.

During the actual implementation of the instructional design, the Taiwanese teacher pre-taught the material to facilitate the lesson and ease the students' conversational anxiety. The students were provided a written copy of the presentation in advance, along with an MP3 audio recording of the text, made by the American. In the recording, the words were pronounced slowly. The Taiwanese teacher reviewed the advance text with students, emphasizing the new vocabulary and meaning of phrases. In the live teleconferences, the American teacher delivered expanded versions of the presentations, adding multimedia material to enrich the text, while the Taiwanese teacher provided scaffolding to the students, such as translating, wording, or clarifying meaning, as needed to lower the anxiety of the students and to enhance their learning.

During each videoconference, the American presented for the planned 20-30 minutes. Following each presentation, Taiwanese students, either as individuals or in small groups based on their comfort levels, asked the American questions or replied with comments regarding the presentation. In later rounds of videoconferencing, the students actually prepared in groups to present back to the American on a Taiwanese aspect of the topic, followed by discussion with the American. In each case, the American's vocabulary was kept close to the range of the students, but they were also challenged by adding new vocabulary specific to the cultural elements being discussed. The Taiwanese faculty researcher used scaffolding techniques, initially remaining close to the student speaking to the American to provide help with listening comprehension, vocabulary, and grammar, but as the rounds of videoconferencing passed, she provided less and less support to encourage the student to become more and more independent.

After each round of videoconferencing, the Taiwanese teacher provided her students with feedback and comments based on the students' performance, as well as both individual and group grades. Therefore, students were well informed of their learning outcomes and were able to self evaluate their own learning progress and performance. The Taiwanese and American teachers also reviewed each session and made adjustments for subsequent rounds. For example, after-the-fact reviews resulted in the decision to add the component of students presenting back to the American, in order to further engage their learning and interaction for learning English.

Table 1- *Sequence of each lesson (Later rounds when students also presented back to the American)*

	Teachers	Students
1. Choose a topic	•	•
2. Write texts & type them	•	
3. Upload advance text & audio recording	•	
4. Listen to the audio recordings prior to each videoconferencing section		•
5. Go through texts if necessary	•	•
6. As a group, decide on topics for each student presentation		•
7. Conduct on-line research for individual part of their presentation		•
8. Make PowerPoint's presentations or pictures		•
9. In-class live group presentation-interaction with the two investigators-Scaffolding Strategy	•	•
10. Review the process and procedure	•	
11. Provide comments and feedback to each individual student and each group for improvement and progress	•	•

EVALUATION METHODS

The researchers a quantitative methodology to explore the perception of students about changes in their motivation, confidence, and ability as the result of a class in which they repeatedly interacted via Internet videoconferencing with a native English speaker.

Delimitations

This study measured the students' perceptions of their own learning dimensions, based on grades and feedback they had received from the Taiwanese instructor for each videoconferencing session because the researchers concluded that self-reporting served as the most authentic method of assessment to meet the goals of this project. Research has shown that older adolescents, such as those who participated in this study, are able to know and to report accurately their present achievement and to accurately predict future learning outcomes (Berk, 2003; Linnenbrink & Pintrich, 2002). As a result, the authors concluded that self-reporting was a valid methodology because the students participating in this project received classroom grades and personalized teacher feedback after each round of videoconferencing. Motivation and confidence are internal aspects that are hard to measure externally. In addition, students' perceived ability was deemed to be worthy of consideration for reasons discussed at length in the literature review. Furthermore, a control group was not considered to be feasible in this study because removal of the videoconferences would have resulted in such a significant restructuring of the control group class that there would be too many confounding variables to isolate the differences resulting only from the videoconferences from other classroom-to-classroom differences.

Quantitative methodology:

The quantitative survey for this study was based on the Attitude/Motivation Test Battery of Gardner (1985), Zeng's (2001) survey of students' English learning achievement, and the 1997 survey conducted by the California Foreign Language Project (Silva, 1997). The decision to divide the instrument with three different sections, including motivation, confidence, and ability, and analyze them separately, was based on the findings of the literature review that the three learning dimensions are appropriately treated as separate and distinct, but related, learning dimensions.

The first survey section of 13 items asked about the degree of change in student interest in studying both the English language and the culture of the target language as well as changes in motivation to study the language. The second section with 11 items dealt with the change the students perceived in their English-proficiency levels. The change in student confidence in using the language was assessed in the third section, consisting of 11 questions. The final section was the students' demographic information about gender, age, program type, years of English study, type of high school attended (technology- or academically-oriented), and experience with online learning and using technology. A five-point scale assessed student perceptions regarding changes in motivation, ability, and confidence as a result of the videoconferencing. The low end of the scale was labeled "significantly reduced" (= 1.00) and the high end of the scale was labeled "significantly increased" (= 5.00). The midpoint of the scale (=3.00) was labeled "no change."

The Taiwanese researcher administered the survey instrument, written in Chinese, to the 227 students at the end of each of the five English conversation classes while the researcher was present. Data were collected at the end of the fall 2006 as well as the conclusion of the spring 2007 semester. The survey, consisting of four major sections, was developed by the two researchers based on the review of the related literature, including items taken from Gardner and Lambert's questionnaire (1972). The survey was piloted to 50 students, who were excluded from the 227 participants in this study. The overall internal reliability for this instrument is .92, with each section also scoring above .85, which is considered to have high reliability compared with the minimum Cronbach α of .75, which is considered reliable.

The researchers chose factor analysis and multiple regression as the primary methodologies (in addition to descriptive statistics) in order to gain a more complete understanding of the students' perceptions of their own motivation, confidence, and ability. Without the opportunity presented by factor analysis to subdivide the three main learning dimensions, the results would have been too general and not as valuable to practitioners wishing to make use of the findings. The researchers further chose to perform separate factor analyses on the three dimensions, based on precedents for this methodology (Deci & Ryan, 1985). In this way, the study could best serve its overarching purpose of providing information of practical use to educators by separately determining factors influencing motivation, confidence, and ability.

For the analysis of the quantitative data, SPSS version 15 was used, especially frequencies, means, reliability, factor analysis, Pearson product-moment correlation, and stepwise multiple regressions.

FINDINGS

Changes in the three variables due to the frequency of videoconferencing

To determine the influence of the videoconferencing sessions on the students' perception of their own motivation, ability and confidence, mean scores for each factor were computed at the end of each semester. Comparing preliminary student responses from the end of the first semester (after four videoconferencing sessions) with the same students at the end of the second semester (a total of six videoconferences over the two semesters), the analysis revealed that the participants showed a moderate increase in their perceived motivation only, with a mean score increasing from 3.80 to 4.09 although the mean scores for the other two factors all increased in the second semester compared to the first semester. Data analysis also showed that more videoconferencing sessions would impact perceived motivation at a significant level, because 4.09 is more than two standard deviations above 3.00. More videoconferencing sessions, however, would not influence their perceived ability or confidence significantly, although the means scores for confidence (M = 3.41) and ability (M = 3.50) were also considered high.

Relationships among the motivation, ability, and confidence

To examine the relationships among the three dimensions, the Person-correlation coefficient was calculated. All three learning aspects positively correlated with each other at the .01 level (see Table 2) while confidence had the strongest relationship with ability, with a coefficient of .679, indicating that confidence was a more reliable predictor of ability than motivation.

Table 2. Summary of intercorrelations among the three learning variables

	Motivation	Ability	Confidence
Motivation	1.000	--	--
Ability	.396**	1.000	--
Confidence	.457**	.679**	1.000

** Correlation is significant at the 0.01 level (2-tailed)

Critical elements of perceived confidence and motivation predicting perceived English ability

Exploratory factor analysis

In order to decrease the number of the components (factors) in each of three dimensions-- motivation, ability, and confidence, a factor analysis was performed, using a principal-axes method with varimax rotation. The analysis revealed an underlying pattern of relationships in each dimension so that the items could be reduced, thus forming several factors. A Kaiser-Meyer-Oklin (KMO) measure of the sample adequacy was to determine the fitness of the data prior to further analysis. The decision to perform a factor analysis was based on a factor loading of 0.4 or higher and an eigenvalue greater than 1.

Factor analysis of motivation

The varimax rotation solution for Motivation revealed that 61.669% of the variance was explained by the four factors, with component 1, *use of media and technology*, contributing 20.610%; component 2, *the social interaction*, contributing 15.638%; component 3, *cultural understanding*, contributing 12.734%; and component 4, *the intrinsic drive*, contributing 12.680. Analysis of internal consistency reliability of these four components yielded a Cronbach α of 0.85, and the KMO of this analysis was 0.877, presented in Table 3.

Table 3 Factor Analysis of Perceived Motivation

Factor	Rotated Factor Loading	% of Variance	Question Items
Factor 1	.742	20.610	13. Your desire to try to learn English through different channels
	.659		9. Your desire to understand the news from native English-speakers' perspective?
	.614		11. Your motivation to watch or listen to TV or radio programs in English?
	.554		12. Your desire to study abroad?
	.423		8. Your motivation to converse with foreigners by using visual and audio Internet tool
Factor 2	.784	15.638	7. Your interest in making foreign friends?
	.745		6. Your interest in traveling to countries where

			English is the primary language?
	.523		10. Your desire to be included in relationships with others who use English?
Factor 3	.827	12.734	5. Your understanding of Western culture?
	.577		4. Your motivation to encounter Western culture?
Factor4	.858	12.687	3. To speak English more often
	.582		1. Your interest in your EFL class?
	.553		2. Your motivation to study English?
Total		61.669	
Cronbach's Alpha Value		.85	

Factor analysis of perceived ability

The subsequent four-component solution for Ability explained 70.186% of the variance, with component 1, *listening skills*, contributing 22.684%; component 2, *speaking skills*, contributing 19.802%; component 3, *reading and writing skills*, contributing 15.103%; and component 4, *skills in relating to other culture*, contributing 12.597%. Analysis of internal consistency reliability of these four components yielded a Cronbach α of 0.88 and the KMO of this analysis was 0. 900.

Table 4 Factor Analysis of Perceived Ability

Factor	Rotated Factor Loading	% of Variance	Question Items
Factor 1	.812	22.684	3. Understand English in conversations with Native speakers?
	.774		2. Understand English in conversations with Taiwanese speakers?
	.720		4. Understand English you hear in the media?
Factor 2	.809	19.802	9. Speak English with your English instructors?
	.736		8. Pronounce English words more accurately?
	.509		10. Communicate with English speaking foreigners?
	.414		6. Speak English with your peers?
Factor 3	.801	15.103	1. Comprehend written English?
	.730		7. Use English grammar?
Factor 4	.710	12.597	5. Understand Western culture and customs
	.511		11. Understand Western people
Total		70.186	
Cronbach's Alpha Value		.88	

Factor analysis of perceived confidence

The subsequent three-components solution for Confidence explained 61.598% of the variance, with component 1, *interaction skill*, contributing 25.338%; component 2, *using technology*, contributing 18.333%; and component 3, *travel*, contributing 17.927 %. Analysis of internal consistency reliability of these three components yielded a Cronbach α of 0.89, and the KMO of this data analysis was 0.807.

Table 5 Factor Analysis of Perceived Confidence

Factor	Rotated Factor Loading	% of Variance	Question Items
Factor 1	.773	25.338	5. Speak English with your English instructors?
	.711		4. Speak English with other students?
	.685		1. Use English generally?
	.651		6. Speak English with English-speaking foreigners?
	.608		3. Hear English spoke by native speakers?
	.514		2. Hear English spoken by Taiwanese?
	.426		11. Read or write English
Factor 2	.811	18.333	7. Use multimedia facilities or the Internet
	.673		8. Learn English through distance learning
Factor 3	.879	17.927	10. Think about traveling
	.834		9. Think about study abroad
Total		61.598	
Cronbach's Alpha Value		.89	

Stepwise multiple regression

To predict students' perceived ability based on their perceived motivation and confidence, a stepwise multiple regression technique was used. Ability was defined as the criterion variable, and motivation and confidence were entered hierarchically as predictor variables in the regression equation. Two regression models were presented in Table 6, the first one containing only confidence as a predictor variable. As shown, perceived confidence alone accounted for 46.1 % of the variance in perceived ability. The second set (Model 2) of analyses was to ascertain the unique contributions of each predictor variable in predicting the criterion variable. Adding perceived motivation as a predictor in the regression model led to a relatively very small increase in explained variance, to a total of 47.0%. Examination of the individual terms showed that perceived confidence had the strongest association linked to perceived ability. Overall, these analyses showed that effect for confidence was more strongly related to ability than motivation. The regression equation is as following:

Ability = .630×confidence + .108×motivation

Table 6. Effect of factors in perceived motivation and confidence on perceived ability

Predictor Variables	Criterion Variable: Ability	
	Model 1	Model 2
Confidence	.679***	.630***
Motivation		.108*
R^2	.461	.470
Adjusted R^2	.459	.466
F	192.642***	99.512***

N=227. Standardized coefficients are shown. *p≦0.05; **p□0.01; ***p□0.001 (two-tailed tests)

To predict students' overall perceived ability based on four motivation factors and four confidence factors, a stepwise multiple regression technique was used. Perceived ability was defined as the criterion variable, and perceived motivation and confidence factors were entered hierarchically as predictor variables in the regression equation. The result presented that Confidence factor 1, *interaction skill,* accounted for 40.7 % of the variance in Perceived Ability (Model 1). Adding the Confidence factor 3, *using technology*, Model 2, accounted for 45.5 % of the variance. Model 3 accounted for 47.5% of the variance, adding Motivation factor 3, *cultural understanding,* to ascertain the unique contributions of each predictor. Overall, these analyses showed that effect for *interaction skill* in Confidence was more strongly related to Perceived Ability than other predictors. The regression equation is as following:

Ability = .444×confidence_1 + .267×confidence_3 + .151×motivation_3

The same technique was used to predict the Ability factor 1, *listening skills*. The individual terms showed that Confidence factor 1, *interaction skill*, had the strongest association linked to *listening skills* in Perceived Ability. All the simultaneous regressions had statistically significance, and variance explained of these models was 27.2 %, 30.8% and 34.7%, respectively for models 1, 2 and 3. The regression equation is as following:

Ability 1 = .342×confidence_1 + .227×confidence_3 + .208×motivation_3

The same technique was used to predict the Ability factor 2, *speaking skills*. The individual terms showed that Confidence 1, *interaction skills*, had the strongest association linked to *speaking skills* in Perceived Ability. All the simultaneous regressions had statistically significance, and variance explained of these models was 39.7 % and 42.0%, respectively for models 1 and 2. The regression equation is as following:

Ability 2 = .508×confidence_1 + .202×confidence_3

Multiple regression analyses were conducted to predict the Ability factor 3, *reading and writing skills*. The individual terms showed that the Confidence factor 1, *interaction skills*, had the strongest association linked to Perceived Ability 3. All the simultaneous regressions had statistically significance, and variance explained by these models was 21.7 % and 24.1%, respectively for models 1 and 2. The regression equation is as following:

Ability 3 = .340×confidence_1 + .211×confidence_3

Multiple regression analyses were conducted predicting the Ability factor 4, *skills in relating to other culture*, a criterion variable. The individual terms showed that the Motivation 3, *cultural understanding*, had the strongest association linked to Perceived Ability 4. All the simultaneous regressions had statistically significance, and variance explained by these models was 20.8 % and 28.2%, respectively for models 1 and 2. The regression equation is as following:

Ability 4 = .403×motivation_3 + .283×confidence_3

DISCUSSION

The overarching intent of this study was to gather information that could be of practical use to educators wishing to move beyond traditional instructor-centered lecture-memorization instructional designs. Although the findings validate the general concept of student-centered instruction, the true value of the study is the emphasis the findings place on interaction as a tool for language learning.

The findings make it immediately evident that the Confidence factor *interaction skills* played a prominent role in the students' perceptions of their own ability. The students' confidence in their interaction skills linked more closely than any other factors to their perceptions of speaking ability, listening ability, and the ability to read and write. Similarly, in the qualitative interviews, students often addressed their beneficial interactions with the teachers and each other.

In particular, the students felt that they benefitted from the opportunity to talk with the native speaker. They were well aware that the teachers of their various English classes throughout their education spoke English with an accent. Thus the students did not always place full confidence in the pronunciations and even the interpretations of Western culture offered by their teachers (Wu & Marek, 2007). The students highly valued the opportunity to hear expert pronunciations and cultural interpretations, and to test their own speaking and listening ability against the native speaker. Even modest success in understanding the American, and in making themselves understood by the American, bolstered their self-confidence.

One student commented on this dynamic during the class, saying that the American's "…reaction to your response showed directly on his face when he understood you or had a difficulty understanding you; therefore, I had a better idea about the accuracy of our pronunciation or the usage of the language. And now, I am less afraid of native speakers."

The videoconferences that were the specific subject of the study, therefore, were actually a tool to increase the students' confidence in their interaction skills. The authors believe that although the technology used for the videoconferences was familiar and interesting to the students, the same benefits would have resulted from regular "live" visits of a native speaker to the classroom. Native English speakers willing to fulfill this role are rare in Taiwan and therefore Internet videoconferences simply remove distance and travel barriers and provide the local Taiwanese teacher more opportunities to find native English speaking partners.

Therefore, this study has shown that Internet videoconferencing is an interaction channel that can effectively substitute for a "live" native speaker, when used in a well-planned and theory-based instructional design and environment. When students succeed in such interactions, it is only to be expected that at the same time their actual ability improves, their confidence will also grow. In short, the more students interact, the more confident they are, and the more willing they are to work to improve.

The importance of motivation

Even though confidence proved to be the best predictor of the student's perception of increased English ability, motivation nevertheless played a crucial role. Over the course of the academic year, the students' mean score in their understanding of their own Motivation increased the most of the three dimensions. While students did feel more comfortable interacting in English and felt they were better at it after six videoconference sessions, the most striking fact is that they had become significantly more interested in *learning* and *using* English in international or inter-cultural settings. As Dörnyei's theory predicted, the more the learners in this study felt connected by language to people from other countries and cultures, the more likely they were to feel high motivation, thus increasing their evaluation of their own confidence and their ability. That Motivation increased in the long term more than either Confidence or Ability may be due to the relative ease with which motivation can change, compared to the longer timeframe required for ability to improve. The study demonstrated that interactive learning in an EFL environment shows great promise for piquing students' interest in other cultures and about their own abilities, leading to beneficial improvements in Motivation, Confidence, and Ability.

Interaction and self image in motivation

The findings of this study highlight the need for multiple perspectives on the value of access to native speakers to EFL learners. Dörnyei (2005) suggested that in the 21st Century, interaction with *native speakers* of English is a less important motivating factor for students than the ability to interact with people from many countries for whom English may be a first or second language. Yet, students in this study were clear that interaction with the native speaker increased their confidence in their pronunciation, listening ability, and in their overall English skills. Therefore, while access to native speakers may be less important today than it once was in the direct motivation of students, it can still play an important role in the way teachers structure a student-centered, active

learning experience. Interaction with anyone from another country who speaks English can help shape a student's vision of functioning in cosmopolitan international society, as can positive classroom experiences, because most students have had few opportunities to interact with any foreigner (Lamb, 2004). Similarly, the growing understanding that other cultures have other ways of doing things, and other ways of thinking, adds to the desire to be able to function on the international stage, stimulating motivation.

CONCLUSION

Although teacher-centered instruction, typically utilizing little interaction in English, is the most common in Taiwanese EFL classrooms, this study shows that an instructional methodology stressing interaction as a tool for building confidence is likely to produce increases in the ultimate ability of the students. In particular, positive interaction with native speakers builds student confidence, leading to the end result of improved ability.

A casual comment by a student participating in this study suggested a metaphor by which the interaction dynamic can be understood — regular interaction in English results in development of a "habit" of using English, and therefore studying to improve. The findings of this study suggest that language instructors should seek ways to include interaction in the subject language as part of their curriculum design, using both formal and informal settings, including interaction at a distance via computer technology. Doing so introduces learners to the language as a usable, familiar medium for real communication. Scaffolding should be an integral part of this, in order to encourage the students to become more and more independent and thus more confident in their interactions. Furthermore, instructors should understand that motivations to study foreign languages may be different for men and women may be different and therefore different approaches may be required to foster desirable motivations.

This study suggests that foreign language instructors should strive to give their students experience in interactions with native speakers, discussing topics of particular interest to the students. In order to accomplish this, the local teachers need to network and socialize with native speakers wherever they meet them, including fellow students of local colleagues who studied abroad and colleagues met at international conferences. Finally, generating any type of communicative practice in the target language or with the target culture will ultimately boost the confidence of students and enhance their motivation.

The ultimate goal of any academic program is to provide a foundation from which students can develop the ability to adapt and continue learning on their own. This study provides evidence that in foreign language instructional realms, it is possible to use technology to provide pedagogically-sound interaction opportunities more commonly found when there is a surrounding population of native speakers. This allows students to become more engaged in using their new language. As shown by the data, even a relatively small amount of authentic interaction in the target language made students more comfortable with information they had already learned, changed their perception of how well they were able to apply their skills, and inspired them to make global, cross-cultural connections. Therefore, this study provides a classroom methodology that can positively influence what Dörnyei called the "self one wishes to become." Although this study was performed using Taiwanese college students studying English, the findings can be applied in any foreign language classroom where the instructor is not a native speaker.

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REFERENCES

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development. Vol. Six theories of child development* (pp. 1-60). Greenwich, CT: JAI Press.

Beed, P. L., Hawkins, E. M., & Roller, C. M. (1991). Moving learners toward independence: The power of scaffolded instruction. *Reading Teacher, 44*(9), 648-655.

Berk, L. E. (2003). *Development through the lifespan*. New York: Pearson.

Berelson, B. (1952). *Content analysis in communication research*. Glenco, Il: The Free Press.

Bottino, R. M. (2004). The evolution of ICT-based learning environments: Which perspectives for the school of the future? *British Journal of Educational Technology, 35*(5), 553-567.

Brunin, R. H., Schraw, G. J., & Ronning, R. R. (1999). *Cognitive psychology and instruction* (3rd ed.). Upper Saddle River, NJ: Prentice-Hall.

Butler, K., & Lumpe, A. (2008). Student Use of Scaffolding Software: Relationships with Motivation and Conceptual Understanding. *Journal of Science Education & Technology*, *17*(5), 427-436. doi:10.1007/s10956-008-9111-9.

Chang, M. M., & Lehman, J.D. (2002). Learning foreign language through an interactive multimedia program: An experimental study on the effects of the relevance component of the ARCS model. *The CALICO Journal, 20*(1), 81-98.
Chung, J. (1991). Collaborative learning strategies: The design of instructional environments for the emerging new school. *Educational Technology, 31*(12), 15 – 22.
Clèment, R. & Kruidenier, B. G. (1985). Aptitude, attitude and motivation in second language proficiency: A test of Clèment's model. *Journal of Language and Social Psychology, 4*, 273-291.
Clément, R., Dörnyei, Z., & Noels, K. A. (1994). Motivation, self-confidence, and group cohesion in the foreign language classroom. *Language Learning, 44*(3), 417-448.
Dantas, A., & Kemm, R. (2008). A blended approach to active learning in a physiology laboratory-based subject facilitated by an e-learning component. *Advances in Physiology Education*, *32,* 65-75.
Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior.* York: Plenum.
Dörnyei, Z. (2000). Motivation in action: Toward a process-oriented conceptualization of student motivation. *British Journal of Educational Psychology, 70*, 519–538.
Dörnyei, Z. (2001). *Teaching and researching motivation*. London: Longman.
Dörnyei, Z. (2005). *The psychology of the language learner: Individual differences in second language acquisition*. Mahwah, NJ: Lawrence Erlbaum.
Fox, G. (1998). The Internet: Making it work in the ESL classroom. *The Internet TESL Journal, 4*(9). Retrieved November 14, 2009, from http://iteslj.org/Articles/Fox-Internet.html
Gardner, R. C. (1985). *The attitude/motivation test battery: Technical report*. London, Ontario, Canada: Department of Psychology, University of Western Ontario.
Gardner, R. C., & Lambert, W. E. (1972). *Attitudes and motivation in second language learning.* Rowley, MA: Newbury House.
Gillies, D. (2008). Student perspectives on videoconferencing in teacher education at a distance. *Distance Education, 29*(1), 107-118.
Gottfried, A. E. (1985). Academic intrinsic motivation in elementary and junior high school students. *Journal of Educational Psychology, 77*, 631−645.
Guthrie L. F., & Richardson, S. (1995). Turned on to language arts: Computer literacy in primary grades. *Educational Leadership, 53*(2), 14 – 17.
Hardré, P. L. & Sullivan, D. (2008). Student differences and environment perceptions: How they contribute to student motivation in rural high schools. *Learning and Individual Differences, 18*, 471-485.
Hastie, M., Nian-Shing, C., & Yen-Hung, K. (2007). Instructional Design for Best Practice in the Synchronous Cyber Classroom. *Journal of Educational Technology & Society*, *10*(4), 281-294.
Hirschfeld, R., Lawson, L., & Mossholder, K. (2004). Moderators of the Relationship Between Cognitive Ability and Performance: General Versus Context-Specific Achievement Motivation. *Journal of Applied Social Psychology*, *34*(11), 2389-2409.
Howard-Kennedy, J. (2004). Benefits of Videoconferencing in Education. *Media & Methods*, *41*(1), 17.
Juell, P., Brekke , D., Vetter, R.J., & Wasson, J. (1996). Evaluation of computer conferencing tools for conducting collaborative seminars on the Internet. *International Journal of Educational Telecommunications*, *2*(4), 233-248.
Kaplan, A., & Midgley, C. (1997). The effect of achievement goals: Does level of perceived academic competence make a difference? *Contemporary Educational Psychology, 22*, 415-435.
Linnenbrink, E. A., & Pintrich, P. R. (2002). Achievement goal theory and affect: an asymmetrical bidirectional model. *Educational Psychologist, 37*(2), 69-78.
Lamb, M. (2004). Integrative motivation in a globalizing world. *System, 32*, 3-19.
Lapkin, S., Swain, M., Shapson, S. (1990). French immersion research agenda for the 90s. *Canadian Modern Language Review*, *46*(4), 639-673.
Leach, C. W., Queirolo, S. S., DeVoe, S. & Chemers, M. (2003). Choosing letter grade evaluations: The interaction of students' achievement goals and self-efficacy. *Contemporary Educational Psychology, 28*, 495-509.
Lee, E. (2003). Learning through scaffolded assistance during interaction in the EFL classroom: The teacher's role to make an effective learning environment. *Journal of Pan-Pacific Association of Applied Linguistics, 7*(2), 189-213.
Linnenbrink, E. A., & Pintrich, P. R. (2002). Achievement goal theory and affect: an asymmetrical bidirectional model. *Educational Psychologist, 37*(2), 69-78.
Liou, H. C. (1997). The impact of WWW texts on EFL learning. *Computer Assisted Language Learning, 10*(5), 455-478.
Merriam, S. B. (2002). Qualitative research in practice: Examples for discussion and analysis. San Francisco: Jossey-Bass.

Noels, K. A., Pelltier, L. G., Clément, R. & Vallerand, R. J. (2003). Why Are You Learning a Second Language? Motivational Orientations and Self-Determination Theory. *Language Learn, 53*(supp 1), 33-63.

O'Dowd, R. (2005). The use of videoconferencing and e-mail as mediators of intercultural student ethnography. In J. A. Belz & S. L. Thorne (Eds.), Internet-mediated Intercultural Foreign Language Education. Heinle: Boston.

Parker, J. E., Heitzman, S. M., Fjerstad, A. M., Babbs, L. M., & Cohen, A. D. (1995). Exploring the role of foreign language in immersion education. Highland, D., Lee, P. W., Milcham, J., Weber, R. R. (Eds.). *Second language acquisition theory and pedagogy.* (235-253). Mahwah, NJ: Lawrence Erlbaum Associates.

Phillips, N., & Lindsay, G. (2006). Motivation in gifted students. *High Ability Studies*, *17*(1), 57-73. doi:10.1080/13598130600947119.

Ramirez, M. (1998). Conversations from afar: Improving conversation skills and cultural understanding through videoconferencing. Paper presented at the annual meeting of the Sunshine State teachers of English to speakers of other languages. (ERIC Document Reproduction Service No. ED424770)

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78.

Sakai, H. & Kikuchi, K. (2009). An analysis of demotivators in the EFL classroom. *System, 37*, 57-69.

Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge-building: A challenge for the design of new knowledge media. *The Journal of Learning Science, 1*(1), 37-68.

Silva, D. (1997). *The California Foreign Language Project.* Retrieved December 12, 2009, from http://www.stanford.edu/group/CFLP/

Tavani, C., & Losh, S. (2003). Motivation, self-confidence, and expectations as predictors of the academic performances among our high school students. *Child Study Journal*, *33*(3), 141-151.

Tesch, R. (1990*). Qualitative research: Analysis types and software tools.* New York, Philadelphia; London: The Falmer Press.

Tiene, D. & Ingram. A. (2001). Exploring current issues in educational technology. New York: McGraw-Hill.

Van Aacken, S. (1999). What motivates L2 learners in acquisition of Kanji using CALL: A case study. *Computer Assisted Language Learning, 12*(2), 113 – 136.

Wang, Y. (2004). Supporting synchronous distance language learning with desktop videoconferencing. *Language Learning & Technology, 8*(3), 90-121.

Wheeler, B.C., Valacich, J.S., Alavi, M., & Vogel, D. (1999). A framework for technology-mediated inter-institutional telelearning relationships. *Journal of Computer-Mediated Communication*, *4*(2), [http://www.ascusc.org/jcmc/vol1/issue1/wheeler/essay.html].

Wolters, C. A., Yu, S. L., and Pintrich, P. R. (1996). The relation between goal orientation and students' motivational beliefs and self-regulated learning. *Learning and Individual Differences, 9*(2), 211-238.

Zeng, K. R., Liao, C. W., Xu, Y. Z., & Wu, S. R. (2001). A study of vocational high school students on how to raise their English ability. Paper presented at *The Sixteenth Proceedings of National Technological and Vocational Education*, 207-218, Hualien, Taiwan.

Wu, W. V. & Bright, L. K. (2006). "Integrative motivation development: Key to increasing ESL online learning effectiveness," *The E-Learn 2006 Conference: The International Forum for Researchers, Developers, and Practitioners to Learn about the Best Practices/Technology in Education, Government, Healthcare, and Business*, Full Paper OCT., 13-17, Honolulu, Hawaii, USA.

Wu, W. V. & Marek, M. W. (2007). Taiwanese student reaction to English language Internet teleconferencing for enriching EFL classroom instruction. *Journal for Language Teaching 41*(2), 124-137.

PEDAGOGICAL USABILITY OF THE GEOMETER'S SKETCHPAD (GSP) DIGITAL MODULE IN THE MATHEMATICS TEACHING

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ABSTRACT
Teacher played an important role in ascertaining effective teaching of mathematics. The objective of this paper was to investigate the pedagogical usability of a digital module prototype that integrated a dynamic geometry software, Geometer's Sketchpad (GSP) in mathematics teaching. The prototype was developed based on Reiser's and Dick's Instructional Design Model that integrated GSP software in the teaching of Quadratic Functions topic. The digital module was developed using Macromedia Authorware 7.0 as its platform. The pedagogical usability criteria included student control, student activities, objective-oriented, application, value-added, motivation, knowledge value, flexibility and response. This was a quantitative study that involved 34 mathematics secondary school teachers in Selangor, Malaysia as samples. The instrument used was pedagogical usability questionnaire. The results showed that the prototype digital modules met the requirements of the pedagogical usability criteria mentioned. It also facilitated the integration of GSP in mathematics teaching. It is suggested that a study on the applications of GSP in mathematics teaching to be carried out to promote higher order thinking skills among secondary school students.
Keywords: pedagogical usability; dynamic geometry; Geometer's Sketchpad; digital module; Mathematics teaching; Quadratic Functions

INTRODUCTION

Teaching in a systematic approach is required from teachers in the process of developing knowledge through suitable methodology to induce effective learning in the classroom. Meanwhile, learning is related to the learning activity process that happened in the classroom [1]. Both play important roles in Mathematics education. According to Tengku Zawawi (2002), in general, the methodology used by mathematics teachers were still teacher-centred and they were influenced by conventional methods. Students tend to memorise mathematical formulae and law without understanding the concepts that lie behind it. This situation produce students who are able to calculate but do not know how to solve every day's problem that involve concepts and mathematical skills.

Teacher plays important roles in ascertaining effective teaching of mathematics. Thus, teachers must be able to intelligently improvise teaching when and where necessary. A variety of approaches can be used to increase students' mathematical skills and their understanding of mathematical concepts (Efandi et al, 2007). An alternative approach is the use of information and communication technology (ICT) that could help teachers not only in the teaching of mathematical concepts but also to lighten their workload and allow teachers to solve students' problem individually (Oldknow & Taylor, 2000). According to a research conducted by Norazah and Effandi (2007), the use of computers in mathematics education was able to make the teaching and learning methodology of the subject more up-to-date and interesting as compared to the conventional method. Indirectly, this has helped to mould young generation to be physically, emotionally, spiritually and intellectually capable in solving mathematical problems.

There are a few factors that affect the usage of information technology in the education field. Factors like personality, attitude and environment are known to have positive relation with ICT usage in the classroom. On the other hand, low level of knowledge and skills coupled with limited sources were known to be the deterrent factor for successful ICT usage in the classroom (Norizan & Mohamed Amin, 2007). The deterrent mentioned

above can be overcome through training or participating in professional development programme (Frey & Fisher, 2009). However, this was not the case as educators in Malaysia, particularly the Science, Mathematics and ICT teachers, faced a number of obstacles in participating in their professional development programme.

According to a study by Effandi et al.(2007a), two factors have been identified as the main factors in the application of technology in the teaching and learning of mathematics. The first factor is the teachers' perception that the use of technology is not able to help in the teaching and learning of mathematics. This was further worsened by the fact that teachers always claim that they do not have sufficient time to prepare for ICT integrated lessons. According to a research by Haslina et al (2000), in the present teachers' professional development courses, there are hands-on activities but this was not supported by relevant modules or manuals for the facilitators and the course participants. The activities conducted in those courses are teacher-centred and in most situations, courses are conducted using softcopy materials supplied by vendors. The approach was rather ineffective in the learning of a particular software which normally requires active participation from the participants.

The ICT software discussed in this paper is Geometer's sketchpad (GSP), dynamic geometry software that uses exploratory approach in mathematics. This software enables the construction and the animation of interactive mathematical model to be used and explored by teachers and students (Ismail et al, 2009). The features in this software opened up space for dynamic image construction which can be manipulated, analysed, conjectured and tested. Research findings have revealed that the learning of mathematics with GSP was made easier compared to the conventional method (Teoh & Fong, 2005). Ministry of Education, Malaysia has bought the GSP license in 2004, hence, enabled the mathematics teachers in secondary schools to use the software in the teaching and learning process. The application of the GSP has given the opportunities to students as well as educators not only to enhance their skills and knowledge in using the computers but also to explore the potentials of GSP. It was spelled out in the Form Four and Form Five Additional Mathematics syllabi that the uses of computer technology, dynamic geometry software, courseware courses, internet and graphic calculator were encouraged in the teaching and learning activities.

According to Stacey (2007), the use of GSP software with exploratory technique was suggested in many teaching and learning of Mathematics activities to enhance the understanding of mathematical concepts. In addition, the use of dynamic geometry software enhanced many aspects of mathematics learning. Among them was to strengthen the understanding of variables and function, to clarify the understanding of problems, to produce simulation as well as motivate the learning of Algebra. Research under the topic of Circular Measurement discovered that the software had many advantages (Marzita & Rohaidah, 2004). One of the advantages of GSP software was its ability to allow students to explore geometric features without erasing or redrawing the figure. Automatic calculation can be done for angles, side length and ratio while adjustment of the drawing was being made. It also enabled user to build, measure and manipulate what was presented on the screen as well as giving immediate feedback when the size and shape of the object is changed (Hannafin & Scott, 1998).

GSP software was popular because of its potential in helping teachers to carry out teaching and learning by testing conjecture on geometrical shapes, relation and transformation (Kurz et al, 2005). The measurement presented on the screen will also change when users manipulate the object. Users can drag and change the position of the object without redrawing thus giving more time for users especially students to think about geometry rather than wasting time reconstructing the diagram. Consequently, this allows students to explore the possibilities of something which is difficult to perform if they were to depend on textbook, paper and pencil. Such activities evidently increase the cognitive competency. Teoh & Fong (2005) demonstrated that the teaching and learning using dynamic visualisation approach helped students to better understand the mathematical concepts taught.

Based on all of the literature review described, a prototype digital module module on the learning and teaching of mathematics was developed (Nik Rahimah, 2008). The digital prototype integrated Geometer's Sketchpad (GSP) in the teaching of Mathematics. For this study the prototype was developed on *Quadratic Functions.* GSP is an exploratory dynamic geometry software, which enable dynamic image construction and the images could be manipulated. It could then be analysed, conjectured and tested before reasoning was made [8]. The use of this software enabled the construction of an animated and interactive Mathematics module. The prototype was developed based on Reiser and Dick instruction model (REiser & Dick 1996). The purpose of this study was to evaluate the pedagogical usability of the digital module for the integration of GSP in mathematics teaching.

METHODOLOGY

This study was conducted using quantitative method. The development of the digital module prototype that integrated the Geometer's Sketchpad (GSP) in Mathematics teaching was based on Reiser and Dick Model (1997). A one day training course was conducted to 34 secondary school mathematics teachers (20 females and 14 males) from all over the state of Selangor. The participants came from schools which were equipped with GSP software. The trainers of the course were the researchers themselves. The participants were introduced to the content of the module as well as the technical aspects of the software. The participants then returned to their schools and they were given two weeks to try out the module in their schools. After two weeks, they were asked for feedbacks by responding to the pedagogical usability questionnaire. The pedagogical usability instrument used was adapted from Nokelainen (2006). The criteria involved were student control, student activities, objective oriented, application, value added, motivation, knowledge value, flexibility and response. The instrument used a Likert scale with a range of strongly agree to strongly disagree. A total score is calculated by assigning a value of 1 (strongly disagree) to 5 (strongly agree) to each item and then adding the values. Possible scores range from 11 to 55. The reliability index of the instrument was 0.74. Descriptive statistic was used for data analysis.

RESULTS AND DISCUSSION

Evaluation was done based on the research question on usability aspect. Pedagogical usability illustrated how the materials function in simplifying the learning content delivered. The usability criteria was evaluated through the eleven items constructed. The results were shown in Table 1. The results showed that the usability items had the overall mean of 4.25. The mean value is categorised as high. Respondents agreed that the module can be used in the teaching and learning of mathematics in the classroom. 63.1% agreed and 30.7 strongly agreed on the usability aspect of this module. The mean value of 4.50 for the item *Printed Item is an added value* is the highest for the usability aspect. 50% of the respondents strongly agreed whilst the remaining 50% agreed with the statement. 97% of the respondents agreed that goals were clearly stated in the module.

Table 1 Results of Usability Criteria

Usability Item	1 Strongly disagree *f* (%)	2 Disagree *f* (%)	3 Quite disagree *f* (%)	4 Agree *f* (%)	5 Strongly agree *f* (%)	Mean	Level
Module could be applied in the teaching of mathematics	0 (0)	0 (0)	4 (11.8)	21 (61.8)	9 (26.5)	4.15	High
Learning goals are clearly stated in the module	0 (0)	0 (0)	1 (2.9)	18 (52.9)	15 (44.1)	4.41	High
Module does integrate ICT in the teaching of mathematics	0 (0)	0 (0)	4 (11.8)	21 (61.8)	9 (26.5)	4.15	High
Plotting graphs using Geometer's Sketchpad in mathematics lesson is appropriate	0 (0)	0 (0)	2 (5.9)	21 (61.8)	11 (32.4)	4.26	High
Application of the module makes learning more interesting	0 (0)	0 (0)	3 (8.8)	20 (58.8)	11 (32.4)	4.24	High
Experience as mathematics teacher does have an added value in using this module	0 (0)	0 (0)	2 (5.9)	24 (70.6)	8 (23.5)	4.18	High
Module is flexible and allows learners to navigate freely	0 (0)	0 (0)	2 (5.9)	25 (73.5)	7 (20.6)	4.15	High
Module allows learners to check their performance	0 (0)	0 (0)	1 (2.9)	21 (61.8)	12 (35.3)	4.32	High
Module motivates learning	0 (0)	0 (0)	2 (5.9)	22 (64.7)	10 (29.4)	4.24	High
Learning is controlled by the learner	0 (0)	0 (0)	2 (5.9)	26 (76.5)	6 (17.6)	4.12	High
Digital module is an added value	0 (0)	0 (0)	0 (0)	17 (50.0)	17 (50.0)	4.50	High
Overall mean	0 (0)	0 (0)	23 (6.1)	236 (63.1)	115 (30.7)	4.25	High

The results also showed that teachers agreed that the module can be used in the classroom to teach *Quadratic Function*s. The usability aspect of this module in the teaching and learning process showed that the integration between information technology and communication in the teaching of mathematics can be aided by the module developed. The findings of this study agreed with the study by Hennessy (2000), who demonstrated that learning graphs in Mathematics through the use of technology simplified learning and increase students understanding and confidence. Similarly, analysis from Teoh and Fong (2005) gave positive feedback on the use of *Mathsoft* in the learning of movements on straight lines which was also related to graphs. Their findings showed that the graph visualisation method using technology could enhance student understanding, thus achieved better level of learning (Becta, 2003a). The findings of this study was also parallel with the findings of Marzita and Rohaidah (2004) which revealed that the use of interactive multimedia was necessary in enticing students' attention and increasing students' understanding of mathematics. The examples and images in GSP enabled students in constructing the concepts learnt (Oldknow & Taylor, 2000). The study conducted by Haslina et al (2000) and Amily and Ahmad Yasir (2004) discovered that the multimedia elements in Mathematics could interest students and increase students performance in Mathematics. The module has successfully integrated information technology and communication in the teaching of *Quadratic Function.* The use of GSP software in this module is suitable in plotting graphs and other dynamic simulations. The facilities are suitable and can make learning more interesting. This technique also allowed the students to use their creativity to explore new shapes, conjectures, and solutions to the difficult ratios (Fallstrom & Walter, 2009). The digital module developed is learner-centred in nature and therefore is controlled by students at maximum level. This also implied that teachers' awareness of the need for change and their increased flexibility to accept learners' autonomy in shifting from teacher-centred to learner-centred pedagogy. This statement is inline with the research output of Uworwabayeho (2009) that Geometer's Sketchpad challenged teachers' practice and then provoked reflection to improve student learning.

CONCLUSION

From the results and discussion, it could be concluded that the digital module prototype developed, that integrates a dynamic geometry software, GSP in the secondary mathematics teaching module can be used as materials that integrated technology in the teaching of Mathematics under the topic of *Quadratic Functions.* The module has also successfully met the requirements of the pedagogical usability criteria that includes student control, student activities, objective-oriented, application, value-added, motivation, knowledge value, flexibility and response. It also facilitates the integration of Geometer's Sketchpad in mathematics teaching. The main implications of this study are two-folds: First, implication on the teachers and second, implication on the students. Teachers might have to spend hours constructing materials using this software but in the long run, it might save them a lot of time. They might be able to look at the topics which pose problems to the students and focus on developing information and communication technology (ICT) on those topics. As ICT materials can run by themselves, students will undoubtedly benefit from it. With the use of GSP, students can be more investigative in trying out their ideas and they will not have to worry about time as the use of GSP negates time as the deterrent. Consequently, the use of GSP may produce generation who are not only ICT literate but also Mathematics literate. The implication of this study is that exploratory learning method and the discussions involved in understanding the mathematical concepts adopted from the gsp digital module can help boost higher order thinking skills. It is suggested that a study on the applications of GSP in mathematics teaching to be carried out to promote such thinking skills among secondary school students.

REFERENCES

Becta. 2003a. *What the research says about using ICT in Maths*. UK : Becta ICT Research.

Bhasah Abu Bakar, Abd. Rahman Daud & Fairuz Abdul Haleem Shah. 2005. Educational Technology in Teaching and Learning Mathematics. 18th Educational Technology Conference: Instructional Technology in Teaching Innovation in Teaching and Learning, Kuala Terengganu, 16-19 September

Boon-Liang Chua & Yingkang Wu. 2005. Designing technology-based Mathematics Lessons: A Pedagogical Framework. *Journal of Computers in Mathematics and Science Teaching* 24(4): 387-402.

Centre of Curriculum Development. 2004. Curriculum Specifications : Additional Mathematics Form Four. Kuala Lumpur : Kementerian Pendidikan

Effandi Zakaria, Md.Yusoff Daud & Norazah Mohd Nordin. 2007a. Technology in Teaching and Learning Mathematics. In Effandi Zakaria, Norazah Mohd Nordin, Sabri Ahmad. Trend in Teaching and Learning Mathematics. 1-14, Kuala Lumpur : Utusan Publications.

Effandi Zakaria, Zolkepeli Haron & Mohd. Mokhtar Tahar. 2007. *Teaching and Learning Mathematics*. In Effandi Zakaria, Norazah Mohd Nordin, Sabri Ahmad. Trend in Teaching and Learning Mathematics. 1-14, Kuala Lumpur: Utusan Publications

Fallstrom, S & Walter, M.I, 2009, Using geometer"s sketchpad to explore, conjecture, and enjoy, *International Journal of Computers for Mathematical Learning* 14(2): 183-194

Frey, N & Fisher, D, 2009, Using common formative assessments as a source of professional development in an urban American elementary school, *Elsevier*, 25(5): 674-680

Hannafin,R.D. & Scott,B.N. 1998. Identifying critical learner traits in a dynamic computer-based geometry program. *Journal of Educational Research* 92(1): 3-12.

Haslina Arshad, Yuzita Yaacob, Maryati Mohd. Yusof & Rodziah Latih. 2000. Implications of introducing Technology in Mathematics Education. *Proceedings of the International Conference on Teaching and Learning*, hlm. 934-943.

Hennessy,S. 2000. Graphing investigations using portable technology. *Journal of Computer Assisted Learning* 16: 243-258

Jones, A. 2004. *A Review of the Research Literature on Barriers to the Uptake of ICT by Teachers.* UK: Becta.

Key Curriculum Press. 2001. *The Geometer's Sketchpad : Reference Manual*. Emeryville, CA : Key Curriculum Press.

Kurz,T.L., Middleton,J.A. & Yanik,H.E. 2005. A Taxonomy of Software for Mathematics Instruction. *Contemporary Issues in Technology and Teacher Education* 5(2): 123-137

Maasz,J. 2005. A new view of Mathematics will help Mathematics teachers. *ALM International Journal* 1(1): 6-18

Mahmud, R., Ismail, M.A.H., & Kiaw, L.A., 2009, Development and evaluation of a CAI courseware 'G-Reflect' on students' achievement and motivation in learning Mathematics, ocial Sciences, 8(4): 557-568

Marzita Puteh & Rohaidah Masri. 2004. Application of Geometer Sketchpad in Learning Mathematics. *Proceeding 2003 Regional Conference on Integrating Technology in the Mathematical Sciences*, 193-203.

Niess,M.L. 2006. Guest Editorial: Preparing Teachers to Teach Mathematics with Technology. *Contemporary Issues in Technology and Teacher Education* 6(2): 195-203

Nik Rahimah Nik Mohamed, 2008, *Digital and Printed Module on the Integration of Geometer's Sketchpad in the Teaching And Learning Of Mathematiics: Development and Evaluation*, Masters Thesis, Universiti Kebangsaan Malaysia.

Nokelainen, P. 2006. An empirical assessment of pedagogical usability criteria for digital learning material with elementary school students. *Educational Technology & Society* 9(2): 178-197

Norazah Mohd Nordin & Effandi Zakaria. 2007. Using Computer in Learning Mathematics. In Effandi Zakaria, Norazah Mohd Nordin, Sabri Ahmad. Trend in Teaching and Learning Mathematics. 1-14, Kuala Lumpur : Utusan Publications.

Norizan Abdul Razak & Mohamed Amin Embi. 2001. Meeting the technology challenge: The resistance factors in using information technology in technical schools. *Proceedings of the International Conference on Technology and Vocational–Technical Education:Globalization and Future Trends,* 91-97

Oldknow, A. & Taylor, R. 2000. *Teaching Mathematics with ICT*. London: Continuum

Reiser,R.A. & Dick,W. 1996. *Instructional Planning: A guide for teachers.* Ed.ke-2. Boston, MA: Allyn and Bacon

Stacey, K. 2007. Using Dynamic Geometry Software to Motivate and Assist Problem Solving with Algebra. EARCOME 4. Pulau Pinang, 18-22 Jun

Tengku Zawawi Tengku Zainal. 2002. Issues in Teaching Mathematics: Belief and Teacher Pedagogical Content Knowledge, *Jurnal Akademik MPKT* 13: 1-28.

Teoh Boon Tat & Fong Soon Fook. 2005. The effects of Geometer's Sketchpad and Graphic Calculator in the Malaysian Mathematics classroom. *Malaysian Online Journal of Instructional Technology* 2(2): 82-96

Uworwabayeho, A (2009), Teachers' innovative change within countrywide reform: A case study in Rwanda, Journal of Mathematics Teacher Education, 12 (5): 15-324

TEACHER TRAINEES AS LEARNING OBJECT DESIGNERS: PROBLEMS AND ISSUES IN LEARNING OBJECT DEVELOPMENT PROCESS

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ABSTRACT
Learning objects (LOs) can be defined as resources that are reusable, digital with the aim of fulfilling learning objectives (or expectations). Educators, both at the individual and institutional levels, are cautioned about the fact that LOs are to be processed through a proper development process. Who should be involved in the LO development process and how should we train them to become proficient LO designers are one of the major challenges for instructional designers. Addressing to this challenge, this study aims to identify problems and issues teacher trainees experience when designing LOs. A course was re-designed for prospective teachers (n=49) to experience LO design process for 14 weeks. From a qualitative paradigm, this paper reports the findings of qualitative data derived from the first cycle of a two-cycle design based research study. The findings indicated that teacher trainees experienced content development related issues (such as, understanding LO paradigm, development software and environments, content packaging and repository) the most. In addition, project management and copyright related issues were emerged, as well. As Becker (2000) puts it well, teachers' beliefs and philosophies impact their use of resources. Therefore, starting the process with prospective teachers and integrating LO design as part of their training curricula, where these issues and problems are addressed, would be beneficial in the long term.
Keywords: Learning objects, teacher training, learning object development, content design

INTRODUCTION

Learning objects (LOs) can be defined as resources that are reusable and digital with the aim of fulfilling learning objectives. By integrating LOs in educational setting, educators may create a dynamic learning environment in which collaboratively developed learning resources are shared with learners both in formal and informal learning settings. In order to create a mutually beneficial environment; however, educators are cautioned about the fact that LOs are to be processed through a proper development process (Wiley, 2006). It would be a challenge for researchers to question that educators who are willing to integrate LOs into their teaching process, don't have the answers of some essential questions like "What is an LO?", "How can you use an LO?", "How an LO can be produced?" (Laverde, Cifuentes and Rodriguez, 2007). It is implied that effectiveness of LOs in education becomes better if LOs were developed with their main characteristics and have diverse usage in education (Fritz, King & Boren, 2005).

Who should be involved in an LO development process is another one of the salient questions for instructional designers. According to Di Nitto, Mainetti, Monga, Sbattella, and Tedesco (2006), three types of users emerge in LO development process: "authors (content writers)", "teachers" and "learners". Teachers and learners can take a role in the process of developing content as authors. Moreover, teacher trainees are at an excellent position to experience LO development and LO use in learning processes both as a learner and a prospective content writer (teacher).

At the institutional level, there are various initiatives (ADL, IMS, IEEE, etc.) to create awareness and improve the effectiveness of LOs, drawn from educational software and standards. Inviting teachers and/or prospective teachers to the process of LO development can increase the effectiveness of and awareness about LOs at the individual level. Kremers and van Dissel (2000), for example, expressed that the value of a technology lies beneath its' efficient and effective usage, and depends on its intended users (Igbaria, Zinatelli,Cragg & Cavaye,1997) like teachers, learners and/or prospective teachers. Both individuals and establishments aim more effective and efficient software (LOs) to be developed, well-accepted, educationally sound, effective and efficient for educational purposes so that they can be accepted and incorporated by teachers, learners or prospective teachers into learning and teaching processes.

LO development is a complex and problematic process with various challenges and difficulties (Gonzalez-Barbone and Anido-Rifon, 2008). In their study, Gonzalez-Barbone and Anido-Rifon (2008) draw researchers'

attention to the limitations and constraints of learning objects, specifically when developed by using the existing content generation software applications. In order to overcome these limitations, they describe the content packaging, which is one of the phases in LO development process, in a step-by-step approach for content developers. As a conclusion, they warn researchers that such software applications do provide machine-readable learning objects; however, they are not functional enough for further adaptations (that is, for educational purposes). This functionality might be explored from LO developers' perspective.

Since LOs are interactive and multimedia-rich recourses, they have the potential for educational institutions. González-Videgaray, Hernández-Zamora and del-Río-Martínez (2009) examined in-house developed LOs in a virtual learning environment by comparing them with the most common LO definitions and attributes. In their study, they indicated that teachers develop and use LOs effectively; however, they had little adherence to prescriptive definitions. They conclude by saying that supporting teachers to use interactive and multimedia contents instead of static contents is paramount. Yet, teachers' LO development process and the issues emerged during the LO development process remain detached.

Griffiths, Stubbs and Watkins (2007) examined how to aggregate LOs from existing course contents. They proclaimed that aggregation should be in consistent with the existing LO definition, LO planning, granularity, reusability and LO categories for novice developers. Although the researchers did not conduct their study with content developers, they urge novice developers to work in collaboration as a team work throughout the process. They further call for a need for more research to outline what issues would emerge when content developers, especially novice content developers, are at work.

In their research, Akpınar and Şimsek (2007) examined the effect of pre-service teachers' experience in information and communication technology (ICT) use on their learning object development with the participation of 76 pre-service teachers. The researchers analyzed participants' learning objects with Learning Object Review Instrument and found that novice and experienced information technology users were able to develop learning objects similar in size and features. They further reported that there was a significant correlation between the quality of the LOs measured with the LORI items and some elements of the developed Los. However, the LOs developed by novice and experienced groups did not differ neither in overall ratings nor at nine individual items of the LORI. The researchers further suggested that more research is needed to understand LO quality, creation of different types of learning objects and reporting on the LO development process with learner feedback.

Akpınar (2009), in his experimental study on learning design of interactive LOs, had prospective teachers develop LOs for K-11 schools. He found that prospective teachers displayed various roles; the role of a teacher, of an expert designer or of an ordinary LO user. Akpınar (2009) also asked the prospective teachers to reflect upon their experiences both in face-to-face and web-based discussions modes. Based on their reflections, he indicated that such a reflective experience helped them understand instructional and learning problems and improve their instructional and learning object design skills.

These studies indicate that, first, software applications alone do not provide an ultimate solution nor produce pedagogically sound LOs. Secondly, including teachers and/or prospective teachers as potential LO content developers is a necessity. In addition to these, educational institutions require teachers to develop Los for their prospective students. Cohen (2006) indicates that e-learning systems cause changes in the roles of teachers, students, and administrators. According to Cohen (2006), in the new emerging system, teachers are considered as course creators. Therefore, prospective teachers should be trained as course creators or designers, as well.
In order to meet this requirement, teachers need to develop these skills; hence, prospective teacher education programs need to address such a change. Moreover, some research findings indicate that when students are confronted with appropriate instructional challenges, they develop their instructional and learning object design skills. As emphasized in the literature, more research is needed to explore what types of issues and problems occur during LO development process. Therefore, the main purpose of this study is to determine and report issues and problems during the LO development process from the views of prospective teachers.

METHOD

Two cycles of design based research (DBR) of LO development have been completed. DBR is considered as an effective and efficient method to explore the processes in educational settings where artifacts are produced (Wang & Hannafin, 2004). DBR involves an iterative process involving design, analysis and re-design phases (Shavelson, Phillips, Towne, & Feuer, 2003). This study reports the findings of qualitative data derived from the first cycle of design based research.

Study Context and Participants

Study group consisted of 8th semester senior students (prospective teachers) at the department of computer education and instructional technologies (CEIT) program at Hacettepe University. CEIT aims at training prospective computer teachers and instructional designers. Some of the courses related of instructional technology are: Computer-based Education, Use of Internet in Education, Distance Education and Design, Development and Evaluation of Educational Software (DDEES), and project development and evaluation.

The participants were selected based on convenience sampling method in order to give researchers to have the advantage of being in a high interaction and in collaboration with study group (Brown, 1992; Cobb, et al., 2003). The group took courses in instructional design, software development, and educational software development in their previous terms. Therefore, it is assumed that they had developed an appropriate background enough to be LO developers. The data was gathered during the DDEES course since the course was designed to introduce the participants developing software as a learning object. Considering that learning objects have been prioritized by the Ministry of Education and other education-related sectors, it is thought that this group of students would be at a perfect situation to reflect upon their experiences. Ultimately, these findings would provide data for the second cycle of the study. The course model in DDEES is presented in Figure 1.

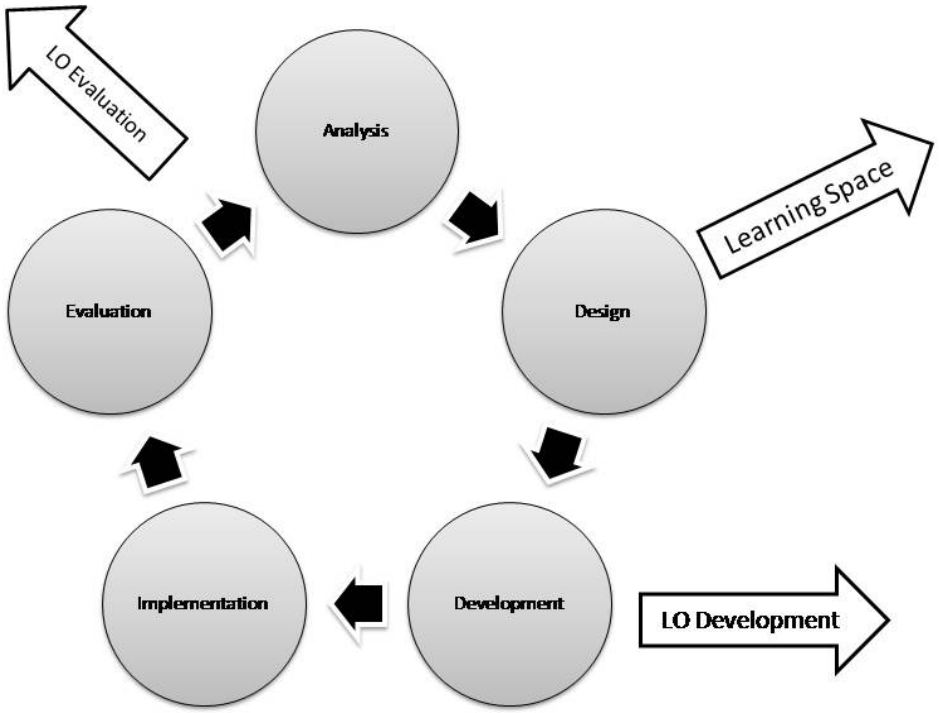

Figure 1: Course model for DDEES

Han and Bhattacharya (2001) emphasized that applying learning by design strategies in design based research is convenient. Therefore, it is decided to use learning by design strategies in DDEES course. It is a common practice to divide study group into project groups (Enkenberg, 2001; Han & Bhattacharya, 2001). It was considered suitable for this study to build up project groups. In the process, teacher trainees (n=49) are divided into 12 project groups. It was explained that each group had to develop LOs by the end of the term (14 weeks).

The groups were assigned tasks to develop LOs based on a learning expectation articulated in K-12 curriculum. The scope of LOs is determined based on Altun and Aşkar's (2008) "Learning Space" metaphor. The metaphor suggests that content is dictated by educational expectations, which can further be deconstructed as concept and/or skill. In this study, the groups were limited to develop their LOs only for skills, articulated in expectations. The skills groups needed to focus on were provided by the course instructor at the very beginning of the course. However, groups were set free to choose the content from math, science, social sciences and Turkish content areas from the primary school curriculum.

The course started with lectures about the definitions and nature of LOs. At the second step, analysis and design processes were introduced. The last major step included the packaging process of LOs. The study group was

familiar especially with the second step; whereas, LO approach as a new paradigm and packaging process was quite novel for the students.

DATA COLLECTION AND ANALYSIS

Qualitative data collection process was employed during the process. During all theoretical and laboratory courses, the researchers were together with the study group in the same environment, having interaction and making observations and interviews.

DDEES course was processed in a blended way, both face to face and online using MOODLE LMS system. MOODLE gave the opportunity to make online interviews with and collect data from the participants. Members of study group were able to contact researchers on behalf of themselves or their project group to get help during the process. Records of these communications were used as data sources.

At the end of the training process, the artifacts that project groups produced were evaluated by the researchers. During the evaluation phase, project groups were interviewed about their LO development process and its outcomes, i.e., the artifacts. The interview questions included questions regarding (a) the most difficult task in the process, (b) the most different thing they faced during the process and (c) their general reflections about LO development process. The interview sessions were recorded on a video tape to be analyzed.

Collected data were analyzed by using nVivo 7 qualitative data analysis software. Content analysis method was utilized. The data analysis process started during the data collection process. All data were transcribed with observation notes. Thematic framework was developed and applied in analysis. Each transcript was repeatedly read, annotated, and coded to reflect the issues as and problems from the emergent content and conceptual themes related to the LO development process. During this process, three conceptual themes existing in the LO literature (ADL, 2004, Di Nitto, Mainetti, Monga, Sbattella, & Tedesco, 2006; Laverde, Cifuentes and Rodriguez, 2007; Churchill, 2007; Mavrommatis, 2008) were applied to the data. Then, the emergent content was revisited to observe how they fit across these conceptual themes, which eventually formed the basis of the coding strategy.

The data was first coded by the first author. To ensure validity, the second author independently coded randomly selected 15 percent of the data again. A percentage agreement was sought and the process lasted as both of the authors agreed fully on the findings listed in the results.

To ensure trustworthiness, first, the data relevant to each category were identified. Secondly, constant comparison was utilized to examine whether these categories are represented by the relevant data. This process was repeated in the light of new emerging themes. Thus, the whole data with the corresponding categories gave the researchers greater insight into the full picture. These themes and the issues were exemplified by a limited number of representative quotations and included in the results section.

For reporting the findings, pseudonyms were assigned to the participants. The following table summarizes the data and the coding convention for each data source:

Table 1: Abbreviations in data analysis

Data source	Abbreviation	Amount of the collected data
Observation Note	ON	166 Pages of word document
Interview Notes	IN	97 Pages of word document
Video Recording Notes	VRN	1 Hours and 24 Min
E-mail Correspondence	EC	37 E-mail (approx.)

FINDINGS

The data collected during the LO development process are coded into three broad themes. The content analysis revealed nine sub-themes, representing the problems and issues teacher trainees experienced. Figure 2 shows the themes schema as a tree.

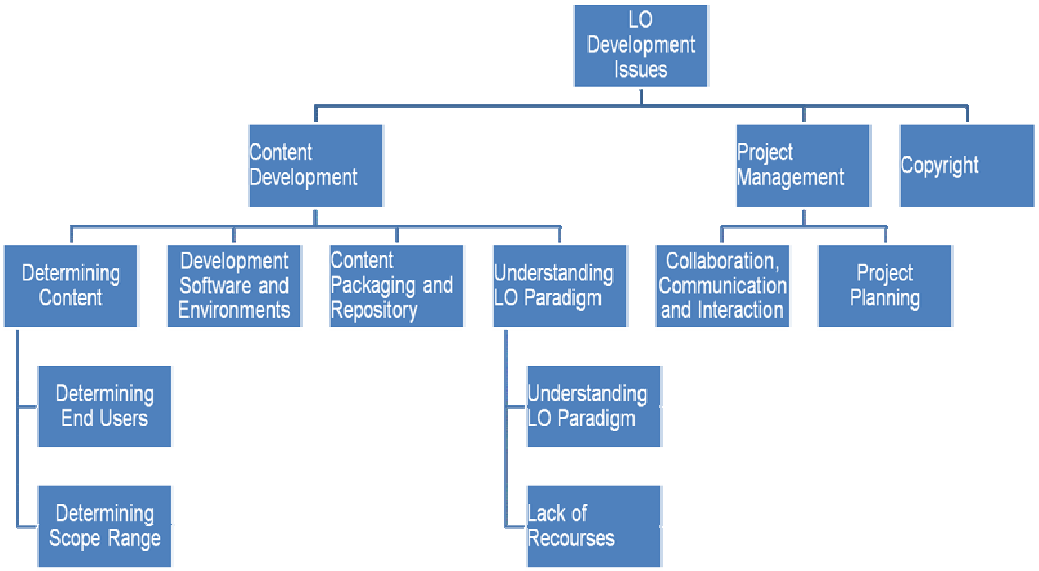

Figure 2: Themes tree schema

Coding data was only done for node themes in order to make themes clearer and specific. Table 2 shows the corresponding qualifications with sample statements across the node themes.

Table 2: Qualifications across themes

Theme	CORRESPONDING QUALIFICATIONS	Sample statements
Understanding LO Paradigm	About how to develop educational software with LO paradigm	"In previous courses or project we developed linear educational software but this approach is not suitable for LOs and we were not familiar LO approach. Therefore, we had some hard time back there"
Development Software and Environments	About software and environments to develop LOs with and deployment	S.Y: We have no idea about which development environment we can use to develop LOs.
Project Planning	About project development and management	AA: We were supposed to handle skills separately but we didn't plan like this. The most significant problem we had was structuring the process.
Lack of Recourses	About lack of recourses on LOs and skill instruction	BŞ: The term "LO" was very strange to us and there are not any recourse about LOs that written in Turkish. Therefore we couldn't get some extra help.
Content Packaging and Repository	About packaging LOs into SCORM packages and repository (metadata, RELOAD)	AD: After learning LO definition we have to aggregate parts of an LO but we had difficulties to understand and accomplish this task.
Collaboration, Communication and Interaction	About human relationship (between/within project group or with other people)	AA: During the analysis phase, some people couldn't answer our questions about skill instruction and we didn't know what to do.
Determining End Users	About artifacts being usable by end user	ID: During the LO development process we tried hard to prepare suitable LOs for our target group and this was a challenge for us.
Determining Scope Range	About LO size and scope	AA: First of all we had to define skill/s. We came up with a very specific definition and the definition made our task harder. We had to define skill/s and determine objectives and this

		was hard to do.
Copyrights	About using materials that developed by someone else	GÇ: We had to rearrange templates that we found from elsewhere and this caused some problems for us.

These themes were further analyzed to observe how often they were raised during the LO development. The findings indicate that Understanding LO Paradigm is the most frequently articulated issue during the process, whereas copyright was raised as the least one. Table 3 displays the frequencies (coding count) and percentages across the theme schema given in Table 2.

Table 3: Counts and percentages of coding themes

THEMES	CODING COUNT (f)	PERCENTAGE (%)
Understanding LO Paradigm	61	33
Development Software and Environments	31	17
Project Planning	23	12
Lack of Recourses	14	7
Content Packaging and Repository	13	7
Collaboration, Communication and Interaction	12	6
Determining End Users	11	6
Determining Scope Range	11	6
Copyrights	11	6
Total	187	100

In the next section, the coding themes are described and exemplified with the selected statements from the data.

Understanding LO paradigm: LO paradigm and LO development were new and unfamiliar to the LO developers especially at the beginning of the process. It was difficult for them to understand this paradigm and develop LOs. They express this issue by stating;

> "Skill instruction was not a familiar subject to us. Especially in evaluation part of skill instruction LOs, we had difficulties. First of all we didn't know anything about LOs then skill instruction. We developed many educational software and we got used to that but this approach and this subject gave us hard times." (AA: IN # 43)
> "While determining granules for LOs we had a big chaos about relationship between LO definition and features of granules" (SD: IN # 47
> "In analysis phase, who would we interview with? (EK: ON # 6), and what kind of questions should we ask?" (FÇ: ON # 7)
> "How many LOs do we have to develop?" (HCB: ON # 13)

Development software and environments: Participants had developed couple of educational software during their training program earlier. But, LO and LO development was a new paradigm for them. They had experienced some difficulties during software development process. Students raised questions about LO development such as;

> "Which environment will we use to develop LOs?" (AS: ON # 4)
> "Does it matter to use video files according to LOs' size?" (FS: ON # 4)
> "Do LOs need to be accessible via the Internet?" (FK: ON # 39)
> "Do LOs have to be flash files? (GK: ON # 65)
> "Can we use visual basic to develop LO?" (GÇ: ON # 66)
> "Is it possible to develop LO in MOODLE?" (HY: ON # 66)
> "We have some problems about Authorware software web publish options, how can we get over it?" (MB: ON # 29)
> "Does Authorware© need any special plug-ins?" (İD: ON # 72)

Students' reflections were not only limited to the software development, but also they were concerned about the environment where the software was to run. The following statements, for example, indicate that this is an issue for them during this process:

> "We have no idea about which development environment we can use to develop LOs" (NA: IN # 11)
> "The most biggest problem for us was determining environment at the beginning. We were confused about first but we assume we can use an LMS but we realized that the LMS couldn't satisfy our needs." (MB: IN # 29)

Project planning: Planning and organizing the entire project was a difficult task for LO developers. They mentioned these difficulties as follows;

> "We write a story that related to all project then we realized that we have to handle each part separately and this task was tiring" (AA: IN # 51)
> "At the beginning of the process we couldn't decide to number of files for our project" (BŞ: IN # 90)
> "During content authoring, we had some problems with organization to reflect requirements analysis outputs to LO content" (EK: VRN # 43)

Lack of recourses: LO is relatively a new subject (Wiley, 2002) and there isn't a lot of recourses that can help LO developers especially written in Turkish. Therefore participants had some difficulties to reach recourses. They vocalized these difficulties.

> "We found a lot of things via the Internet but most of them weren't LOs. At least we couldn't distinguish" (BŞ: IN # 88)
> "Most of things we found that were supposed to be LOs didn't match our theoretical knowledge that we learnt in course" (İD: IN # 23)

Content packaging and repository: Packaging content and repository were unfamiliar terms for LO developers. They didn't know about packaging and packaging software as well as the repository where LOs are stored. LO developers mentioned their troubles in content packaging and understanding repository as in the following:

> "Preparing suitable LOs to LCMSs like MOODLE was one of the difficult parts in process." (AD: IN # 8)
> "Packaging LOs's content to be appropriate for aggregation and repository gave us hard times" (MB: IN # 25)
> "How do we package?" (SÇ: ON # 128)
> "How can we arrange navigation in RELOAD? (AA: ON # 131) and How can we edit/insert metadata with RELOAD?" (EK: ON # 132)
> "How can we upload packages to MOODLE environment?" (HY: ON # 41)

Collaboration, communication and interaction: Each LO developer was a member of a project group throughout the process. The groups had been assigned a task to develop their LOs in a project based approach. During the project development process, they needed to communicate and interact with each other and prospective end users (i.e., learners and teachers at schools). Members of groups also had to collaborate to finish tasks and develop a successful project. Some of them had experienced problems on this. They mentioned this issue as in the following statements:

> "I do know some technical stuff like using Photoshop but I am not so good at animating and I didn't know about my group members' skills". (AA: IN # 14)
> "During the analysis phase, some people couldn't answer our questions about skill instruction and we didn't know how to reach them and get the answers" (GÇ: IN # 59)

Determining end users: Learners, end users or target group are very important in almost all production processes. LO developers had some difficulties about their prospective learners. They mentioned these difficulties as in the following statement:

> "During the LO development process we tried hard to prepare suitable LOs for our target group and this was a challenge for us". (İD: VRN # 24)

They also asked questions during the process regarding this problem. For example;

> "Which courses or degrees are in the range to determine objectives?" (GK: ON # 19)

Determining scope range: Participants had to develop LOs for specific subjects within a specific scope. But, all they had was the name of a cognitive skill. They were required to develop an operational definition for these skills and to determine the scope according to that definition. Some students had hard time during this task and they expressed their struggle with the following statements:

> "First of all we had to define skill/s. We came up with a very specific definition and the definition made our task harder. We had to define skill/s and determine objectives and this was hard to do" (AA: IN # 15)
> "Do we have to have only one objective?" (YY: ON # 7)
> "Will we chose a subject and then adopt our objectives to the subject?" (EK: ON # 7)

Copyrights: Copyrights is raised as another issue during LO development. The LO developers raised copyrights as an issue for them. They didn't know whether they can or cannot use other LOs or materials or how can they use. The following statements represent how copyright is an issue for them:

> "We had to rearrange templates that we found from elsewhere and this caused some problems for us". (GÇ: IN # 60)

Some students asked questions like:

> "Finding samples or developing samples, which one is better?" (AA: ON # 23)
> "Can we use LOs developed by someone else?" (AŞ: ON # 83)

RESULTS, DISCUSSION AND RECOMMENDATIONS

The highest percentage of the issues in LO development process is understanding the LO paradigm theme with 33%. This finding reflects LO developers' summative evaluation. It is evident that teacher trainees need to be trained for LO development (as suggested by Boot, van Merrienboer, & Theunissen, 2008). Such training is usually geared toward a particular software use and asset production. The findings in this study indicate that LO is a new paradigm for teacher trainees as learners and they need to be oriented toward LO design and development at the theoretical level in addition to software development.

Packaging and uploading the LOs to the repository is another issue emerged in this study. In order to store LOs properly and make LOs reuseable, it is essential to supply metadata and apply proper packaging processes. A generic packaging editor (such as RELOAD) or a content specific packaging editor (such as KOSİG) can be used for this purpose as suggested by many authors (i.e., Gonzalez-Barbone & Anido-Rifon, 2008; Güler, Altun & Aşkar, 2009; Atasayar & Altun, 2009). In addition, training on how to use these editors should be incorporate into the training process.

Teacher trainees experienced difficulties in the process of project management. LO development process needs collaboration of multi disciplines and expertise (Gonzalez-Barbone & Anido-Rifon, 2008). In the study, this requirement was tried to be met by forming project groups, involving people with different strengths. Theoretical side of project management was lectured and experiments were transferred to the project groups. The lecturing part was considered to be helpful to increase good collaboration, interaction and communication.

In the study, the project groups were given specific cognitive skills as a content to develop an LO about. An LO about skill instruction can have more than one objective. These kinds of LOs generally required aggregating more than one LO. Determining a specific objective is more suitable for LOs that are not combined from other LOs (Gonzalez-Barbone & Anido-Rifon, 2008).

Lack of recourses about LOs and LO development and confliction and contradiction between existing recourses are among the other issues that were raised by teacher trainees. This issue could mainly be attributed to the participants' characteristics. Almost all LO developers in the study know only Turkish and could use Turkish recourses primarily. Therefore, more research would be needed to explore whether the lack of recourses is a language specific population or not.

Another issue that was faced during the process was copyrights. Using or editing materials developed by someone else is a problem. Copyrights are protected by laws. If someone wants to use materials developed by someone else, he/she has to have permission or know that it is already permitted. Permission types are also another issue. Whether it is allowed to edit or just use can constrain developers. Using such material has some

benefits like time and cost and some handicaps that restricting developers. It is important that the suggested training contains informing and warnings about copyrights.

Based on the findings of this study, some suggestions can be made for further studies. By addressing the problems and issues reported in this study, a new course on LO development can be designed for prospective teachers. In this course, prospective teachers could develop LOs, get familiar with them, and improve their beliefs and philosophies about learning objects (Becker, 2000). Therefore, the effectiveness of such an instructional intervention can be investigated in further studies.

Secondly, at the beginning stages of the study, it was decided to apply ADDIE model for developing LOs; but, LO design and development had their specific requirements (Laverde, Cifuentes and Rodriguez, 2007) and specifications. Thus, it was decided to modify ADDIE model to be applicable for the current context. Two new main steps were added to the model so that it can be applied for a proper LO development process by addressing problems and issues experienced (Figure 3).

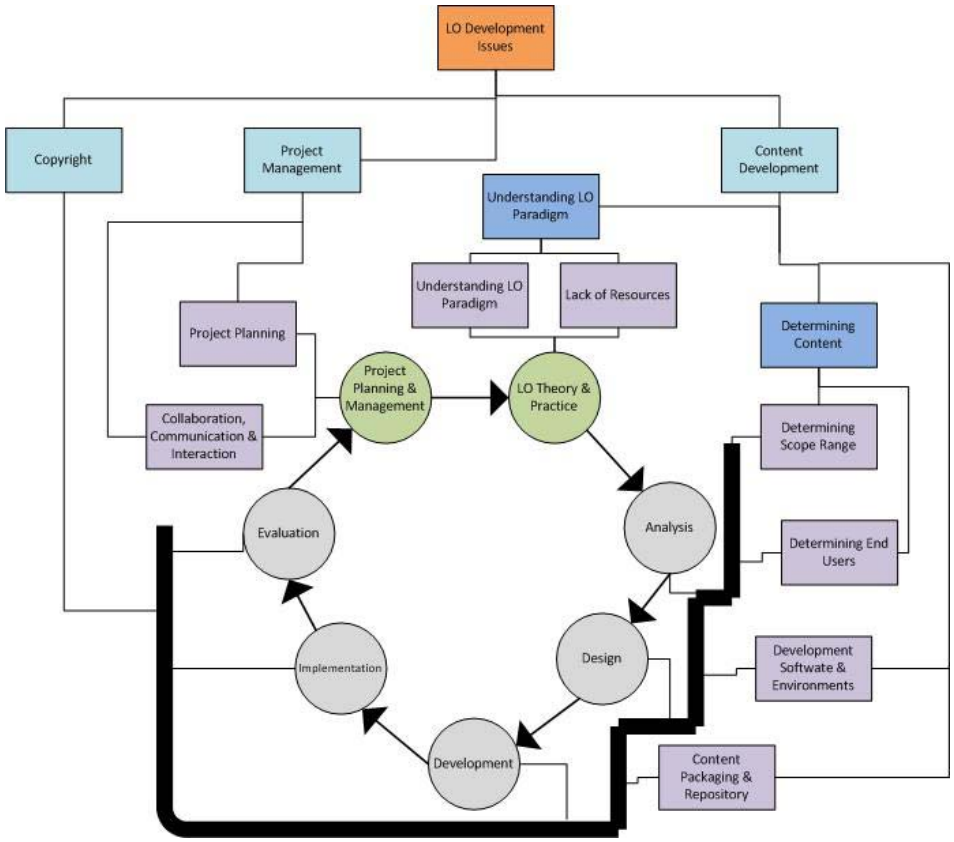

Figure 3: Modified LO development model and LO development issues

Thirdly, LO literature lacks a common definition and attributes. As a response to this problem, some consortiums are being formed among the LO community around the world. In order to operationalize the LO development and integration into educational settings, such a step is to be taken by institutions and/or educational organizations at the national level, as well. Such a community would help build the LO knowledge-base and minimize the problems related to understanding the LO paradigm.

Finally, this study was limited to LO for skill instructions. A study with the improved design model for LO can be performed for other content types (such as concept teaching, attitude formation, etc.) instruction as well.

REFERENCES

ADL, (2004). SCORM content aggregation model - version 1.3.1. Retrieved March 16, 2008 from http://www.adlnet.org/downloads/70.cfm .

Akpınar, Y. (2009). Conventional and web based reflection tools in learning the design of interactive learning objects. *Procedia - Social and Behavioral Sciences, 1*(1), 215-218.

Akpınar, Y. & Şimsek, H. (2007). Pre-service Teachers' Learning Object Development: A Case Study in K-12 Setting. *Interdisciplinary Journal of Knowledge and Learning Objects, 3.*

Altun,A. & Aşkar, P. (2008). *An Ontological Approach to Designing Learning Objects*. Paper presented at E-Learn, November 17-21, Las Vegas, Nevada, USA.

Altun, A. & Atasayar, A. (2009). Kavram Öğretiminde İçerik Geliştirme Yazarlığı İçin Üstverilerin Belirlenmesi. *International Educational Technology Conference* (*IECT)*, Ankara, Hacettepe Üniversitesi, 6-8 May 2009.

Becker, H. (2000). Findings from the Teaching, Learning, and Computing Survey. *Education Policy Analysis Archives, 8*, 51. Retrieved from http://epaa.asu.edu/ojs/article/view/442

Brown, A. L. (1992). Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings. *Journal of the Learning Sciences, 2*(2), 141 - 178.

Boot, E. W., van Merrienboer, J. J. G., & Theunissen, N. C. M. (2008). Improving the development of instructional software: Three building-block solutions to interrelate design and production. *Computers in Human Behavior, 24*(3), 1275-1292.

Churchill, D. (2007). Towards a useful classification of learning objects. *ETR&D-Educational Technology Research and Development, 55*(5), 479-497.

Cobb, P., Confrey, J., diSessa, A., Lehrer, R., & Schauble, L. (2003). Design Experiments in Educational Research. *Educational Researcher, 32*(1), 9-13.

Cohen, E. B. & Nycz, M. (2006). Learning objects and e-learning: an informing science perspective. *Interdisciplinary Journal of Knowledge and Learning Objects, 2*,(23-34). Available at http://ijklo.org/Volume2/v2p023-034Cohen32.pdf

Di Nitto, E., Mainetti, L., Monga, M., Sbattella, L., & Tedesco, R. (2006). Supporting interoperability and reusability of learning objects: The virtual campus approach. *Educational Technology & Society, 9*(2), 33-50.

Enkenberg, J. (2001). Instructional design and emerging teaching models in higher education. *Computers in Human Behavior, 17*(5-6), 495-506.

Fritz, S., King, J. & Boren, A. (2005). Principles of Sustainable Learning Object Libraries. *Interdisciplinary Journal of Knowledge and Learning Objects*, (1).

Gonzalez-Barbone, V., & Anido-Rifon, L. (2008). Creating the first SCORM object. *Computers & Education, 51*(4), 1634-1647.

González-Videgaray, M., Hernández-Zamora, G., & del-Río-Martínez, J. H. (2009). Learning objects in theory and practice: A vision from Mexican University teachers. *Computers & Education, 53*(4), 1330-1338.

Griffiths, J., Stubbs, G., & Watkins, M. (2007). From course notes to granules: A guide to deriving Learning Object components. *Computers in Human Behavior, 23*(6), 2696-2720.

Güler, Ç., Altun, A., Aşkar, P (2009). *Developing reusable learning objects: Hacettepe University case.* Paper Presented at the Third International Conference on Internet Technologies and Applications (ITA 09) Conference, 8 - 11 September, Wrexham, North Wales, UK.

Han, S. & Bhattacharya, K. (2001). Constructionism, Learning by Design, and Project-based Learning. In M. Orey (Eds.), *Emerging perspectives on learning, teaching, and technology* Available from http://www.coe.uga.edu/epltt/LearningbyDesign.htm.

Igbaria, M., Zinatelli, N., Cragg, P. & Cavaye, A. L. M. (1997). Personal computing acceptance factors in small firms: a structure equation model. *MIS Quarterly, 21*(3), 279–306.

Kremers,M. & van Dissel, H. (2000). ERP system migrations. *Communication of the ACM*, *43*(4), 53–56.

Laverde, A. C., Cifuentes, Y. S., & Rodriguez, H. Y. R. (2007). Toward an instructional design model based on learning objects. *ETR&D-Educational Technology Research and Development, 55*(6), 671-681.

Mavrommatis, G. (2008). Learning objects and objectives towards automatic learning construction. *European Journal of Operational Research, 187(3),* 1449-1458.

Shavelson, R. J., Phillips, D. C., Towne, L., & Feuer, M. J. (2003). On the Science of Education Design Studies. *Educational Researcher, 32*(1), 25-28.

Wang, F. & Hannafin, M. (2004). *Using design-based research in design and research of technology-enhanced learning environments*. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Wiley, D. & Edwards, E. (2002). *Online self-organizing social systems: The decentralized future of online learning*. Retrieved February 27, 2008 http://wiley.ed.usu.edu/docs/ososs.pdf.

Wiley, D. (2006). *RIP-ping on learning objects*. Consultado en 01, 15, 2006 en. Retrieved December 2, 2008 from http://opencontent.org/blog/archives/230.

TEACHERS' EPISTEMIC BELIEFS AND THEIR PEDAGOGICAL BELIEFS: A QUALITATIVE CASE STUDY AMONG SINGAPOREAN TEACHERS IN THE CONTEXT OF ICT-SUPPORTED REFORMS

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ABSTRACT
Many current ICT-supported reform efforts demand teachers to assume the role of epistemic facilitator of knowledge construction supported by technology. It is thus important for teacher educators to understand teachers' epistemic beliefs. This qualitative study investigated seven Singaporean in-service teachers' epistemic beliefs and their pedagogical beliefs. Two interviews were conducted for each teacher. Employing a case study design, the transcripts were analyzed for assertions that reflected the teachers' beliefs. Results indicated that all seven teachers expressed more or less relativistic epistemic beliefs. The pedagogical beliefs held by teachers were more knowledge transmissionist in orientation. Results also implied that the relationship between epistemic beliefs and pedagogical beliefs seemed to be mediated by teachers' awareness of students' readiness and what they perceived as their priorities in the school context.
Keywords: In-service teachers, Teachers' beliefs, Epistemology, Pedagogical beliefs

INTRODUCTION

Teachers' beliefs have been viewed as a key area that needs to be addressed in the context of most educational reforms (Woolfolk-Hoy, Davis, & Pape, 2006). This is especially so when teachers are to facilitate students' co-construction of knowledge through ICT and computer-supported collaborative learning (CSCL) (Abdelraheem, 2004; Erkunt, 2010; Ertmer, 2005; Teo, 2009). Many studies reported that teachers' beliefs could affect teachers' practice and teachers' learning (Abdelraheem, 2004; Richardson, 1996). In this study, we investigate in-service teachers' epistemic beliefs (beliefs about knowledge and learning; Schommer, 1990) and their pedagogical beliefs (beliefs about teaching; Teo, Chai, Lee & Hung, 2008). The relationships between these two constructs have been conceptually and empirically explored in the literature through the quantitative approach (Chan & Elliott, 2004; Hofer, 2001; Wong, Chan, & Lai, 2009). However, very few qualitative investigations have explicitly explored these relationships among the Asian teachers (Hofer, 2008; Wong & Chai, 2010). It is important for teacher educators to understand the complex relationships between teachers' epistemic beliefs, their pedagogical beliefs and how the teaching contexts influence the enactment of these beliefs. This article attempts to address this research gap. Hofer (2008) suggests that the theoretical models of personal epistemology as well as models linking personal epistemology to other variables in the educational context should be widely tested in diverse cultures. In addition, studies of in-service teachers' epistemic beliefs are arguably rare (Feucht & Bendixen, 2010). This study therefore would contribute to several areas of research.

LITERATURE REVIEW

Teachers' Epistemic Beliefs

Perry (1970) has delineated the developmental trajectory of epistemic beliefs into four stages: (a) dualistic, (b) multiplistic, (c) relativistic and, (d) commitment with relativism. Individuals with a dualistic view of knowledge believe in right-or-wrong knowledge handed down by authority. They move on to the multiplistic stage when they begin to acknowledge the possibilities of multiple views, but they still believe that most knowledge is certain. Individuals progress to a relativistic stage when they see most knowledge as tentative and contextual. Individuals at this stage also tend to believe that knowledge is generated by the self through thinking rather than given by authorities. At the last stage, individuals may commit themselves to the belief that knowledge is uncertain and based on the weighing of accumulated evidence. This scheme of categorization presupposes a structural development of epistemic beliefs. Perry's developmental model has been further refined by others. For example, Belenky, Clinchy, Goldberger and Tarule (1986) have proposed a similar model comprising the following four levels for woman epistemological development: (a) silenced/received knowing, (b) subjective knowing, (c) procedural knowing and, (d) constructed knowing. However, Schommer (1990) contended that the developmental model may fail to capture the complexity of epistemic beliefs due mostly to its unidimensional nature. She proposed a multidimensional model that conceives epistemic beliefs as a system of more-or-less independent beliefs. These dimensions include beliefs about innate ability, quick learning, simple knowledge, and certain knowledge. The first two dimensions focused on beliefs about learning, while the last two on beliefs about knowledge. Based on Perry and Schommer's work, Hofer and Pintrich (1997) suggested that epistemic beliefs should be divided into two major categories: (a) nature of knowledge, which includes certainty of knowledge and simplicity of knowledge; and (b) nature of knowing, which comprises source of knowledge and

justification of knowledge. Later, Hammer and Elby (2002) argued that the above models seem to regard epistemic beliefs as theories and traits that are assumed to be consistent across contexts. Hammer and Elby treat epistemic beliefs as made up of a range of epistemic resources. Individuals are believed to hold both naïve and sophisticated resources in their cognitive structures. Different epistemic resources are activated by different contexts.

Researchers typically employ either the developmental model (Perry, 1970) or the multidimensional model (Schommer, 1990, 1994) to investigate pre-service teachers' epistemic beliefs. Adapting the ill-structured problems of the reflective judgment interview (King & Kitchener, 1994) to problematic classroom situations, White (2000) elicited 20 American student teachers' epistemic beliefs. These teachers were mainly second and third year students. Their responses were coded into five categories: Departing Absolutist; Intuitive Relative; Selective Relative; Informed Relative and; Reflective Relative. The results showed that these student teachers held a range of epistemic beliefs distributed across these categories, and that 50% of them were defined as selective relativists. Using interview methods, Brownlee (2001) studied 29 Australian student teachers' beliefs about the nature of knowing. The findings also indicated that participants expressed a range of epistemic beliefs. Eighteen (62%) participants believed that personal truths are constructed individually based on evidence. Ten student teachers held mixed beliefs that knowledge can be both constructed and received. Only one participant believed in received knowledge. These studies seem to be mainly guided by Perry's (1970) developmental model of epistemic beliefs. Also, they were carried out in a Western context involving a small number of participants.

Employing Schommer's (1994) multidimensional model, several researchers have explored the epistemic beliefs of pre-service teachers in Asia. Adapting Schommer's (1990) four-factor questionnaire, Chan and Elliott (2002) surveyed 385 Hong Kong pre-service teachers using the 30-item Epistemic Beliefs Questionnaire. The results indicated that teachers tended to believe that knowledge is ever changing. They seemed to believe that knowledge is constructed through effortful learning processes rather than handed down from authority figures. Most students were uncertain in their beliefs about whether learning ability is innate or fixed. They suggested that the in-depth interview would facilitate better understanding of the complexity of epistemic beliefs. Cheng, Chan, Tang and Cheng (2009) follow-up study employing the same questionnaire coupled with additional interviews has discovered similar pattern of beliefs among the Hong Kong pre-service teachers.

By adapting Chan and Elliott's four-factor instrument, Chai and Khine (2008) have reported similar profiles of epistemic beliefs held by Singaporean pre-service teachers (N=877). Several background variables were found to be associated with these teachers' epistemic beliefs. These variables included teachers' program level, gender, major subjects, ethnicity, and teaching experience. Using the same instrument, Chai, Deng, Wong and Qian (2010) investigated the epistemic beliefs held by teacher education students (N=445) from the South China context. The Chinese student teachers' epistemic beliefs were similar to the preservice teachers from Hong Kong and Singapore.

There are currently only a small number of studies of in-service teachers' epistemic beliefs and these studies are generally situated in the Western society (Feucht & Bendixen, 2010; Kang & Wallace, 2005; Schraw & Olafson, 2002). These studies indicate that practicing teachers' epistemic beliefs are related to their pedagogical beliefs and they are reviewed below. Study on Asian practicing teachers' epistemological beliefs, especially through qualitative interview, seems to be currently unavailable.

Most researchers interested in studying teachers' epistemic beliefs seem to share the assumption that teachers' epistemic beliefs may affect their teaching practices (Pajares, 1992) and that the relation between epistemic belief and teaching practice may be mediated by teachers' pedagogical beliefs (Hofer, 2001). In this article, the focus is mainly on the relationships between teachers' epistemic beliefs and their pedagogical beliefs. A brief review of teachers' pedagogical beliefs is provided in the following paragraphs.

Teachers' Pedagogical Beliefs

Pedagogical beliefs refer to preferred ways of teaching by teachers. These beliefs are generally categorized into the knowledge transmission view or the knowledge construction view (Teo et al., 2008; Wong et al., 2009). Teachers who embrace the knowledge transmission view are inclined to prepare and conduct lessons in a teacher-centered and content-oriented manner. They prefer didactic instruction and act as the sole provider of knowledge. Students accordingly act as passive recipients of content knowledge. By comparison, the knowledge construction view advocates that students should actively make sense of their learning experiences while teachers design meaningful learning experiences and scaffold students' sense making. Teachers who hold the *constructivist* view tend to emphasize more student-centered activities that facilitate students' knowledge

construction through active self-reflection, peer interaction, and meaning-making process (Wong et al., 2009; Chan & Elliott, 2004).

Relationship between Epistemic Beliefs and Pedagogical Beliefs

The relationships between teachers' epistemic beliefs and their pedagogical beliefs have drawn considerable attention from researchers. These researchers generally agree that these two constructs usually relate to each other (Pajares, 1992). For example, Hofer and Pintrich (1997) argued that "beliefs about learning and teaching are related to how knowledge is acquired, and in terms of the psychological reality of the network of individuals' beliefs, beliefs about learning, teaching, and knowledge are probably intertwined" (P. 116).

Such a conceptually accepted viewpoint about the relationship between the two constructs has been buttressed by a few empirical studies. In the Western context, preservice teachers' relativistic epistemic beliefs have been reportedly related to constructivist pedagogical beliefs (Brownlee, 2004; Sinatra & Kardesh, 2004). Using interview methods, Schraw and Olafson's (2002) found that 23 out of 24 practicing teachers can be categorized as relativist. These teachers tended to prefer constructivist oriented teaching. In Kang and Wallace's (2005) work, practicing teachers who view science as a body of factual information were inclined to express a transmissionist pedagogical belief.

Only a small number of studies have investigated the above relationship within an Asian context. Chan and Elliott (2004) required 385 Hong Kong pre-service teachers to complete two five-point Likert-scales for assessing their epistemic beliefs and pedagogical beliefs, respectively. Their results were slightly different from those generated from the aforementioned Western studies. For example, traditional beliefs about teaching were positively and significantly related the three dimensions of epistemic beliefs: "innate/fixed ability", "authority/expert knowledge", and "certainty knowledge". However, the constructivist beliefs about teaching were found to be negatively related to "learning effort/process" dimension. The direction of these correlations appeared conceptually inconsistent. Chan and Elliott suggested that this surprising result may be due to the fact that the Hong Kong pre-service teachers perceive learning effort/process as working hard in terms of repetitive drills for knowledge acquisition. Using Structural Equation Modeling approach, Chai and his colleagues (2010) investigated the relationships among beliefs about learning, knowledge, and teaching of pre-service teachers (N=718) in Singapore. Results indicated that transmissionist pedagogical beliefs were positively related to "innate/fixed ability", but were negatively related to "learning effort/process" dimension. The constructivist pedagogical beliefs were positively predicted by the "learning effort/process" dimension.

However, several conflicting findings should be noted when interpreting the relationships between teachers' epistemic beliefs and their pedagogical beliefs. In Chan and Elliott's (2004) work, for example, Hong Kong pre-service teachers may be categorized as relativists, but these teachers did not show inclination towards constructivist pedagogical beliefs. Likewise, Richardson (2003) suggested that pre-service teachers may express a relativistic epistemic belief, but they may also view teaching as knowledge transmission. As reported by Chai, Teo and Lee (2010), Singaporean pre-service teachers were found to embrace constructivist beliefs about teaching, although they may not hold relativistic beliefs about knowledge. Therefore, the relationships between these two constructs should be addressed in future research. Furthermore, the above studies seemed to investigate such relationships by mainly using quantitative methods (Likert-type questionnaire). According to Hofer (2008), these simplified written measures may risk trivializing the complexity of individuals' beliefs. She also suggested that "assessment has been most reliable and valid with interviews (p. 7)." Furthermore, a large majority of studies reviewed seemed to examine the relationships by recruiting pre-service teachers. Very few studies, especially within the Asian cultural background, have investigated how in-service teachers' epistemic beliefs and pedagogical beliefs are intertwined in their real-life teaching practice. The present study thus attempted to address these research gaps. This study was guided by the following research questions:

(1) What are the Singaporean teachers' reported epistemic beliefs (beliefs about knowledge and learning)?
(2) What are the Singaporean teachers' reported pedagogical beliefs?
(3) What are the relationships between epistemic beliefs and pedagogical beliefs of teachers in Singapore?

METHOD

The study focused on Singaporean teachers' epistemic beliefs and their pedagogical beliefs. The qualitative case study approach was adopted based on principles of constructivist inquiry (Guba & Lincoln, 1989) and a constant comparative method wee employed for data analyses (Strauss & Corbin, 1990). The following sections provided the description of the context and research design.

Participants and Context

The seven teachers who participated in this study were enrolled in an in-service program that equips them with advanced pedagogical knowledge for the integration of ICT in classroom teaching through the use of ICT as mindtools (Jonassen ,2000) and CSCL (Scardamalia & Bereiter, 2003). Table 1 shows some background information on these seven teachers. These teachers have at least 3 years of teaching experiences in primary schools. The researcher obtained their permission to participate in this study through private invitation. Pseudonyms were used in this article.

Table 1 *Background of the Seven Teachers*

Teachers (Pseudonym)	Gender	Ethnicity	Years of Service	Teaching Subjects
Ian	M	Chinese	7	Mathematics, Social Studies
Karen	F	Chinese	5	English, Mathematics, Science
Nadia	F	Malay	3	English, Mathematics, Science
Nora	F	Malay	9	Malay Language
Sarah	F	Chinese	5	English, Mathematics, Science
Sue	F	Chinese	3	English, Science
Zoe	F	Malay	4	Malay Language

Data Collection and Analysis

Semi-structured interviews were employed as the main method for data collection. Each participant was individually interviewed twice in this study. In the first interview, all the participants were asked about their epistemic beliefs (beliefs about knowledge and learning) and their pedagogical beliefs (beliefs about teaching). The interview questions are listed in Appendix 1.

All interviews were audio-taped and transcribed. Verbatim transcriptions of interviews were then returned to the participants for verification. After that, the interview transcripts were analyzed through a combination of the thematic coding (Flick, 2002) and constant comparative methods (Strauss & Corbin, 1990). Open coding was first performed on the transcript of an individual teacher. Categories were then formed by grouping the labels during open coding. Thereafter, the relationships between the codes and the categories were explicated through the general scheme of axial coding. Case profiles for individual teacher were then generated and cross case analyses were employed to identify emerging themes. After three months, a follow-up interview was conducted and the data was analyzed employing the same process.

Issues with Reliability, Internal Validity, External Validity and Objectivity

For the purpose of this study, the researcher adopts the standard of "trustworthiness" as laid down by Guba and Lincoln (1989) to guide this study. Based on the notion of trustworthiness, Guba and Lincoln derived four criteria to assess the quality of a naturalistic study. They are credibility, transferability, dependability and confirmability. They are parallel to the notions of internal validity, external validity, reliability and objectivity respectively. Detailed discussion is omitted here due to space constraint.

This study employed a number of strategies to enhance its trustworthiness. First, the professional development activities were about six months, allowing the researcher to have prolonged period of contact with all the participants. This had provided the researcher with ample opportunities to observe how the teachers learn and construct knowledge, which served as a form of check against what they say during the interview. Second, the verbatim transcripts of the interviews and the interpretations in the form of assertions and supporting quotes were provided to all seven participants for member check. This allowed the researcher to be corrected by the participants. Third, the findings were subjected to peer examination. For example, the pilot study had been written and given to two colleagues for comment. The researcher had also reported the findings through departmental sharing and asked for critical feedback. Fourth, all transcripts and coded data have been subjected to external examination as part of the audit trail for the author's doctoral examination. These measures, taken together, should be able to ensure the rigor of this study (Cohen, Manion, & Morrison, 2000, Creswell, 1998; Merriam, 1998).

FINDINGS AND DISCUSSION

The findings are reported in the form of assertions supported by quotes from the interview transcripts. Assertion 1 and Assertion 2 jointly answered the first research question of this study. The other two research questions were addressed by Assertion 3.

Assertion 1: The teachers held a range of epistemic stances that were more or less relativistic in orientation.

The seven teachers were likely to hold a range of epistemic beliefs that stretched from multiplistic to relativistic (Perry, 1970). None of the teachers was at the dualistic stage where everything could be labeled as either right or wrong. They all seemed to be well aware that truth is evolving and knowledge claims can change as new evidence is found. In the following quote, Nora expressed her view that scientific constructs were possible explanations that could be overturned.

> *I don't think scientists can really discover the truth... presently, scientists have made a lot of improvements. They do research and they come out with all those theories which can help us to explain what are happening so far. But it might not be the true theories… I don't think scientists can ultimately find the truth.* (Nora)

The other teachers also reported a similar notion of knowledge as ever changing. For example, Sarah reported that, "*The truth now is the truth now. You won't know whether the truth will still be the truth in the future.*" Ian drew on the example that the earth was once treated as flat but later proven to be spherical. These results were within the researchers' expectation. Since all the teachers had completed their tertiary education, they should be aware that many "truths" have been replaced by better understanding.

The multiplistic stage is different from the relativistic stage since the former regards uncertain knowledge as exceptional while the latter regards certain knowledge as exceptional (Hofer & Pintrich, 1997). This distinction posed some difficulties for the researcher with respect to distinguishing who among the participants were more relativistic than the others. All teachers disagreed with the statement that "Scientists can ultimately discover the truth" to a certain extent but how extensive was the disagreement was unclear. Responses such as "*maybe some but not all*" (Zoe) and "*I don't think I agree totally*" (Nadia) indicated that both were relativistic. The degree to which they were inclined towards the relativistic beliefs appeared to differ when the participants' level of consciousness about epistemic issues and their views about themselves as knowledge constructors were taken into account. Among the participants, Zoe and Nora were recognized as at the multiplistic stage, or in White's (2000) terms, as departing absolutists. They both revealed that they had not consciously considered epistemic issues during the first interview. For example, when Nora was asked when she began to develop the relativistic stance, her reply was "*when you asked me.*" She further elaborated that "*if you were not to ask me, I would not really think about it.*" There was another incident that may help to corroborate the researchers' argument. When Nora was asked how she would respond if the experts disagreed, part of her response was as follows:

> *To personally construct or to follow? Hmm… I think I belong to the category that I will be the follower, based on majority. But of course I will think whether what I am going to follow is really the correct thing, especially at this point of time, whereby I can really know how to judge and analyze thing. Maybe I will be more open-minded; I will be thinking more about whether what the majority think was right or wrong.* (Nora)

When the researchers alleged that what she was doing was constructing her knowledge about this matter, she responded, "*Ah… correct, Yah, come to think of it.*" This may indicate that she was not conscious for her active role as a knower. Within this short quote, it also seemed that she was changing her stance as a knower from accepting what the majority says to constructing her own understanding. This could mean that she had not encountered controversial situations that compelled her to reflect on epistemic issues (Schraw & Olafson, 2002) prior to the interview.

Only two participants, Sue and Ian seem more relativistic than their peer. For example, Sue did not treat knowing as a matter of receiving knowledge from authority figures. To her, knowledge was not exclusively mastered by the experts. The role of experts in instructional settings was to her that of facilitators "*rather than providing me with all the facts.*" The relationships between the learners and the experts are illustrated by the following quote.

> *The learners have to do the groundwork, rather than trying to get all the inputs from the experts. The experts will be there to answer certain questions, which I feel that the learners might not be able to find. Then again, the experts might not be able to answer all the questions.* (Sue)

Among the seven participants, Ian seemed to be the only teacher who had reached the stage of committed relativism. He appeared to have carefully considered some philosophical issues. The following interaction episode (R-Researcher; I-Ian) may provide a glimpse of his epistemic stance.

> *R: Some people think that scientists can ultimately discover the truth, what do you think?*
> *I: Scientists cannot. The question is…first define truth.*

R: Scientific truth.
I: Scientific truth? They can never. In philosophy there is this concept about truth. It caused a lot of fall of theories actually. Question is they came out with a new philosophy which is called verification. For example numbers are infinite. However, numbers are infinite does not mean that the calculators cannot be used. You just have to test one plus one and the answer is two. You have verified that the calculator is working. It is a question of verification.

The above quote seems to imply that although truth cannot be arrived at, it does not follow that everything is therefore relative. One can test and verify certain assumptions and act according to the verification. The next quote provides further corroborating data on Ian's relativistic understanding of situations and yet absolutely committed stance to certain values.

R: Do you agree when someone says that there is no right answer, anybody's opinion is as good as another?
I: Wrong. I do not agree. There are certain things that I would say are definitely right. Maybe I give an example. Some people tend to say that when you get cancer…cancer is evil, but that is questionable. It is relative. I remember that I knew about this doctor. Famous oncologist, when he operates on patients, he was so inhuman. But when he had cancer himself, he began to realize the pain of cancer. He became a patient. When he was finally cured, the cancer actually did him good.
R: You saw it as contextual?
I: Contextual. But there are certain things that are of absolute values. For example, killing a person… The value can be verified by the impact that it has. For example, let's look at the impact that it creates on people. Pain. Negative connotations all come out from it... So there are absolute values. There are certain things that I believe that are still absolute.

As to the other three participants, their responses are clearly relativistic and could perhaps be also classified as either "subjective knowing" (Nadia and Sarah) or "procedural knowing" (Karen) according to Belenky et al.'s (1986) scheme. For instance, Sarah appeared to be a rather comfortable in relying on herself.

How confident? If I don't believe B and B is not believing what I believe, it's like why should I follow B? No point! Even if what I believe might not be the universal truth at least I'm comfortable with my thinking… (Sarah)

Karen appeared to be less subjective in a similar situation and she would attend to the evidence bearing on the assertions.

If they disagree, there must be some basis of this disagreement. I'll respect their decisions as long as the two of them can come up with evidence…I won't choose (sides) because normally it's like for this type of study you have to base it on evidence. (Karen)

In summary, the seven participants of this study appeared to embrace a range of epistemic beliefs with Nora and Zoe at the multiplistic end of the continuum and Ian at the committed relativistic end. Although the sample of this study was small, the distribution seemed to parallel Brownlee's (2001) work where most teachers were at the relativist stage (see also Chan & Elliott, 2004; White, 2000). None of the participants was holding the naïve belief that knowledge is certain.

Assertion 2: The teachers' beliefs about learning may vary along the dimension of knowledge acquisition and knowledge construction. Their beliefs about learning generally matched their beliefs about knowledge.
As previously mentioned, the beliefs about knowledge and beliefs about learning are considered to be two inter-related aspects of "epistemic beliefs" (Schommer, 1990). In this study, we recognized that the teachers' beliefs about how learning occurs and how students should learn may be related to their beliefs about knowledge. For two teachers, Ian and Sue, learning seemed to be more of a process of constructing personal understanding and problem solving. For example, Ian reported that he would consider a person as having learnt something when "*they've considered actually all possible and allowed research on the matter.*" Sue's response indicated that she appeared to believe rather strongly that learning should be active and constructive.

I feel that learning involves, it's not purely from text, from what you have read from the textbook. It involves exploration, self-discovery…In a way it's like you see the real thing, and then you try to find out more facts about it, that's what I would define as meaningful learning. (Sue)

The beliefs about learning held by Ian and Sue seemed rather congruent with current emphases in Singapore education reforms (Ministry of Education, 2008). However, the researcher also discovered some inconsistencies between what they have advocated as ideal learning and their reports on their teaching practices. This will be elaborated later.

Three teachers' (Nora, Sarah, and Zoe) beliefs about learning seemed to be more inclined towards traditional view of learning as acquiring more knowledge and new knowledge. As examples, the following quotes from these participants are given below:

> *Learning is about role modeling after someone who I think is right. It is also about gaining more knowledge in aspects that I already know or gaining new knowledge in aspects that I have no knowledge at all.* (Sarah)
> *You learn to gain knowledge. You will improve or discover you own talent and skill. Learn something new that can be related to your life in future.* (Zoe)

However, the following quotes may imply the inappropriateness of portraying Sarah and Zoe simplistically as only holding onto a narrow view of learning as receiving knowledge.

> *Learning requires students to be involved and to explore and to search for knowledge on their own. They are usually given the necessary help so that they are able to explore on their own.* (Sarah)
> *Student learning is whereby the students are able to widen their knowledge horizon meaningfully, able to think and answer critically and creatively.* (Zoe)

When Karen or Nadia talked about learning during the interviews, they tended to emphasize more on learning as meaning making as indicated by the following quotes.

> *Pupils are able to make meaning of what they have learnt in class and try to apply it in other circumstances…They must see the connection between what they have learnt and how it benefits them in the real world.* (Karen)
> *I believe learning takes place when the learners can make sense of what is being taught and being aware of how it becomes relevant in the future.* (Nadia)

All the participants reportedly support student-centered learning. However, in supporting their stance, Nora and Zoe did not quote substantially concrete experiences from either personal learning or teaching experiences. Sarah explicitly expressed that she did not implement student-centered learning because she questioned "*how much can they learn on their own?*" Sarah seems to see her students as not being ready (see Kang & Wallace, 2005). Karen, however, had started to experiment with students creating their own PowerPoint presentation based on mini projects, and she "*was quite impressed that most of them are able to come up with the final product.*" Nadia, on the other hand, seemed to have incorporated student-centered learning in her classroom.

In summary, the teachers' beliefs about learning appeared to vary along the dimension of knowledge acquisition and knowledge construction. The pattern seemed to match their beliefs about knowledge. This may lend support to Schommer-Aikin's (2004) argument that individuals' beliefs about knowledge and their beliefs about learning were intimately related to each other. However, it seemed that none of teachers embraced only one type of belief. In the following paragraphs, their pedagogical beliefs, with some references to their reported teaching practices, are delineated.

Assertion 3: The teachers' pedagogical beliefs in this study were more knowledge transmissionist in nature. The relationship between the teachers' epistemic beliefs and their pedagogical beliefs seemed to be mediated by other factors such as teachers' beliefs about students' readiness and what they conceived as important in the school context that they were in.

Four teachers (Nora, Zoe, Sarah, Karen) reported that teaching is a process of "*imparting knowledge*" among students. For example,

> *"Pupils have to be able to understand what is being conveyed to them during the teaching process. It is a two-way process that involves the transmission of knowledge from teachers to pupils."* (Nora)

Inferring from the term "*imparting knowledge*", these teachers tended to believe that knowledge could be transmitted from the teachers to the students. All of them also admitted that they mainly adopted a teacher-centered pedagogy at school. Their reported teaching practices also seemed to corroborate their reported beliefs.

For instance, Sarah viewed her duty as completing the syllabi and expressed that, "*I will deliver whatever that is required.*" She elaborated further that unless "*I am very sure that after removing this time for student-centered activity, I will still cover my syllabus*", she would not implement student-centered learning.

The other three teachers also articulated that they adhered to the syllabi closely and based their teaching on the textbooks. Assessments were reported to be in-class questioning for correct answers and tests and examinations at the end of the semesters. Sarah was aware that her teaching practice was not congruent with her epistemic beliefs and acknowledged that she taught "*absolute truth*". The main reason for her was "*the system makes us do so*". Since the teachers adhere to syllabi and textbooks, it seems that one possibly simple and effective way to tweak their practices would be for the local education curriculum planners to conceptualize and write the curriculum in a more relativistic manner. Textbooks could also present a more relativistic and historically evolving view of today's truths (see Grossman & Thompson, 2008).

Nadia seemed to differ slightly from the above four teachers. This was first reflected in her initial articulation of her pedagogical beliefs as shown below. She appeared to agree less with fixed objectives and curricular.

> *"I cannot go into the classroom with the sole objective to complete the syllabus and deliver the lesson planned per se. Teaching has to have an impact on the students' learning. If by the end of the day my students only manage to regurgitate facts without understanding and appreciation, then effective teaching hasn't taken place and learning would have been minimal."* (Nadia)

Among the participants, Ian and Sue again seemed to be outstanding in terms of their pedagogical beliefs. However, their reported teaching practices appeared to differ because Ian treated his context as not so supportive while Sue seemed to have a very supportive school environment. Ian has ample experience in facilitating students' digital art project and robotics project. However, Ian appeared to adopt didactic teaching practices because of the students that he was currently teaching. Ian stated rather clearly that his goal for his class was to help students to pass examinations. In other words, he was teaching to the test. The following account may reflect the eclectic nature of his teaching approaches based on students' achievements in mathematics.

> *First stage, it's more of drilling…it is more behavioral technique. But when it comes to the later part when it is more abstract, it is a mixture of the different theories about the ways to teach. When coming into the third stage, if the very weak ones still cannot understand, then I apply solely behavioral technique of teaching…But the fast ones, you can start using a lot of constructivist scaffolding. Keep scaffolding their understanding by either real-life examples or real-life situations.* (Ian)

Ian reported that his class was the weakest in the Primary 6 level. Most of them "*never pass mathematics before in their whole life*". He has about 10 months to prepare his pupils for the Primary School Leaving Examination. Employing this mixed approach that was coupled with many drill-and-practices, Ian proudly stated that most of his students passed mathematics and went on to the secondary schools. Ian's account appeared to be a case of school context inhibiting the actualization of beliefs (Richardson, 2003). More concretely, it seemed to be a case where teachers' perceptions of student readiness may influence the teacher's instructional design (Kang & Wallace, 2005). However, Ian did not seem to be concerned about the potential inconsistencies between what he believed to constitute knowing and what he was practicing in teaching. Given the sociocultural context of Singapore and other Asia regions (example Hong Kong and Taiwan) that emphasize much on examination results, teaching to test is likely to be deemed as appropriate and responsible behavior among teachers.

Sue's pedagogical beliefs seemed to be more consistent with her epistemic beliefs. Her goal in teaching was to "*develop independent learners*" who "*will learn for the quest and joy of learning rather than learn for the sake of passing exam*" and "*share their knowledge with their friends and peers*". She tended to believe strongly in activity-based lessons that are "*dependent on teamwork*" and "*encourage them to explore things*".

> *I feel that for kids to learn, they need to have hands-on and activities that are meaningful, that will engage them in order for them to be able to remember whatever they have actually learnt. And it must be something that is enjoyable.* (Sue)

Sue described a series of lessons anchored by an animated and interactive website that she had designed. The following quote illustrates how she realized her pedagogical beliefs.

> *This lesson is supposed to be in unit one, on My School. So in one of the activity books they are supposed to write down the functions of the various rooms… I felt that the pupils already know, so*

> *what's the point of me doing this? I came up with this idea of promoting the Media Resource Library (MRL), which I proposed the name to be Media Magical Island. So it's actually a 3-in-1 kind of thing because I'm supposed to have an assembly talk for MRL. Bearing in mind the pupils are actually good pupils, I have actually come up with this reader's theatre. They are able to read, but most of the time they are not able to read with expression. So at the end of the lesson it is hoped that they are able to come up with a script pertaining to Media Magical Island that promotes the Media Magical Island to the school. This also allows them to read the script because reader's theatre you don't memorize, they read, but with expression. It allows them to gain confidence when they're on stage. It was quite a success because at the end of it when I get the people to write the reflections, they actually wrote that they enjoyed and they hoped to have another session.* (Sue)

This account demonstrated how Sue typically used her knowledge of the students (they knew about the places but were lacking in reading with expression), the purpose of the curriculum (practicing writing about places), school contexts (assembly talk as consequential task) to craft engaging activity-based lessons. Sue's pedagogical beliefs were clearly reform-oriented. Her teaching context also allowed her to implement what she believed in. She reported that the principal had created the "mega" class where all the high achievers were put into one class and assigned her to challenge the students with innovative teaching. She had also reported an incident whereby her principal defended her when one parent expressed her displeasure with Sue's series of mini projects.

While Sue's reported teaching practice seemed constructivist oriented, her account also seemed to emphasize more of the activities aspect rather than the sense-making of the activities. Focusing on activities has been pointed out by researchers as a potential danger which could lead to shallow constructivism (Scardamalia & Bereiter, 2003). Sue also seemed to hold an accumulative view of knowledge. For example, when she talked about the advantage of collaboration, she stated, "*I always encourage students to find out from their peers because their peers could have more knowledge*". She also referenced the strength of problem-based learning as "*retain the facts that they have learned.*" Similar to Ian, she was not concerned about the potential inconsistencies. An alternative explanation for the inconsistencies would be that the participants were expressing relativist views of knowledge because they were aware that the researcher, who was their facilitator/ teacher, was portraying such a view most of the time. However, this seems unlikely since both Ian and Sue had provided consistent accounts across their epistemic beliefs, personal histories, views of learning and their teaching practices. It was only in this aspect that they were providing inconsistent views.

In summary, it seemed that none of the participants believed that knowledge is not transmittable and in varying contexts all of them practiced didactic teaching. Regarding teaching as transmitting knowledge is common among teachers (Richardson, 2003). Also, it seemed that the teachers who were more relativistic tended to prefer constructivist teaching practices. However, to construct or to transmit knowledge seemed to be for the teachers a methodological choice informed by contextual constraints for achieving their goals of enabling students to advance to the next grade rather than an actualization of personal epistemic beliefs. In schools, teachers are not held accountable for such inconsistencies. Rather, they were accountable for students' examination performance. As such, the inconsistencies between the teachers' epistemic beliefs and their teaching practices reported in the literature (Fang, 1996; Schraw & Olafson, 2002) may only be meaningful to the "theorist". The teachers' accounts appeared to be moving along the pragmatics of school rather than on the plane of philosophical arguments. Alternatively, Hammer and Elby's models of epistemology (2002) seemed to help to account for such inconsistencies. Teachers may possess different teaching approaches along with its epistemological assumptions. They employed these approaches based on the various contexts they encounter (whether students were ready or not).

CONCLUSION

This case study examined teachers' epistemic beliefs and their pedagogical beliefs within the Singapore context. Based mainly on their reports, the seven teachers seemed to hold more or less relativistic beliefs about knowledge. As it seems that there are not many teachers with highly developed epistemic beliefs, it would imply that teacher educators should provide opportunities for teachers to explicate their beliefs. This forms the foundation of future development for the teachers' epistemic beliefs. The teachers' beliefs about learning appeared to vary from knowledge acquisition to knowledge construction. Their reports also indicated that their pedagogical beliefs were fundamentally knowledge transmissionist. Furthermore, it seemed that the extent of (epistemic) beliefs manifestation depended mostly on what the teacher conceived as their priorities with regard to goal achievement and their awareness of students' readiness. Given these, it seems important to change the context in which teachers operate in if the ICT-supported reform efforts are to take root. In other words, it is insufficient for teacher educators to facilitate development in teachers' beliefs. A more conducive environment jointly created by the policy makers and school leaders has to be in place. Without such environment, teachers

may choose to adopt traditional teaching approach that works well for examinations and tests. It is the hope of the researcher that this article illustrates the complex interplay between teachers' beliefs and their teaching context, from the teachers' point of view. For future research, it seems important for researchers to identify teachers who are able to resolve the tension between their beliefs and their teaching context and document their development trajectories. Case studies on systemic changes that facilitate development of teachers' beliefs coupled with changes in teaching context are also needed to advance the course of ICT-supported reforms.

REFERENCES

Abdelraheem, A. Y. (2004). University faculty members' context beliefs about technology utilization in teaching. *The Turkish Online Journal of Educational Technology, 3* (4), 76-84.

Belenky M. F, Clinchy, B. M, Goldberger, N. R., & Tarule, J. M. (1986*). Women's ways of Knowing: The development of self, voice and mind*. New York: Basic Books.

Brownlee, J. (2001). Knowing and learning in teacher education: A theoretical framework of core and peripheral epistemic beliefs. *Asia-Pacific Journal of Teacher Education and Development, 4*(1), 131-155.

Brownlee, J. (2004). Teacher education students' epistemic beliefs. *Research in Education*, 72, 1-17.

Chai, C. S., & Khine, M. S. (2008). Assessing the epistemological and pedagogical beliefs among pre-service teachers in Singapore. In M. S. Khine (Ed.), *In Knowing, knowledge and beliefs: Epistemological studies across diverse cultures* (pp. 287-299). Amsterdam, Netherlands: Springer.

Chai, C. S., Teo, T., & Lee, C. B. (2010). Modelling the relationships among beliefs about learning, knowledge, and teaching of pre-service teachers in Singapore. *The Asia-Pacific Education Researcher, 19*(1), 25-42.

Chai, C. S., Deng, F., Qian, Y., & Wong, B. (2010). South China Education Majors' Epistemological Beliefs and their Conceptions of the Nature of Science. *The Asia-Pacific Education Researcher, 19*(1), 111-125.

Chan, K. W., & Elliott, R. G. (2002). Exploratory study of Hong Kong teacher education students' epistemic beliefs: Cultural perspectives and implications on beliefs research. *Contemporary Educational Psychology, 27*, 392-414.

Chan, K. W., & Elliott, R. G. (2004). Relational analysis of personal epistemology and conceptions about teaching and learning. *Teaching and Teacher Education*, *20*, 817-831.

Cheng, M. H. H., Chan, K., Tang, S. Y. F., Cheng, A. Y. N. (2009). Pre-service teacher education students' epistemic beliefs and their conceptions of teaching. *Teaching and Teacher Education, 25*, 319-327.

Cohen, L., Manion, L. & Morrison, K. (2000). *Research methods in education.* (5th ed.). New York, NY: Routledge Falmer.

Creswell, J.W. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: SAGE.

Erkunt, H. (2010). Emergence of epistemic agency in college level educational technology course for pre-service teachers engaged in CSCL. *The Turkish Online Journal of Educational Technology, 9* (3), 38-51.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for
technology integration. *Educational Technology Research and Development, 53*(4), 25–39

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research*, *38*, 47-65.

Feucht, F. & Bendixen, L. D. (2010). Exploring similarities and differences in personal epistemologies of U.S. and German elementary school teachers. *Cognition and Instruction, 28*(1), 39-69.

Flick, U. (2002). *An introduction to qualitative research.* London, UK: SAGE.

Grossman, P., & Thompson C. (2008). Learning from curriculum materials: Scaffolds for new teachers. *Teaching and Teacher Education, 24,* 2014-2025.

Guba, E., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Newbury Park, CA: Sage Publications.

Hammer, D. M., & Elby, A. (2002). On the form of a personal epistemology. In B. K. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 169-190). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Hofer, B. K. (2008). Personal epistemology and culture. In M. S. Khine (Ed.), *In Knowing, knowledge and beliefs: Epistemic studies across diverse cultures* (pp. 3-24). Amsterdam, Netherlands: Springer.

Hofer, B. K. (2001). Personal epistemology research: implications for learning and teaching. *Educational Psychology Review, 13*(4), 353-383.

Hofer, B. K., & Pintrich, P.R. (1997). The development of epistemic theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research, 67*(1), 88-140.

Jonassen D. H. (2000). *Computers as Mindtools for schools* (2nd ed.). Upper Saddle River, NJ: Prentice-Hall.

Kang, N. & Wallace, C. S. (2005). Secondary science teachers' use of laboratory activities: Linking epistemic beliefs, goals, and practices. Science Education, 89(1), 140-165.

King, P. M., & Kitchener, K. S. (1994). *Developing Reflective Judgement.* San Francisco, CA: Jossey-Bass.

Merriam, S. B. (1998). *Qualitative research and case study applications in education.* San Francisco, CA: Jossey-Bass.

Ministry of Education, Singapore, (2008). MOE Launches Third Masterplan for ICT in Education. Retrieved Jan 20, 2010, from http://www.moe.gov.sg/media/press/2008/08/moe-launches-third-masterplan.php

Pajares, M. F. (1992). Teachers' beliefs and educational research: cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332.

Perry, W. G. (1970). F*orms of Intellectual and Ethical Development in the College Years: A scheme*. New York: Holt, Rinehart and Winston.

Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula., T. J. Buttery., & E. Guyton (Eds.), *Handbook of research on teacher education* (2nd ed.) (pp. 102-119). New York, NY: Macmillan.

Richardson, V. (2003). Preservice teachers' beliefs. In J. Raths, & A. C. McAninch (Eds.), *Teacher beliefs and classroom performance: The impact of teacher education.* (pp. 1-22). Greenwich, Connecticut: Information Age Publishing.

Scardamalia, M. & Bereiter, C. (2003). Knowledge Building. In J. W. Guthrie (Ed.), *Encyclopedia of Education* (2nd ed.) (pp. 1370-1373). New York: Mcamillan Reference, USA.

Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology, 82*(3), 498-504.

Schommer, M. (1994). Synthesizing epistemic belief research: Tentative understandings and provocative confusions. *Educational Psychology Review, 6*, 293-320.

Schommer-Aikins, M. (2004). Explaining the epistemological belief system: Introducing the embedded systemic model and coordinated research approach. *Educational Psychologist, 39*(1), 19-29.

Schraw, G. & Olafson, L. (2002). Teachers' epistemic world views and educational practices. *Issues in Education 8*(2), 99-149.

Sinatra, G. M., & Kardash, A. M. (2004). Teacher candidates' epistemic beliefs, dispositions, and views on teaching as persuasion. *Contemporary Educational Psychology, 29*, 483-498.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage.

Teo, T. (2009). Examining the relationship between student teachers' self efficacy beliefs and their intended uses of technology for teaching: A structural equation modelling approach. *The Turkish Online Journal of Educational Technology*, *8* (4), 76-84.

Teo. T., Chai, S. C., Hung, D., & Lee, C. B. (2008). Beliefs about teaching and uses of technology among pre-service teachers. *Asia-Pacific Journal of Teacher Education, 36*(2), 163-174.

White, B. C. (2000). Pre-service teachers' epistemology viewed through perspectives on problematic classroom situations. *Journal of Education for Teaching,26*(3), 279-305.

Wong A. K., Chan, K-W., & Lai, P-Y. (2009). Revisiting the relationships of epistemic beliefs and conceptions about teaching and learning of pre-service teachers in Hong Kong. *The Asia-Pacific Education Researcher, 18*(1), 1-19.

Wong, B. & Chai, C. S. (2010). Asian personal epistemologies and beyond: Overview and some reflections. *The Asia-Pacific Education Researcher, 19*(1), 1-6.

Woolfolk-Hoy, A., Davis, H., & Pape, S. J. (2006). Teacher knowledge and beliefs. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of Educational Psychology* (2nd ed., pp. 715-737). Mahwah, NJ: Lawrence Erlbaum.

Appendix 1: Interview Schedule

Learning

1. Can you describe a significant learning experience?
2. What comes to your mind when you think about learning?
3. How do you go about learning in general?
4. What strategies do you use?
5. How do you know when you have learnt something?

Teaching

1. Let's talk about a lesson that you have conducted.
    a. How do you decide the instructional goals and the objectives?
    b. How do you select the activities?
    c. How do you select the resources?
    d. How do make use of students' interest and prior knowledge?
2. How reflective is this lesson compare to the rest of your lesson?
    a. What comes to your mind when you think about teaching?
    b. What are the things that you do before you teach a lesson?
    c. What are the things that you do when you teach?
3. How do you usually evaluate students' learning?
4. How do you usually make use of the textbook?
5. What do you think of student-centred lesson?
    a. For example, project work. Do you consider it as a student-centred lesson? What are the value and problem?
    b. Can students construct knowledge? How?

Epistemology

1. Some people think that scientist can ultimately discover the truth. What do you think about this statement?
2. What about the statement "Today's truth maybe yesterday or tomorrow fiction"?
3. How do you come to know?
4. How do you know when you know something?
5. In learning about something that you really want to know, what is the role of an expert?
    a. How do you know someone is an expert?
    b. What do you do when you discovered that experts disagree with each other?
6. Do you agree when someone says that there are no right answers and anybody's opinion is as good as another's?

THE EFFECT OF ELECTRONIC STORYBOOKS ON STRUGGLING FOURTH-GRADERS' READING COMPREHENSION

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ABSTRACT
This quantitative research examined the differences in struggling readers' comprehension of storybooks according to the medium of presentation. Each student was randomly assigned with one of three conditions: (1) computer presentation of storybooks with animation; (2) computer presentation of storybooks without animation; and (3) traditional print storybooks. 77 participants were selected among fourth-grade students who were reading below current grade level and not meeting Sunshine State Standard as measured by Florida Comprehensive Assessment Test (Reading Level one or Reading Level two). Comprehension was measured by using retelling. Analysis of variance (ANOVA) was used to test research question at the .05 level of significance. The results of statistical analysis indicated that there was significant difference in the students' comprehension scores. When the student controlled the animation functions of electronic storybooks, the animated illustrations were shown to result in significantly higher improvement of comprehension scores, both in terms of the students' ability to retrieve information and to make inferences from the stories. The results of the research also indicated that electronic storybooks can improve reading comprehension and can be beneficial for struggling readers.
Keywords: Literacy and technology, electronic storybooks, reading comprehension, struggling readers

INTRODUCTION

Background

The main objective of reading is to understand a written message (Doty, 1999). National Center for Educational Statistics [NCES], (2005) defines reading as "an active and complex process that involves understanding written text, developing and interpreting meaning, and using meaning as appropriate to type of text, purpose and situation" (p. 2). Reading comprehension is crucial to the development of children's reading skills and thus to their ability to obtain an education. (Durkin, 1993; National Institute of Child Health and Human Development [NICHD], 2000; Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007). Without comprehension, reading words is reduced to imitating the sounds of language, repeating text is simply memorization and oral drill (Paris, & Hamilton, 2008). There are many definitions of reading comprehension. Harris and Hodges (1995) defined comprehension as "intentional thinking during which meaning is constructed through interactions between text and reader" (p. 207). Similarly, the report of National Reading Panel [NRP] (2000) reported that reading comprehension is a complex and cognitive process that requires an intentional and thoughtful interaction between the reader and the text. When readers actively relate the ideas represented in print to their own knowledge, experiences and construct mental representations in memory, text comprehension is improved. All of these definitions and information concluded that reading comprehension is an active cognitive process, and involves interaction between reader and text to construct meaning. Also the reader's schema, prior knowledge, and metacognitive skills play important roles in comprehension as well as characteristics of texts such as coherency, additional aids, and organizational hints (Doty, 1999).

Even though reading comprehension is very important to children's reading skills and it is a predictor of their future academic success, many students struggle with reading. Reading difficulty is not only a problem for younger children; older students also have similar issue. National Assessment of Educational Progress [NAEP] (2007) reported urgency of the problem. Seven hundred and thirty schools and 191,000 fourth-graders participated in a reading assessment. The results of this assessment showed that about one third of fourth graders cannot read at a basic level (NCES, 2007). Furthermore, struggling readers read and learn less than their peers, resulting in the Matthew Effect, where the rich become richer and the poor get poorer (Stanovich, 1986). Therefore, reading problems often continue into adulthood; approximately 23% of U.S. adults meet only basic reading proficiency levels (NCES, as cited in Rapp et al., 2007). All of these issues emphasize the need for effective approaches for struggling readers.

Computer technology has a role to play in the remediation of children with reading problems and successes in reading instruction (NICHD, 2000) such as motivation, personal instruction, and interaction. The NRP's meta-analysis of the extant research in computer technology revealed several findings. First, all the studies report positive results, suggesting that it is possible to use computer technology for reading instruction. Second, new computers have many multimedia presentation functions and research is needed on the use of multimedia presentations in reading instruction. Third, computer-presented text indicates that this may be a promising use of

technology in reading instruction. Fourth, use of computer technology to assist reading is a relatively new field, the number of studies published in this area is small and many questions remain unanswered (NICHD, 2000).

Dalton and Strangman (2006) point out that "technology and computer-mediated text have the potential to support students with reading problems in two ways: providing access to text and helping students learn how to read with understanding" (p. 75). Print is often thought of as a traditional technology that often serves as barrier, rather than a gateway, to learning. Even though traditional print text requires interaction between reader and texts, traditional print texts is passive, non-interactive with non-adaptable features, static with two-dimensional images, and cannot response to individual readers, restricted by their linear composition, and relies heavily on the reader's internal strategies to activate prior knowledge (Doty, 1999; Pearman, 2008). Additionally, readers follow the structure or plot which is designed by the author. On the other hand, electronic texts typically have different and new formats. These new formats are nonlinear, non-sequential, interactive, and can provide a literal interaction between the reader and the text (Coiro, 2003; Reinking, 1992; Schmar-Dobler, 2003; Sutherland-Smith, 2002).

In the last decade, given the promise of the technology for student with reading problems, the technology research literature focused on computer-mediated texts. Progress in software development has dramatically changed the nature of software for reading. Until recently, not many software programs suitable for struggling readers were available (Lewis, 2000). A valuable tool in educational settings, the electronic book has been widely used in classroom literacy learning in the early school years (Chen, Ferdig, & Wood, 2003; Matthews, 1996; Underwood, 2000). Electronic storybooks are reading software for children in illustrated storybooks that help children develop visual recognition. In addition, these interactive electronic storybooks offer more comprehension hints and a better background for story than traditional printed texts (Doty 1999, Reinking 1988). Electronic storybooks are mainly designed to integrate text, graphics, animations, music and other multimedia components in order to bring support to the story line (Chen et al., 2003; Glasgow, 1996-1997). Electronic storybook technology has significantly improved the potential for adding animations for readers. Children could read the stories on their own or listen to the stories read and animate parts of illustrations.

Statement of the Problem

A great number of children struggle with reading. The latest results of a NAEP report clearly show the urgency of problem: 33 % of fourth graders were not able to achieve even a "basic" level of proficiency on the NAEP reading test (NCES, 2007). Although data from NAEP 2007 Reading Report Card shows increased scores for low performing students in the fourth and eighth grades in 2007 as compared to previous years (fourth-graders in 2007 scored two points higher than in 2005 and four points higher than in 1992), there is not a lot of good news on this report. On the average, there was little improvement in the reading skills for fourth graders across the nation since 1992. Furthermore, reading comprehension problems have also been very stubborn. Even 46% of fourth-graders performing at the basic level were not able to demonstrate full comprehension (34% partial or surface comprehension, 11% little or no comprehension, 1% omitted) (NCES, 2007). Anderson-Inman & Horney (1998) add, "Unfortunately, a large percentage of students in our country are not effective in their attempts to acquire and use information from text due to significant deficiencies in reading" (p.15).

Another problem was pointed out by Robb (2000); he claimed that children's interest in reading for pleasure and motivation to read was being reduced. Electronic storybooks can help these unmotivated and uninterested children. In addition, two-thirds of American classrooms have fewer than 50 children's books, and almost 60% of childcare centers buy less than one book per child a year (Neuman, Celano, Greco, & Shue, 2001). Fourth-graders who reported having 25 books or more at home had higher scores on the NAEP reading test than children who reported they didn't have that many books (NCES, 2001). Through the use of electronic storybooks, educators have a promising solution for very limited availability of children books.

Weak decoding skills and lack of fluency are major barriers to comprehension for struggling readers (Ehri, 1994). Digital texts have the capability to eliminate decoding and fluency problems through text-to-speech and digitized speech (Dalton & Strangman, 2006). New vocabulary and concepts, complex sentence structure, lack of previous knowledge and new text structure are the other reasons for poor comprehension (Lipson & Wixson, 1997). Struggling readers are also less strategic in their approach to text and they have a difficulty for monitoring understanding (Graham & Harrison, 1996, as cited in Dalton & Strangman, 2006; Swanson & Alexander, 1997). Many struggling readers do not view themselves as in charge of their learning and may avoid reading whenever possible (Dalton & Strangman, 2006, p. 80). The problem is critical, and promise of technology apparent, there is continued research, focusing on students with reading problems (MacArthur, Feretti, Okolo, & Cavalier, 2001; Strangman & Dalton, 2005, 2006).

New technologies offer great opportunity and great challenge (Dalton & Strangman, 2006, p. 88). As a scaffolded learning environment, digital texts provide support to the students with diverse learning needs. Digital learning environments, through good quality of flexibility of the medium, have the potential of scaffold instruction in a rich variety of ways (Bus, De Jong, & Verhallen, 2006). For example, images and animated graphics can be incorporated into digital texts to supplement textual definitions, supporting vocabulary understanding and reading comprehension (Anderson-Inman, Horney, Chen, & Lewin, 1994; Boone & Higgins, 1993). Electronic texts also changed to offer strategic scaffolds such as self-monitoring questions (Anderson-Inman & Horney, 1998). Several studies reported encouraging findings using electronic storybooks. For instance, electronic storybooks improve reading motivation for children with reading difficulties (Adam & Wild, 1997; Glasgow, 1996-1997), recognition of words for kindergarten children (De Jong & Bus, 2002; Lewin, 2000), story comprehension (Doty, Popplewell, & Byers, 2001) and story retelling (Matthew, 1996).

However, the results of the few available studies are not consistent. Some of the studies have shown that electronic storybooks elements may also potentially become distractions (De Jong & Bus, 2002; Matthew, 1996; Okolo & Hayes, 1996; Trushell & Maitland, 2005; Underwood & Underwood, 1998). De Jong and Bus (2002) revealed that children's understanding of a story's content was less supported by the electronic version than the traditional print book format. Additionally, the illustrations, games, attractive pictorial options included in the story motivate children but if they are not matching with the story, they can distract the children's focus on the story instead of supporting the narrative's comprehension and could cause passive reading, and delay children's early literacy development (De Jong & Bus, 2002; Labbo & Kuhn, 2000; Matthew, 1996; Shamir & Korat, 2006; Underwood & Underwood, 1998).

This study is different from previous researches in several ways. Firstly, the results of the studies previously carried out in this area have been conflicting and are frequently hard to interpret. If there is any difference, it is not clear whether it is coming from narration and/or animation features of storybooks. Usually there was no obvious explanation or detail about what kind of illustrations or animations were used in the study. The current study is an attempt to address some of the shortcomings of previous research and this study provides an empirical data, to do specific and systematic investigation that confirms which features and types of story presentations are more effective than others for older struggling readers.

Secondly, most of the previous researches are focused on younger children and early grades. Some of these researches claim that electronic books are quite effective in early literacy development, reading comprehension, and language development for young children (De Jong & Bus, 2004; Grant, 2004; Higgins, 1999; Korat, 2008; Lewin, 2000; Maynard, 2005). Korat (2008) stated that young children are found to especially respond well to enhance features of electronic books. Therefore, this study is focused on fourth-grades students' literacy achievement. Thirdly, previous researches often compare two groups, reading paper version texts and electronic versions, as a research design, validity and reliability are a major problem, and the findings are very limited and general, thus, we need more specific and systematic investigations.

Fourthly, the previous studies do not tell us much about how struggling students are reading and understanding the new multimedia texts. We enter a new technological era where computers are readily accessible to children; questions arise as to the potential of this type of software on literacy development (Labbo, 1996). We know very little about specifically which features of electronic text work best for struggling readers, and in relation to different types of texts and reading comprehension. This should be a major area of investigation. Several questions remain unanswered; do children passively view screens that distract their attention away from meaning making? Do electronic storybooks support struggling readers' comprehension? Although, findings from recent studies suggest various elements play important roles in whether electronic books provide proficient scaffolds for children of various literacy ability levels, Bus et al. (2006) emphasized that "additional work is needed to learn more about the effects of considerate animations as scaffolds to children's story comprehension" (p. 134). More studies are needed to test which particular features of electronic storybooks, such as animation interactivity of texts, have potential to improve comprehension when the story is presented as static illustrations, and animated illustrations (De Jong & Bus, 2002; Bus et al., 2006). For all these reasons and questions mentioned above, this research investigated the extent to which use of medium of storybooks positively influenced struggling readers' comprehension.

Purpose of the Research

The objective of this research was to compare and explore the effects of the medium of storybooks presentations on struggling readers' reading comprehension. For this purpose of the research, each student was presented with one of three conditions: (1) computer presentation of storybooks with animation; (2) computer presentation of

storybooks without animation; and (3) printed version of storybooks. These three conditions were compared with respect to reading comprehension as measured by multiple-choice comprehension test and retelling.

Research Question

The following research question was addressed in this research: Do fourth-grade struggling readers differ on reading comprehension as measured by retelling when they read the same storybooks presented in electronic format with and without animation and in a traditional print format?

LITERATURE REVIEW

Comprehension Difficulties of Struggling Readers

Cooper et al. (2006) defines struggling reader as "a student who is experiencing significant difficulty learning to read" (p.11). Many struggling readers exhibit reading difficulties (Rapp et al., 2007). According to Biancarosa and Snow (2004), older struggling readers, who are between fourth and twelfth grade, mostly do not need help to read the words. However, their frequent problem is that they fail to comprehend what they read. Struggling readers are less conscious and have less management of their comprehension process when they are reading (Baker, 2002). Background experiences, oral language, decoding, phonemic awareness, fluency, oral reading, and writing vocabulary, comprehension, maintaining attention, and motivation are likely areas of difficulties exhibited by struggling readers. Struggling readers are not exactly the same; for instance, some may not have difficulty decoding words or fluency but have difficulty comprehending the text (Asselin, 2002; Yuill & Oakhill, 1991).

In the early grades, the primary emphases are on the alphabetical principle, phonemic awareness, decoding, and word recognition (Adams, 1990; Kingham, 2003). However, once students reach upper grade levels, the primary emphasis shift towards reading comprehension and the anticipations of reading comprehension increase. The expectations are to understand more complex texts and to apply appropriate background knowledge in a variety of contexts (Gardill & Jitendra, 1999; Kingham, 2003).

The existing literature provides that reader characteristics, text properties, and instructional contexts are main elements of comprehension difficulties (Rapp et al., 2007). Kingham (2003) claims that there are three basic theories offered to clarify reading comprehension difficulties. The first theory is that comprehension problems are rooted in word recognition problems. Students with good comprehension have stronger word recognition skills than poor comprehenders. Slow decoding causes a block in the working memory of the reader. Since students with poor comprehension do not use their working memory efficiently, this gives them a lower functioning capacity for comprehension purposes (Perfetti & Lesgold, 1979). The second theory claims that readers have difficulties in syntactic and semantic analysis of texts, and are incapable of making use of the structural limit of language. Students with poor comprehension are presumed to pay no attention to the syntactic clues in texts and read word by word instead of processing texts in appropriate units (Cromer, 1970). The third theory hypothesizes that readers have difficulty making inferences from texts, and combining the ideas with them. Poor comprehenders are argued to have enough word recognition and syntactic skills but experience difficulty at inference and integration levels and fall short to monitor their comprehension (Kamhi, 1997; Kingham, 2003; Yuill & Oakhill, 1991).

Research in the cognitive sciences has provided important insights into the challenges and potential sources of reading comprehension difficulties (Gernsbacher, 1990; Graesser, Gernsbacher, & Goldman, 2003). First, "one of the most consistent findings from cognitive psychological research on reading is that the construction of a coherent representation of text in memory is central to successful comprehension" (Rapp et al., 2007, p. 292). Second, a coherent mental representation as a network that shows the meaningful connections between elements of text and the reader's background knowledge (Kintsch & van Dijk, 1978; Rapp et al., 2007). A lack of background knowledge or failure to activate background knowledge is a potential source of difficulty for struggling readers (Cooper et al., 2006). However, some researchers are concerned that struggling readers often over rely on their background knowledge causing them to move further from the intended meaning of texts (McCormick, 1992; Trabasso & Suh, 1993; Williams, 1993, as cited in Rapp et al., 2007). Struggling reader's schema for simple stories is not developed or as efficiently utilized as that of good readers (Rahman & Bisanz, 1986).

The other major sources of comprehension difficulties that influence a student's ability to comprehend are readers' processing capacities, a lack of interest in reading, negative attitudes to reading, and motivation (Rapp et al., 2007). Most struggling readers are particularly uninterested. Struggling readers may perhaps have low self-confidence in their reading skills and they believe they cannot comprehend. The educators in literacy

development suggest that the struggling reader must be expanded to recognize that this individual is disengaged from literacy (Moje, Readance, & Moore, 2000).

The content and format of texts also influence struggling readers' comprehension. The characteristics of text a student is reading, the difficulty of the text, and type of text can also limit his or her ability to comprehend (Alexandar & Jetton, 2000 Kingham, 2003). Struggling readers often have little knowledge of text structures. Using charts, graphs, and diagrams to provide visual aids are helpful for understanding text. For example, if a student is given a full page of text with no illustration, probably the student is overwhelmed by it. "When the student is given the same material spread over more pages, with less text on each page and with some illustrations; the student could read the words and comprehend the text" (Cooper et al., 2006, p. 121).

Another important variable that influences how well students comprehend is their knowledge and ability to use strategies (Paris et al., 1991). Many struggling readers fail to apply reading strategies such as self-questioning or explanations summarization and explicit self-monitoring of comprehension. They are less strategic, and particularly lack effective memory search strategies. Because of repeated failures, struggling readers do not recognize the effective strategies they do use. Instead of learning alternative strategies from their failure, they often give up. NRP (2000) report has shown that struggling readers can increase reading comprehension skills by learning the specific strategies such as prediction, questioning, clarifying, imagining and summarization.

In summary, struggling readers have difficulty with comprehension for a variety reasons. Helping struggling readers overcome problems with comprehension is not an easy task, because they often have multiple difficulties. Every student's needs and the reason for their problems must be evaluated and identified. The findings can be used to supply interventions that teach students how to activate their prior knowledge and how to use various strategies for constructing meaning or comprehending text (Cooper et al., 2006).

Technology and Reading Comprehension

Reading comprehension is influenced by new technology and literacy. Recent literature has stated a long tradition of book and print media is insufficient, students and teachers use new and varied forms of technology. The need for changes in the way we think about reading comprehension is inevitable (Coiro, 2003). Rand Reading Study Group (2002) pointed out "an explosion of alternative texts" and "electronic texts that incorporate hyperlinks and hypermedia introduce some complications in defining comprehension because they require skills and abilities beyond those required for the comprehension of conventional, linear print" (p. 14). These new reading environments bring out cognitive and aesthetic challenges to comprehension (Spires & Estes, 2002) and there is a need for theoretical description of the comprehension process (p.123).

Technology's Effects on Struggling Readers

Review of research on technology involvement with struggling readers demonstrates constantly encouraging findings and studies have agreed the contribution of technology involvement resulted in considerable gains in reading comprehension (Denman, 2004). The NRP meta-analysis has found the 21 studies used to assess computer technology that showed promising results (NICHD, 2000). Computer-supported environments can help our understanding of the struggling readers' reading problems and "may help compensate for inadequate reading ability" (McKenna et al., 1999, p. 113).

Research findings are also optimistic about the future of multimedia applications for struggling readers. For example, Higgins, Boone, and Lovitt (1996) found that electronic social studies texts improved comprehension for students with learning disabilities. Hegarty, Carpenter, and Just (1991) reported that animation in electronic text help to illustrate unfamiliar processes for students with low mechanical ability. Many features of electronic storybooks are well matched for phonemic awareness, phonics, fluency; vocabulary, and comprehension (Pearman & Lefever-Davis, 2006). Computer software has the exceptional capacity to bring individualized practice to students who need to enhance their reading fluency (Oakley, 2003). In addition to providing practice in developing reading fluency, electronic storybooks can help poor readers' vocabulary development (Pearman & Lefever-Davis, 2006). The ability to recognize sound-symbol relationships is essential, but it is not enough for comprehension. Students must also activate their prior knowledge and use context hints to comprehend what they read. There is growing indication that computer-supported effects such as animation and sound allow students to make these connections (Matthew, 1997). Greenlee-Moore and Smith (1996) indicate that the use of interactive storybooks may help improve reading comprehension for elementary students. In addition, electronic storybooks develop the story setting through animated graphics and sound effects indicating story mood and events and thus supporting comprehension (Lefever-Davis & Pearman, 2005). Visual aids in electronic storybooks are helpful for understanding text and building coherent mental representation. Multimedia

presentation, which includes text, graphics, sound, and animated images, is also helpful motivation for a struggling reader who is particularly uninterested.

Electronic Texts

Electronic texts possess new characteristics that require different types of comprehension processes and a different set of instructional strategies. "Electronic texts introduce new supports as well as new challenges that can have a great impact on an individual's ability to comprehend what he or she reads" (Coiro, 2003, p. 458). In addition, special features of electronic texts provide powerful advantages like facilitating the process of constructing meaning and assisting reader's difficulties (Reinking et al., 1998).

Text features of traditional and electronic texts are completely dissimilar. For example, traditional print text is passive, non-interactive with non-adaptable features, linear, static with two-dimensional images. Additionally, reader follows the structure or plot which is designed by author. On the other hand, electronic texts typically have new formats. For instance, these new formats are nonlinear, and interactive (Coiro, 2003; Schmar-Dobler, 2003; Sutherland-Smith, 2002). Images are more lifelike than in traditional print texts (Sutherland-Smith, 2002). Also electronic texts combine different functions such as animations, cartoons, and audio and visual video clips (Coiro, 2003). For the new text format, the readers need to apply and develop new literacy skills and strategies, because text structure is dissimilar between electronic and conventional texts. Sutherland-Smith (2002) electronic texts necessitate high levels of visual literacy skills, comprehension strategies, and new ways of thinking. Electronic texts users must be skilled in interpreting, evaluating and synthesizing information and all graphic features in new text format (Coiro, 2003; Schmar-Dobler, 2003).

Reading comprehension is influenced by new technology and literacy. Recent literature has stated that a long tradition of book and print media is insufficient; students and teachers use new and varied forms of technology (Coiro, 2003). As a valuable tool in educational settings electronic books have been used in classroom literacy learning (Chen, et al., 2003; Matthews, 1996; Underwood, 2000).

Pearman and Lefever-Davis (2006) claimed that comprehension skills can be developed through electronic storybooks. However, a review of the literature has shown that a limited number of studies have investigated comprehension comparing the use of electronic storybooks to a traditional print text. Basically, there are three groups of studies related to electronic story books and comprehension. The first group early works claimed comprehension can be supported and developed by electronic storybooks. The second group research on electronic storybooks found detrimental effects on comprehension. The third group of studies found mixed results with increase in comprehension depending on the assessment instrument or found no evidence that storybooks support or distract comprehension.

METHODOLOGY

Research Design

In this research, experimental research design with one dependent variable and one independent variable was used for testing three conditions. Dependent variable is reading comprehension as measured by the retelling. The independent variable is the type of medium of presentation. Three conditions: (1) electronic storybooks with animation, (2) electronic storybooks without animation, and (3) printed version of storybooks were tested.

Participants

The subjects were 77 fourth-grade students from five elementary schools in the Alachua, Florida school district. Of the 89 students were eligible to be considered for this study and 77 students returned signed permission letters from their parents. The subjects' ages ranged from 9-11, with a mean of 9.96 years. Forty-eight participants were female, and 29 were male. The subjects were selected among fourth-grade students who were reading below at least one or two years from current grade level and not meeting Sunshine State Standard [SSS] as measured by Florida Comprehensive Assessment Test [FCAT] in 2007 (Reading Level one, (n=27); Reading Level two, (n=50). Florida's retention policy requires students to reach a minimum threshold on the reading portion of the Florida Comprehensive Assessment Test (FCAT) to be promoted to the fourth grade. For instance, third-graders must pass the reading test to be promoted to fourth grade. In other words, by State of Florida law, third-grade students who scored at Level one of the FCAT were required to spend at least one extra year in third grade. Therefore, some of the subjects of the research held back and repeated the third grade. According to Florida Department of Education (2004) the FCAT is a highly reliable test. On fourth-grade reading test correlation between the FCAT and Sunshine State Standard in year 2001, 2002, and 2003 were .90. Correlation between FCAT, Sunshine State Standard and Norm Referenced Test (Stanford 9) confirmed that the FCAT demonstrates

concurrent validity. For fourth-grade reading test in 2001, correlation was .80, and following two years .83, and .82. "The evidence of reliability and validity support the claim that FCAT is technically sound and meets or exceeds the professional standards for standardized achievement tests" (Florida Department of Education, 2004, p. 24). The subjects' selection was based on FCAT scores. The subjects were assigned to each of the three treatment groups by first ranking them on reading ability level using FCAT scores. Once ranked, subjects were matched on reading ability with three students per matched set. Each treatment groups consists of equal number (n=9) of reading level one students The subjects in each matched set were then randomly assigned to read the electronic storybooks under the program's "read to me" option, or called without animation or passive mode (n=26), the second group of students were assigned to read under the program's "let me play" option, called with animation or active mode (n=25) and the last group of students were assigned to read print based story, or called traditional storybook (n=26). During the research, using computers skill was not a problem. The students were generally very skilled at using computers. All schools that were visited had computer labs and allocated regular computer time to students in the computer labs. Therefore, there is no significant difference in the using computer skills of these three groups. Students who have previously read and/or seen the storybooks were eliminated from the research. It is important that the storybooks were previously unknown to subjects.

Finally, characteristics of the fourth-grade struggling students participated in this study can be described as following: (1) They are reading below level their current grade level and not meeting Sunshine State Standard as measured and documented by Florida Comprehensive Assessment Test (Reading Level one or Reading Level two). (2) The struggling students at this study usually have the basic decoding skill to be able to read a story which is third or second grade level. (3) They have comprehension difficulties to understand texts in fourth-grade level. Similarly, Catts and Hogan (2002) point out that fourth-grade is particularly critical period for the reading development because some children begin to experience serious comprehension difficulties around fourth-grade. The reason is likely increasing demands of readings and materials in this grade.

Instrument

For this study, it was decided to use a storybook, Sheila Rae, the Brave, which was available in printed paper book form and CD-ROM with an interactive mode (with animation) and passive mode (without animation). Designing of electronic formats of storybooks is similar in concept to printed paper book in that the reader progresses from one page to the next in a linear way. The pages are numbered, with easy directional arrows to either go to the next page or return to the beginning of the book. Electronic format of storybook includes animations, a range of sounds, music and opportunities for interaction. In addition, electronic storybook allows the reader to click on individual words to hear them read aloud but these functions were not used in this study. Groups of words are highlighted as they are read aloud. There are options to select the language (English or Spanish) at the top of the control panel page (see Figure-1). After choosing a language, the reader can begin by selecting "let me play" to play within the story (with animation) or selecting "read to me" to read the story (without animation). Electronic storybook is completely based on printed paper format of the storybook. The contents in the three formats of storybooks, electronic storybooks with animation, electronic storybook without animation, and printed paper based format, were similar in length of texts and with regard to illustrations (see Figure-2). Trushell and Maitland (2005) used Sheila Rae, the Brave in their research and they stated that both electronic and print formats of the story contain 52 propositions, including a lengthy setting and an event structure of two episodes. Both electronic storybooks with and without animation formats include 12 fully interactive pages. Only difference between these two formats is animated storybook provides over 20 hidden click able interactive picture-plays, by cued animations on each page.

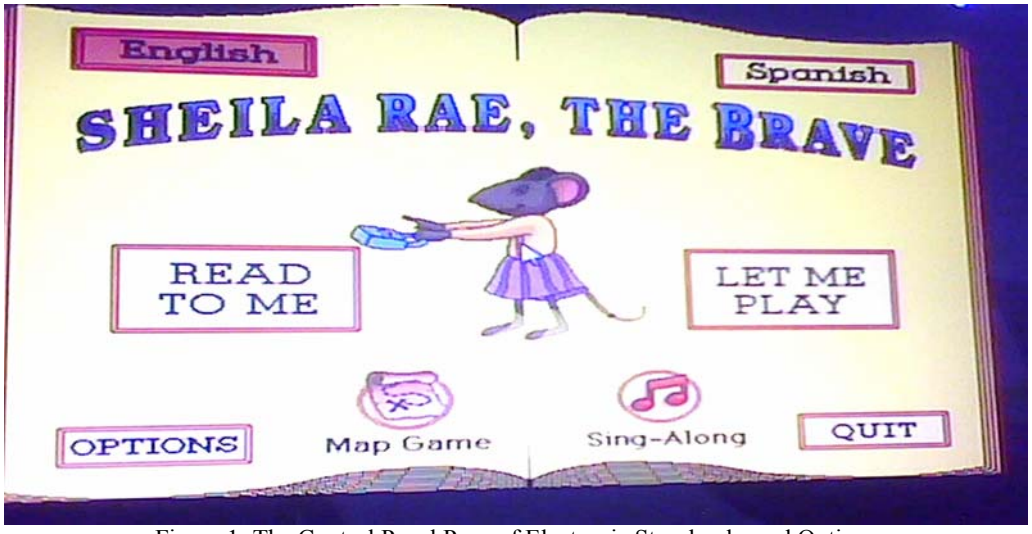

Figure 1: The Control Panel Page of Electronic Storybooks and Options

The storybook was approved by experts, the teachers and fourth-grade coordinator as being suitable for the age group being tested. The electronic storybook, which are part of the Living book series, was selected based on their appropriateness for this age of reader with regard to content and reading level. Storybook was Sheila Rae, the Brave by Kevin Henkes: Developmental Assessment Level (DRA): 18-20. The Interactive storybook offered a "read to me" option, providing linear progression through the text screen by screen, and a "let me play" option which, while encouraging linear progression, permitted linear regression and screen selection. During electronic storybooks word pronunciations, definitions, narration functions were turned off so as not to provide extra help to students.

Figure 2: Sample Screen Captures of the Storybooks; Traditional Print Storybook, the Storybook without Animation, and the Storybook with Animation

The electronic storybook was chosen for several reasons. First, the subjects are struggling readers (Reading Level one and Level two) at least one or two years below their current grade level. O'Connor, Bell, Harty, Larkin, Sackor, & Zigmond (2002) found that the reading-level matched texts are more beneficial than grade-level matched texts. It is also essential that struggling readers be given materials on their level. They should know that at least 90-95 percent of the words in a text, that text is at the appropriate level of difficulty to read with no assistance (Leslie & Caldwell, 2001). More difficult text is not appropriate for reading instruction. If given materials on higher level, they are unable to apply reading strategies (Kletzien, 1991). Therefore, the storybook, which is low difficulty level for regular fourth-graders, was chosen by the researcher. The second reason the electronic storybook and paper versions were used in previous studies. For example, Sheila Rae, the Brave by Kevin Henkes used by Trushell et al. (2003, 2005) for year 4 and year 5 primary school children in United Kingdom. It was an evident to the researcher was using the storybook was valid and reliable for this research.

Measurement Tool (Retelling)

In this research, retelling used to assess students' reading comprehension performance.
Comprehension is truly reflected by story retelling, and the use of retellings provides readers with an opportunity to transform the story into their own words, and also to share their individual understanding of text (Doty, 1999).

One of the dependent variable of the research was comprehension as measured by oral retelling. Morrow's 10-Point Scale was used for analysis and evaluation story retellings. Morrow's 10-Point Scale is a reliable assessment instrument for retelling. According to Morrow's research (1986), to verify the reliability of the scale, six evaluators independently analyzed for inclusion of structural elements (setting, theme, plot episodes, resolution) and they scored the same 12 story retellings. Morrow (1986) reported that "mean correlation among evaluators was .93 for setting scores, .88 for theme scores, .90 for plot episodes scores, .90 for resolution scores, .86 for sequence scores, and .90 for total retelling scores" (p. 144). Additionally, the literature review has shown that previous studies applied retelling as assessment of comprehension widely used Morrow's 10-Point Scale. For example, Doty (1999), Doty et al. (2001), Matthew (1996, 1997), and Pearman (2003, 2008) used this scale with retellings.

Data Collection

The research consisted of having each child read the storybook. The research was conducted by researcher with the cooperation of elementary schools in north Florida, USA. Data collection took about 8 weeks. The first group of students (n=25) read electronic storybooks with animation of storybooks on the computer. The second group (n=26) read electronic storybooks without animation of storybooks on the computer. The third group of students (n=26) read the same stories on print version.

Prior to data collection, all students had been trained with Just Grandma and Me (by Mercer Mayer) from Living Books series to familiarize themselves with the comprehension measure, story retellings. Additionally, students in the electronic storybooks groups were given directions for using the computer. For the purposes of data collection, the students read the following storybook, which was published in print and electronic formats: Sheila Rae, the Brave by Kevin Henkes (1987).

After reading, all students gave an oral retelling after reading the story. Student retellings were recorded for later scoring by independent raters. For the retellings, students were told to tell the story to share with a friend who had never read the story. They were reminded to tell as many details as they could remember.

The retellings were scored in accordance with Morrow's (1986) 10-point scale. Students received two points, one point for partially correct responses, and zero points for an incorrect or missing response each of following items in the retelling: a) setting b) theme c) plot episodes d) resolution (Matthew, 1996). The highest total possible score was 10 points for this assessment. The students responses were scored by the researcher and then by an independent rater who is native English speaker. The independent rater was trained in the general use of Morrow's (1986) 10-Point Scale. The correlation between raters was .81. Scoring differences greater one point were discussed and resolved.

Data Analysis

One-way analysis of variance (ANOVA) was performed to compare the groups on the basis of outcome measures at the .05 level of significance. The Statistical Package for Social Sciences (SPSS) used for the purpose of data entry, manipulation, and analysis. According to Balian (1994), ANOVA is the most traditionally and widely accepted form of statistical analysis. ANOVA can test three or more group means utilizing a single statistical operation. ANOVA accomplishes its statistical testing by comparing variance between the groups to the variance within each group. A significant statistical finding would indicate that group means were significantly different from each other. In case of a significant statistical finding, there is a need to use a Post-Hoc test (Tukey, Scheffe, Bonferroni or others) to find exactly which groups differed from which other groups (Balian, 1994). In this research, because of a significant finding from ANOVA, Bonferroni test was used to find exactly which groups differed from each other. In addition, Kruskal-Wallis one-way analysis of variance was used to decide whether or not the average differences between the groups are due chance. Kruskal-Wallis one-way analysis of variance is the nonparametric statistical test for analyzing data from two or more independent samples of subjects (Shavelson, 1996).

FINDINGS

Analysis of Variance for Retelling Scores

Table 1. Analysis of Variance for Retelling Scores

		df	F	Sig.		N	Mean	Std. Deviation
Retelling	Between Groups	2	5.475	.006	with animation	25	6.88	2.00
	Within Groups	74			without animation	26	5.46	2.16
	Total	76			printed	26	4.81	2.62

To assess the difference in reading comprehension scores on a multiple choice comprehension test and reading comprehension scores on retellings for students reading electronic storybooks with animation, electronic storybooks without animation and traditional printed storybooks, an analysis of variance (ANOVA) was conducted. The findings are presented in Table 1. A one-way ANOVA indicated significant differences in reading comprehension scores on retelling (F=5.475, df=2/74, p<.05) between students reading electronic storybooks with animation, electronic storybooks without animation and traditional print storybooks.

For the reading comprehension scores on retelling, a higher level of comprehension score was reported in the reading electronic storybooks with animation condition (M=6.88, SD=2.00), followed by electronic storybooks without animation condition (M=5.46, SD=2.16) and traditionally print storybooks condition (M=4.81, SD=2.62) (Table 1).

Post-Hoc (Bonferroni) Test Results for Retelling Scores

Table 2. Post-Hoc (Bonferroni) Test Results for Retelling Scores

		Mean Difference (I-J)	Std. Error	Sig.
(I) condition	(J) condition			
with animation N=25, M=6.8800 SD=2.0067	without animation	1.4185	.6390	.089
	printed	2.0723	.6390	.005*
without animation N=26, M=5.4615 SD=2.1583	with animation	-1.4185	.6390	.089
	printed	.6538	.6327	.914
printed N=26, M=4.8077 SD=2.6233	with animation	-2.0723	.6390	.005*
	without animation	-.6538	.6327	.914

* The mean difference is significant at the .05 level.

Employing the Bonferroni Post-Hoc test, significant differences were found between the electronic storybooks with animation, and the traditionally printed storybooks (p<0.05). There were no significant differences between the electronic storybook with animation and the electronic storybook without animation (p=.089), and the electronic storybook without animation, and the traditional print storybook (p=.914) (Table 2).

Kruskal-Wallis Test Results for Retelling

Table 3. Kruskal-Wallis Test Results for Retelling

	Retelling #6	Retelling #8
Chi-Square	9.079	10.362
df	2	2
Asymp. Sig.	.011	.006

a. Kruskal Wallis Test

b. Grouping Variable: Condition

Differences in reading comprehension scores on retellings for the story “Sheila Rae, the Brave” between students reading the electronic storybooks with animation, the electronic storybook without animation and the traditionally printed storybook groups were analyzed through Kruskal-Wallis tests. The findings are displayed in Table 3. Kruskal-Wallis analysis of variance (ANOVA) revealed that accuracy varied significantly across

storybooks presentation conditions (electronic with animation or electronic without animation or printed) on the retelling item #6, $H(2,N=77)=9.079$, $p<.05$, and item #8, $H(2,N=77)=10.362$, $p<.05$ (Table 3).

Table 4. Kruskal-Wallis Means Ranks for Retelling

Retelling	Condition	N	Mean Rank
item #6	with animation	25	48.22
	without animation	26	36.79
	printed	26	32.35
	Total	77	
item #8	with animation	25	47.18
	without animation	26	40.25
	printed	26	29.88
	Total	77	

The Kruskal-Wallis mean ranks revealed that the electronic storybooks with animation group (n=25) ranked highest, the electronic storybooks without animation group (n=26) ranked second, and the traditional print storybook group (n=26) lowest on the retelling items #6, and #8 (Table 4). Other questions did not reveal statistical differences between the electronic storybooks with animation, the storybooks without animation group, and the traditional print storybook group.

DISCUSSION

This research found that electronic storybooks can improve and support reading comprehension of struggling readers. These finding are consistent with earlier research by Doty (1999, 2001), Greenlee-Moore and Smith (1996), Grimshaw et al. (2006), Matthew (1997), McNabb (1998), Miller et al. (1994), Pearman (2003, 2008), Pearman and Lefever-Davis (2006), and Shamir et al. (2008).

However, some previous research on electronic storybooks is inconsistent with the findings of this research (De Jong & Bus, 2002; Labbo & Kuhn, 2000; Trushell & Maitland, 2005; Okolo & Hayes, 1996; Scoresby, 1996; Trushell, Burrell, & Maitland, 2001; Trushell, Maitland, & Burrell, 2003; Underwood, 2000). Those claimed that the electronic environment has detrimental effects on comprehension. Characteristic of kids are different these days. In a digital age, today's kids have exposure to multiple alternatives of the stories and multimedia texts. For example, they may have experience with video games, hypertext, online texts, the Web, and other interactive media that they might not have been able to do in the past. Therefore, the influence of interactive media can be a factor that the findings of this research are inconsistent with the results of some previous studies. In addition, it should be considered that most of those studies' subjects were younger children and also these subjects did not have any reading problems.

In addition to improving comprehension, animation may be beneficial when struggling readers read narrative texts. Therefore, having animation and playing options on electronic storybooks can be helpful for struggling readers to construct meaning from narrative reading materials. This result is supported by ChanLin (2001), and Pearman & Lefever-Davis (2006); however, it is inconsistent with studies by DeJean et al. (1997), Nibley (1993), Okolo and Hayes (1996), and Scoresby (1996). These authors were concerned about the potential distraction of animations in reading comprehension. If animations do not support the text, they may draw students' attention away from the main points of the text; and may even hinder comprehension. Scoresby (1996) found that animation in electronic books diverted from reading rather than improved it and the animation slowed down recall of textual information.

Another result of this research was that struggling readers' comprehension is more improved when the story is presented as animated illustrations instead of static illustrations. The retelling results showed that struggling readers understand theme, plot episodes and resolution in stories better with animations available in electronic storybooks than with static visualizations available in electronic storybook and printed storybooks. The result of the research found that the advantages of animation in improving story comprehension and in supporting struggling readers' ability to make inferences about story events.

This research does not include any quantitative data whether electronic storybooks increase student motivation, and enjoyment, however, the interview results show that the students usually were enthusiastic about reading electronic storybooks.

Electronic storybooks can help struggling readers to build or activate more complete schemas of stories. According to the present research struggling readers reached more complex levels of story understanding with

multimedia storybooks. Additionally, it is clear that the electronic books offer interactive features that may serve as electronic scaffolds for struggling readers (Bus, De Jong & Verhallen, 2006).

A possible explanation of higher comprehension scores for electronic storybooks with animation group lies in the interactivity that electronic storybooks allow. The rich visual support and animation in the electronic storybooks used in this research may be a reason that influenced the amount of comprehension. Sutherland-Smith (2002) stated that images in electronic texts are more lifelike than in traditional print texts. It has been shown that animation on the electronic storybooks, the design quality of on-screen elements can bring in greater interest from the reader, a more effective activation background knowledge, and deeper processing of information (Alvarez, 2006).

Comprehension can be supported by interaction and self-direction which both are available in electronic storybooks with animation. In other words, the interactive features of storybooks can contribute to the readers' comprehension. Dalton and Strangman (2006) stated that the novelty effect and student opportunities for control and choice might be potential sources of students' positive responses to electronic storybooks.

CD-ROM software technologies present new promise for introducing children to reading through computers. For instance, in the Netherlands and other parts of the world, young children can independently practice electronic versions of those books on a computer screen (Bus, De Jong, & Verhallen, 2006). Teachers and families can use electronic storybooks, as less dependent on adult scaffolding, for supporting struggling readers.

CONCLUSION

This research investigated the effects of electronic storybooks on reading comprehension of fourth-grade struggling readers. Many struggling readers exhibit reading difficulties for a variety reasons (Rapp et al., 2007). According to Biancarosa and Snow (2004) a common problem of older struggling readers, who are between fourth and twelfth grade, is that they fail to comprehend what they read. Coiro (2003) says that print media is insufficient. As a valuable tool in educational settings electronic storybooks and the features of electronic storybooks may help the reader in building context and activate student's background knowledge (Doty, 1999; Pearman, 2008).

The results of the study showed that retelling scores were higher for struggling readers reading the electronic storybooks with animation than struggling readers reading the electronic storybooks without animation (static illustration) and struggling readers reading printed storybooks (see Table 1). In other words, animations were shown to positively affect the comprehension of the fourth-grade struggling readers. Struggling readers who read the storybook with animations were being able to remember more story details and information when the story was finished. Another important result of the study was that the retellings of student group who read animated version of story were longer, and more creative related or unrelated the stories. In addition, the electronic storybooks with animation group spent significantly longer time overall in reading when we compare to the other groups. Spending more time in reading might be a clue of engaged reading, reading pleasure, and reading attention. Engagement is clearly an important literacy outcome o for reading in digital environments (Dalton & Strangman, 2006).

There could be a variety of causes for these higher retelling and comprehension test scores of struggling readers reading the electronic storybooks with animation. The most obvious cause is animations that give contextual support and increase readers' understanding of a text (Trushell, Maitland, & Burrell, 2003). Pearman and Lefever-Davis (2006) stated that "when book characters visually react to an event via animations, it is easier for readers to infer word meanings" (p. 306). Another cause can be the connections between multimedia and time (the dual coding) on task, student interest and engagement with the texts, animation and student motivation result in superior memory of story. Multimedia features can support processing, memory, or motivation, which may cause better comprehension (Zucker, Moody, & McKenna, 2009). The group of struggling fourth-grade students reading electronic storybooks with animation spent a longer amount of time reading storybooks. Interactive storybooks caused this result because their formats are more engaging, interesting, and thus, more motivating to readers (Pearman & Lefever-Davis, 2006).

Zucker, Moody, and McKenna (2009) found similar results in their research about e-books. They say that "quality of visual design features, particularly embedded hotspots and animations, can influence the impact of e-books on learning outcomes" (p.53). However, some e-books appear to do too many these features. Too many hotspots or incongruent animations can encourage passive viewing or slow down comprehension by creating visual distractions that lure the child away from the text ((Labbo & Kuhn, 2000; Trushell, Burrell, & Maitland, 2001). In addition, there are some concerns about electronic text that can distract the attention of struggling

readers, and they can also cause cognitive overload or damage comprehension of these readers (Duke et al., 2006). However, this research found that electronic storybooks might be beneficial in helping struggling readers better understand the narratives and animation feature of electronic storybooks which has the potential to improve struggling reader comprehension.

REFERENCES

Adam, N., & Wild, M. (1997). Applying CD-ROM interactive storybooks to learning to read. *Journal of Computer Assisted Learning, 13*(2), 119–132.

Adams, M. (1990). Beginning to read: Thinking and learning about print. Cambridge, MA: MIT Press.

Alexander, P.A., & Jetton, T.L. (2000). Learning from text: A multidimensional and developmental perspective. In M.L. Kamil, P.B. Mosenthal, P.D. Pearson, & R. Barr (Eds.), *Handbook of reading,* Volume III (pp. 285–310). Mahwah, NJ: Erlbaum.

Alvarez, O.H., (2006). Developing digital literacies: Educational initiatives and research in Colombia. In M. C. McKenna, L. D. Labbo, R. D. Kieffer, & D. Reinking (Eds.), *International handbook of literacy and technology,* Volume II (pp. 29-40). Mahwah, NJ: Erlbaum.

Anderson-Inman, L., & Horney, M. A. (1998). Transforming text for at-risk readers. In D. Reinking, M. C. McKenna, L. D. Labbo, & R. D. Kieffer (Eds.), *Handbook of literacy and technology: Transformations in a post-typographic world* (pp. 15-43). Mahwah, NJ: Erlbaum.

Anderson-Inman, L., Horney, M. A., Chen, D. T., & Lewin, L. (1994). Hypertext literacy: Observations from the electro text project. *Language Arts*, *7*(4), 279-287.

Asselin, M. (2002). Comprehension instruction: Directions from research. *Teacher Librarian, 29*(4), 55-57.

Baker, L. (2002). Metacognition in Comprehension Instruction. In Block, C.C., & M. Pressley (Eds.). *Comprehension instruction: Research-Based best practices* (pp. 77-95). New York: The Guilford Press.

Balian, E. S. (1994). The graduate research guidebook: A practical approach to doctoral/masters research (3rd ed.). Lanham, MD: University Press of America.

Biancarosa, G., & Snow, C. E. (2004.) Reading next-A vision for action and research in middle and high school literacy: A report to Carnegie Corporation of New York. Washington, DC: Alliance for Excellent Education.

Boone, R., & Higgins, K. (1993). Hypermedia basal readers: Three years of school-based research. *Journal of Special Education Technology, 12*(3), 86-106.

Bus, A.G., De Jong, M. T., & Verhallen, M. (2006). CD-ROM talking books: A way to enhance early literacy? In M. C. McKenna, L. D. Labbo, R. D. Kieffer, & D. Reinking (Eds.), *International handbook of literacy and technology,* Volume II (pp. 129-144). Mahwah, NJ: Erlbaum.

Catts, H. W., & Hogan, T. P. (2002, June). *The fourth grade slump: Late emerging poor readers.* Poster presented at the annual conference of the Society for the Scientific Study of Reading, Chicago, IL.

ChanLin, L. (2001). Formats and prior knowledge on learning in a computer-based lesson. *Journal of Computer Assisted Learning. 17*(4), 409-419.

Chen, M., Ferdig, R., & Wood, A. (2003). Understanding technology-enhanced storybooks and their roles in teaching and learning: An investigation of electronic storybooks in education. *Journal of Literacy and Technology, 3*(1). Retrieved January 20, 2008, from http://www.literacyandtechnology.org/volume3/chenferdigwood.pdf

Coiro, J. (2003). Reading comprehension on the internet: Expanding our understanding of reading comprehension to encompass new literacies. *Reading Teacher, 56*(5), 458-464.

Cooper, J. D., Chard, D., & Kiger, N. D. (2006). *The struggling reader: Interventions that work.* New York: Scholastic.

Cromer, W. (1970). The difference model: A new explanation for some reading difficulties. *Journal of Educational Psychology, 61,* 471-483.

Dalton, B., & Strangman, N. (2006). Improving struggling readers' comprehension through scaffolded hypertexts and other computer-based literacy programs. In M. C. McKenna, L. D. Labbo, R. D. Kieffer, & D. Reinking (Eds.), *International handbook of literacy and technology,* Volume II (pp. 75-92). Mahwah, NJ: Erlbaum.

Dejean, J., Miller, L., & Olson, J. (1997). CD-ROM talking books: What do they promise? *Education and Information Technologies 2*(2), 121-130.

De Jong, M. T., & Bus, A. G. (2002). Quality of book-reading matters for emergent readers: An experiment with the same book in a regular or electronic format. *Journal of Educational Psychology, 94*, 145-155.

De Jong, M. T., & Bus, A. G. (2004). The efficacy of electronic books in fostering kindergarten children's emergent story understanding. *Reading Research Quarterly, 39*(4), 378-393.

Delany, P., & Landow, G.P. (Eds.). (1991). *Hypermedia and literary studies.* Cambridge, MA: MIT Press.

Denman, J.S. (2004). Integrating technology into the reading curriculum: Acquisition, implementation, and evaluation of a reading program with a technology component (READ 180) for struggling readers. Unpublished doctoral dissertation, University of Delaware.
Doty, D.E. (1999). *CD-ROM storybooks and reading comprehension of young readers.* Unpublished doctoral dissertation, Ball State University, Muncie.
Doty, D.E., Popplewell, S. R., & Byers, G. O. (2001). Interactive CD-ROM storybooks and young readers' reading comprehension. *Journal of Research on Computing in Education, 33*(4)*,* 374-384.
Duke, N. K., Schmar-Dobler, E., & Zhang, S. (2006). Comprehension and technology. In M. C. McKenna, L. D. Labbo, R. D. Kieffer, & D. Reinking (Eds.), *International handbook of literacy and technology,* Volume II (pp. 317-326). Mahwah, NJ: Erlbaum.
Durkin, D. (1993). *Teaching them to read*. Boston, MA: Allyn & Bacon.
Ehri, L.C. (1994). Development of the ability to read words: Update. In R. Ruddell and H. Singer (Eds.), *Theoretical models and processes of reading* (4th ed., pp. 323-358). Newark, DE: International Reading Association.
Florida Department of Education. (2004). *Assessment and Accountability Briefing Book.* Retrieved on April 27, 2008 from http://fcat.fldoe.org/pdf/fcataabb.pdf
Florida Department of Education. (2005). *Reading First*. Retrieved on April 27, 2008 from http://www.justreadflorida.com/reading_first.asp.
Gardill, M. C., & Jitendra, A. K. (1999). Advanced story map instruction: Effects on the reading comprehension of students with learning disabilities. *The Journal of Special Education, 33*(1), 2-17.
Gernsbacher, M. A. (1990) *Language comprehension as structure building.* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
Glasgow, J. (1996-1997). It's my turn! Part II: Motivating young readers using CD-ROM storybooks. *Learning and Leading with Technology, 24,* 18-22.
Graesser, A. C., Gernsbacher, M. A., & Goldman, S. R. (2003) *Handbook of discourse processes.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
Grant, J. M. A. (2004). Are electronic books effective in teaching young children reading and comprehension? *International Journal of Instructional Media, 31*(3), 303.
Greenlee-Moore, M., & Smith, L. (1996). Interactive computer software: The effects on young children's reading achievement. *Reading Psychology, 17*(1), 43–64.
Grimshaw, S., Dungworth, N., McKnight, C., & Morris, A. (2006). Electronic books: Children's reading and comprehension. *British Journal of Educational Technology, 38*(4), 583-599.
Harris, T., & Hodges, R. (Eds.). (1995). *The literacy dictionary.* Newark, DE: International Reading Association.
Hegarty, M., Carpenter, P. A., & Just, M. A. (1991). Diagrams in the comprehension of scientific texts. In R. Barr, M. L. Kamil, P. Mosenthal, & P. D. Person (Eds.), *Handbook of reading research,* Vol. II (pp. 641-668). New York: Longman.
Henkes, K. (1987). *Sheila Rae, the brave.* New York: Greenwillow Books.
Henkes, K. (1996). *Sheila Rae, the brave* [CD-ROM]. Novato, CA: Living Books.
Higgins, K., Boone R., & Lovitt, T.C. (1996). Hypertext support for remedial students and students with learning disabilities. *Journal of Learning Disabilities, 29*, 402-412.
Higgins, N. (1999). Using electronic books to promote vocabulary development. *Journal of Research on Computing in Education, 31*(4), 425-430.
Kamhi, A. G. (1997). Three perspectives on comprehension: Implications for assessing and teaching comprehension problems. *Topics in Language Disorders, 17*(3), 62-72.
Kingham, P., H. (2003). *Developmental Approaches to Reading Comprehension in Children with Reading Difficulties*. Unpublished master's thesis. Curtin University of Technology. Retrieved on January 23, 2009, from http://adt.curtin.edu.au/theses/available/adt-WCU20030904.135502/unrestricted/03chapter2.pdf
Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review 85*, 363-394.
Kletzien, S. B. (1991). Strategy use by good and poor comprehenders reading expository text of differing levels. *Reading Research Quarterly, 26,* 67-86.
Korat, O. (2008). The educational electronic book as a tool for supporting children's emergent literacy in low versus middle SES groups. *Computers & Education, 50*(1), 110-124.
Labbo, L.D. (1996). A semiotic analysis of young children's symbol making in a classroom computer center. *Reading Research Quarterly, 31*(4), 356–385. doi:10.1598/RRQ.31.4.2.
Labbo, L.D., & Kuhn, M.R. (2000). Weaving chains of affect and cognition: A young child's understanding of CD-ROM talking books. *Journal of Literacy Research, 32,* 187-210.

Labbo, L. D., Leu Jr., D. J., Kinzer, C., Teale, W. H., Cammack, D., Kara-Souteriou, J., et al. (2003). Teacher wisdom stories: Cautions and recommendations for using computer-related technology for literacy instruction. *Reading Teacher, 57*(3), 300-304.

Lefever-Davis, S., & Pearman, C. (2005). Early readers and electronic texts: CD-ROM storybook features that influence reading behaviors. *The Reading Teacher, 58*(5), 446-454.

Leslie, L., & Caldwell, J. (2001). *Qualitative reading inventory-3.* New York: Longman.

Lewin, C. (2000) Exploring the effects of talking book software in UK classrooms. *Journal of Research in Reading, 23*(2), 149-157.

Lewis, R.B. (2000). Project LITT (literacy instruction through technology): Enhancing the reading skills of students with learning disabilities through hypermedia-based children's literature. Final report. San Diego, CA: San Diego State University, Department of Special Education. (ERIC Document Reproduction Service No. ED438648).

Lipson, M.Y., & Wixson, K.K. (1997). Assessment and instruction of reading and writing disability. New York: Addison-Wesley.

Mac Arthur, C. A., Ferretti, R. P., Okolo, C. M., & Cavalier, A. R. (2001). Technology applications for students with literacy problems: A critical review. *Elementary School Journal, 101*(3), 273-301.

Matthew, K. (1996). The impact of CD-ROM storybooks on children's reading comprehension and reading attitude. *Journal of Education Multimedia and Hypermedia, 5*(3-4), 379-394.

Matthew, K. (1997). A comparison of influence of interactive CD-ROM storybooks. *Journal of Research on Computing in Education, 29*(3), 263-276.

Mayer, M. (1983). *Just grandma and me.* New York: Golden Press.

Mayer, M. (1993). *Just grandma and me* [CD-ROM]. Novato, CA: Living Books.

Maynard, S. (2005). Can electronic textbooks help children to learn? *The Electronic Library, 23*(1), 103.

McKenna, M. C., Reinking, D., Labbo, L. D., & Kieffer, R. D. (1999). The electronic transformation of literacy and its implications for the struggling reader. *Reading & Writing Quarterly, 15*(2), 111-126.

McNabb, M.L. (1998). Using electronic books to enhance reading comprehension of struggling readers. *Yearbook of the National Reading Conference* (pp. 41-55). Scottsdale, AZ.

Miller, L., Blackstock, J., & Miller, R. (1994). An exploratory study into the use of CD-ROM storybooks. *Computers in Education, 22,* 187-204.

Moje, E.B., Young, J.P., Readence, J.E., & Moore, D.W. (2000). Reinventing adolescent literacy for new times: Perennial and millennial issues. *Journal of Adolescent & Adult Literacy 43*(5), 400-410.

Morrow, L.M. (1986). Effects of structural guidance in story retelling on children's dictation of original stories. *Journal of Reading Behavior, 18*(2), 135-152.

National Center for Education Statistics. (2001). *The Condition of Education 2001.* NCES 2001–072. Washington, DC: U.S. Department of Education.

National Center for Educational Statistics. (2005*). 2009 NAEP reading framework.* Washington DC: Author.

National Center for Education Statistics. (2007). *The nation's report card: Reading 2007.* Retrieved February 19, 2009, from http://nces.ed.gov/nationsreportcard/pdf/main2007/2007496.pdf

National Institute of Child Health and Human Development. (2000). *Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction* (NIH Publication No. 00-4769). Washington, DC: U.S. Government Printing Office.

National Reading Panel. (2000). *Teaching Children to Read: Reports of the Subgroups.* Washington, DC: National Institute of Child Health and Human Development.

Neuman, S. B., Celano, D. C., Greco, A. N., & Shue, P. (2001). *Access for all: Closing the book gap for children in early education.* Newark, DE: International Reading Association.

Nibley, M. (1993). Words and pictures: Scripting and producing the multimedia educational program. *Journal of Interactive Instruction Development*, *6*(2), 10-13.

Oakley, G. (2003). Improving oral reading fluency (and comprehension) through the creation of talking books. *Reading Online, 6*(7). Retrieved on July 25, 2008, from http://www.readingonline.org/articles/art_index.asp?HREF=oakley/index.html

O'Connor, R. E., Bell, K. M., Harty, K. R., Larkin, L. K., Sackor, S. M., & Zigmond, N. (2002). Teaching reading to poor readers in the intermediate grades: A comparison of text difficulty. *Journal of Educational Psychology*, *9,* 474-485.

Okolo, C. & Hayes, R. (1996, April). *The impact on animation in CD-ROM books on students' reading behaviors and comprehension.* Paper presented at the Annual International Convention of the Council for Exceptional Children, Orlando, FL. ERIC Document Reproduction Service No. ED395434. Retrieved June 23, 2008, from ERIC database.

Paris, S.G., & Hamilton, E.E. (2008). The development of children's reading comprehension. In Israel, S. E., & Duffy, G., G. (Eds.). *Handbook of research on reading comprehension* (pp. 32-53). Manwah, NJ: Erlbaum.

Paris, S.G., Wasik, B.A., & Turner, J.C. (1991). The development of strategic readers. In R. Barr, M.L. Kamil, P. Mosenthal, & P.D. Pearson (Eds.), *Handbook of Reading Research,* Vol. II (pp. 609-640). New York: Longman.

Pearman, C. (2003). Effects of electronic texts on the independent reading comprehension of second grade students. Unpublished doctoral dissertation, University of Arkansas.

Pearman, C.J., & Lefever-Davis, S. (2006). Supporting the essential elements with CD-ROM storybooks. *Reading Horizons, 46*(4), 301-313.

Pearman, C.J. (2008). Independent Reading of CD-ROM Storybooks: Measuring Comprehension with Oral Retellings. *The Reading Teacher*, *61*, 594.

Perfetti, C. A., & Lesgold, A. M. (1979). Coding and comprehension in skilled reading and implications for reading instruction. In L. B. Resnick & P. Weaver (Eds.), *Theory and practice of early reading.* Hillsdale, NJ: Erlbaum.

Rahman, T., & Bisanz, G. L. (1986). Reading ability and use of a story schema in recalling and reconstructing information. *Journal of Educational Psychology*, *78*, 323-333.

RAND Reading Study Group (2002). Reading for understanding: Toward an R&D program in reading comprehension. Santa Monica, CA: Rand.

Rapp, D. N., van den Broek, P., McMaster, K., L., Kendeou, P., & Espin, C., A. (2007). Higher-order comprehension processes in struggling readers: A perspective for research and intervention. *Scientific Studies of Reading, 11*(4), 289-312.

Reinking, D. (1992). Differences between electronic and printed texts: An agenda for research. *Journal of Educational Multimedia and Hypermedia, 1*(1), 11-24.

Reinking, D. (1998). Introduction: Synthesizing technological transformations of literacy in a post-typographic world. In D. Reinking, M.C. McKenna, L.D. Labbo, & R.D. Kieffer (Eds.), *Handbook of literacy and technology: Transformation in a post-typographic world* (pp. xi-xxx). Mahwah, NJ: Erlbaum.

Reinking, D., McKenna, M. C., Labbo, L. D., & Kieffer, R. D. (Eds.) (1998). *Handbook of literacy and technology transformations in a post-typographic world.* Manwah, NJ: Erlbaum.

Robb, L. (2000). *Teaching reading in the middle school.* New York: Scholastic.

Shamir, A & Korat, O. (2006). How to select CD-ROM storybooks for young children: The teacher's role. *The Reading Teacher, 59*(6) 532-543.

Shamir, A., Korat, O., & Barbi, N. (2008). The effects of CD-ROM storybook reading on low SES kindergarteners' emergent literacy as a function of activity context: Paired peer tutoring versus individual use of the e-storybook. *Computers & Education*, *51*, 354-367.

Shavelson, R.J. (1996). *Statistical reasoning for the behavioral sciences* (3rd Ed.). Boston: Allyn and Bacon.

Schmar-Dobler, E. (2003). Reading on the internet: The link between literacy and technology. *Journal of Adolescent & Literacy, 47*(1), 80-85.

Scoresby, K. J. (1996). *The effects of electronic storybook animations on third graders' story recall.* Unpublished doctoral dissertation, Brigham Young University.

Sutherland-Smith, W. (2002). Weaving the literacy web: Changes in reading from page to screen. *Reading Teacher, 55*(7), 662-669.

Swanson, H. L., & Alexander, J.E. (1997). Cognitive processes as predictors of word recognition and reading comprehension in learning disabled and skilled readers: Revisiting the specificity hypothesis. *Journal of Educational Psychology, 89*(1), 128-158.

Trushell, J., Burrell, C., & Maitland, A. (2001). Year 5 pupils reading an interactive storybooks on CD ROM: Losing the plot? *British Journal of Educational Technology, 32*(4), 389-401.

Trushell, J., & Maitland, A. (2005). Primary pupils' recall of interactive storybooks on CD-ROM: inconsiderate interactive features and forgetting. *British Journal of Educational Technology, 36*(1), 57-66.

Trushell, J, Maitland, A., & Burrell, C. (2003). Pupils' recall of an interactive storybook on CD-ROM. *Journal of Computer Assisted Learning, 19*(1), 80-89. doi:10.1046/j.0266-4909.2002.00008.

Underwood, G. & Underwood, J. (1998). Children' s interactions and learning outcomes with interactive talking books. *Computers and Education, 30,* 95-102.

Underwood, J. (2000). A comparison of two types of computer support for reading development. *Journal of Research in Reading, 23*(2), 136-148.

Yuill, N., Oakhill, J. (1991). *Children's problems in text comprehension.* Cambridge, MA: Cambridge University Press.

Zucker, T. A., Moody, A. K., & McKenna, M. C. (2009). The effects of electronic books on pre-kindergarten-to-grade 5 students' literacy and language outcomes: A research synthesis. *J. Educational Computing Research, 40*(1), 47-87

THE EFFECT OF WEB-BASED HOMEWORK ON UNIVERSITY STUDENTS' PHYSICS ACHIEVEMENTS

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ABSTRACT
In this study, the effect of web-based homework on university students' physics achievement was compared. One of the two identical sections of introductory physics course students received pen-and-paper homework done in groups while the other received web-based online homework performed individually. And then both groups' homework performance and achievements were compared by homework assignments and standardized test scores (like Force Concept Inventory and Conceptual Survey of Electricity and Magnetism). Although there was not any significant difference in standardized test score results, in the first (fall) semester, pen-and-paper homework group performed better than the web-based group; yet, the web-based homework group did better in the second (spring) semester.
Keywords: Web-based homework, pen-and-paper homework, physics achievement, first year university students.

INTRODUCTION

The rise of the Internet in the last decade has led to become an important means for disseminating various educational materials to students. As part of this trend, a number of software packages have been developed, which allow students to complete homework assignments online. Student's assessment is one of the most important elements in an education system. The purpose of assessment is to provide a measure of student performance and a context for improving a course or an academic program. The two assessment (self and peer/groups) methods are becoming more pervasive and dominant (Paris & Paris, 2001; Shepard, 2000).

The importance of homework and the relationship between homework and academic performance has already been recognized by many individual and meta-analytic studies (Cooper, 1989; Cooper, Lindsay, Nye, & Greathouse, 1998; Keith & Cool, 1992; Warton, 2001). Homework is an activity related to motivation, mastery of material, and to achievement (Keith & Benson, 1992; Keith, 1982; Paschal, Weinstein, & Walberg, 1984). It is also obvious from some studies that homework may be necessary but not satisfactory for achievement on exams (Peters, Kethley & Bullington, 2002; Porter & Riley, 1996).

Some researchers stated that electronic homework as a course element has more positive effects than written homework (Dufresne, Mestre, Hart, & Rath 2002; Ogilve, 2000; Thoennessen and Harrison, 1996). For example, Dufresne et al. (2002) compared the effect of electronic homework and written homework on student achievement found that electronic homework led to higher overall exam performance. However, the study conducted by Bonham et al. (2001, 2003) showed that no significant differences in student performance that could be attributed to the homework method used.

Web-based homework has some benefits. These benefits include obtaining students' results faster, having the ability to place grades into an electronic format, measuring learning accurately, focusing on a student-centered environment, and costing less in comparison to pen-and-paper homework (Bartlett, Reynolds, & Alexander, 2000; Dash, 2000; Oregon to Administer, 2001). On the other hand, using a pen-and-paper homework has some limitations (for example: recording, scoring, getting immediate feedback, etc.). The possible constraints may be compensated by technology. Several studies (for example: Bonham, Beichner, & Deardorff, 2003; Dufresne, Mestre, Hart, & Rath, 2002; Toback, Mershin, & Novikova, 2005) have reported mixed findings on student homework performance, but little on student homework preferences. Therefore, the present study attempts to determine the effect of web-based homework on university students' physics achievements and to give new insight into the physics educator to use homework in their lectures.

Testing and Online Homework

Testing in general is used for providing feedback and evaluation. Feedback refers to the response regarding a critical analysis of students' work. Evaluation refers to the grading and recording of students' work for assessing their understanding of the material. A testing instrument, whether it is a homework assignment, quiz, exam, or practice test, can satisfy both purposes to a varying degree. Evaluation and feedback have different goals and thus have different implementation requirements. Evaluation is primarily used to record student responses and assign grades, security concerns such as verifying a student's identity, protecting answer keys, limiting access according to a specific time or location, and preventing unauthorized sharing of information need to be

considered. Feedback is to be able to respond to students' input by providing "correct/incorrect" answers, hints, and solutions or by engaging the student in additional learning activities much like present study.

The online homework method has some advantages for the instructor as well (Johnston, 2002). The primary benefit is savings in the effort spent running the coordination of the pen-and-paper homework process. Copying, distributing, collecting, sorting, and filing homework documents are freed by the instructor. Educators should consider and evaluate the effectiveness of this technology for increasing student learning. Homework assignments must exist in education because it might increase students' interest in school and/or course topics and improve their academic development (Altun, 2008). The online method also eliminates the need to score homework and record the scores in a grade book. The problems of missed, lost, and submitted-late assignments are largely eliminated. The online approach automates the tasks. Moving these tedious tasks outside of the class time period enables an instructor to cover more things in classrooms.

Purpose

The main aim of this study was to compare the effect of web-based homework and pen-and-paper homework on university students' physics achievement as measured by exam and homework performance.

METHODOLOGY

Participants

The participants of this study were chosen from a sample of convenience of Computer Education Department. They have many experiences online and computer-based assessment methods. In order to eliminate novelty effect, any kind of activities in the study has to be not new to students. In an introductory physics course, all students were taught partially "peer instruction" method (adopted from Mazur, 1997; Fagen, Crouch, & Mazur, 2002). In the study, there were two identical classes (according to their pretest scores). One class used online homework system and the other class used pen-and-paper homework. Specifically, 41 students in the fall semester of 2005, and 48 students in the spring semester of 2006 used the Web-based homework system; 37 students in the fall semester of 2005, and 42 students in the spring semester of 2006 used the pen-and-paper based homework.

Design and Procedures

A two-group pretest–posttest quasi-experimental design was used in this study. One group is subjected to a treatment, and the other is subjected to a control group (Fraenkel & Wallen, 1996). Students were registered for the two different sections through a standard course registration system and were unaware of the homework method until they were announced that they were assigned the indicated homework group (the first week of physics-1 [in the fall semester) and physics-2 (in the spring) classes, respectively]. The physics-1 and -2 courses have two main exams, one of which is mid-term and the other is the final exam. The homework performance scores in both groups were added to include the 20 % of the final grade of the course for each semester. The treatment group received their homework via an online quiz system where it was automatically graded by the software. Control group wrote out solutions to homework exercises on paper with working as groups consisted of four to five students. These exercises were turned in and graded by the instructor. Through semesters completing the each unit; homework assignment was administrated to students according to their assigned method (pen-and-paper or online) (mainly these assignment questions derived from Turkish translation of Principles of Physics by Bueche and Jerde, sixth edition, 1995). There were eight-homework exercises in the fall semester (for physics-1) and six exercises in the spring semester (for physics-2). All results were graded in percent scores, and then average scores were calculated to be used as the homework performance score. In the fall semester, T*he Force Concept Inventory (FCI)* test *(Hestenes,* Wells, & Swackhamer, 1992) administered before (in the first week of the semester) and after the instruction (the last second week semester). In the spring semester, also *The Concept of Survey on the Electricity and Magnetism* (CSEM) test (Maloney, O'Kuma, Hieggelke, & Heuvelen, 2001) was administered before (in the first week of the semester) and after (the last second week of the semester) the instruction to both groups. FCI and CSEM tests scores (in percent average scores) and homework performance scores were entered into the SPSS package programme for statistical analyses.

Structure of groups

Pen-and- paper homework group consisted of four or five students per group. There were 37 students in the fall semester and 42 students in the spring semester. Heterogeneous groups (according to prior knowledge) were formed to provide students with opportunities to interact with the content through the varying perspectives of their peers. According to Mahendra, Bayles, Tomoeda, and Kim (2005), promoting a collaborative, supportive classroom culture increases the opportunities for learners to be exposed to diverse viewpoints and values.

Students in this group worked with their group members and turned in their homework at the end of each unit by the end of each semester.
The types of problems used in this group homework assignment were identical to those used in web-based homework assignments; in fact, the vast majority of problems in the web based homework library came from the end-of-the chapter problems of the standard first year university algebra-based physics textbooks with the addition to some conceptual questions. After finishing every unit --there were eight units in the fall semester and six units in the spring semester--, students were given one assignment of five to nine problems. Gibson, Tesone, and Blachwell, (2001) suggested that the online testing should be one component of the evaluation of the student; therefore, in both groups, 20 % of the course final grade comes from the average homework score. In the web-based homework group, each student first registered the system and did their homework via online individually. The web-based homework system is called "*online testing*" and detailed description of the program is given below.

The Web-based homework system
The goal of the web-based homework system called "online testing" is to get immediate "correct" or "incorrect" feedback. The "online testing" system did not correct the student's errors or give them hints. The Web-based homework system was developed by Linux based .php extension html environment with using the MySQL database system and has two main modules. The first module is for students, and the second is for teachers.

In students' module, students have to register into a password protected web-based homework system at the beginning of the course. Until the end of the semester, they only need their ID number and password to log into the system. Once they enter the system whenever homework is activated by the instructor after each unit, one would be able to take that test. After finishing that test, students could see their results immediately and get the feedback. Student may ask any question related to testing or any problem encountered any time just clicking the provided link to communicate with the instructor via e-mail.

The teacher module provides teachers with a convenient user interface that allows them to execute various setup and management functions online, such as setting up accounts, setting up test parameters, queries as to students' scoring process and observing various assessment results at any time. Web-based homework system offers parameters to configure the options of various types of activities. By the teacher module, the instructor might do the following main tasks:

- Create or delete homework assignments, quizzes and define the number of questions to be asked for each assignment.
- To see students' homework results and progress, and see their detailed assignment results such as starting and finishing time.
- Answer their e-mail messages to communicate with them to solve their problems they might have encountered during the process.
- Able to activate or deactivate any particular assignment.
- Define the level of difficulties of questions uploaded to a server (specifically based on Bloom's taxonomy, questions in cognitive, knowledge and conceptual level labeled as "easy"; questions in application level labeled as "normal"; questions in complex application and analysis level labeled as "difficult").

RESULTS
This part consists of two sections, descriptive statistics, and inferential statistics.

Descriptive Statistics
Results devoted to FCI and CSEM tests
The results of FCI pre-, posttest scores, normalized-gain scores also known as Hake factor (Hake, 1998), and homework performance scores (in percent) for both groups are given in Table 1.

Table 1 *The results of FCI Tests and Homework Performance Scores in Percentage*

	Web-based homework-group			Pen-and-paper homework group		
	n	Average	S. Deviation	n	Average	S. Deviation
Homework performance	41	71.15	15.428	37	80.30	7.237
FCI pre-test	40	41.05	11.89	33	42.73	9.69
FCI post-test	39	62.87	9.96	36	61.44	9.97
FCI normalized gain		%37.01			%32.66	

It can be seen in Table 1 that average FCI pretest score calculated (in percent) in both groups are about in the forties and posttest score are about in the sixties. However, homework performance (percent) score calculated for web-based group is about 71%, and for pen-and-paper group is about 80 %. While web-based homework group's FCI normalized gain score is about 37 %, the pen-and-paper-based homework group's gain scores are found about 32.6 %. Pen-and paper group got higher scores on homework performance, but lower on the normalized gain score than the web-based homework group in the fall semester.
The results of CSEM pre-, posttest scores, normalized-gain scores, and homework performance scores (in percent) for both groups are given in Table 2.

Table 2 *Results of he CSEM Tests and Homework Performance Scores in Percentage*

	Web-based homework-group			Pen-and-paper homework group		
	N	Average	S. Deviation	N	Average	S. Deviation
Homework performance	48	78.13	8.41	42	71.66	10.60
CSEM pre-test	42	31.40	11.15	31	31.25	9.24
CSEM post-test	42	53.79	17.19	31	53.43	8.12
CSEM normalized gain		%32.63			%31.36	

Inferential Statistics
Summary of the t-test results related to FCI and CSEM pre- and post-test scores and homework performance scores for both groups are given in Table 3.

Table 3 *t-test Summary Results*

Test differences between groups	df	t-test	p
Homework performance differences for physics-1	76	-3.29	0.002
FCI pre-test differences	71	-0.65	0.517
FCI post-test differences	73	0.61	0.539
Homework performance differences for physics-2	88	3.08	0.003
CSEM pre-test differences	71	-0.264	0.793
CSEM post-test differences	71	0.153	0.879

CONCLUSION AND DISCUSSIONS
There was not any statistically significant difference were found in the means of the web-based and grouped pen-and-paper homework with respect to FCI and CSEM pre- and posttest scores. Although there was a significant difference in students' homework performance scores in favor of the pen-and-paper group in the fall semester, this was changed in the spring semester to the web-based group. Bonham, Beichner, and Deardorff (2001, 2003) reported that students who used traditional hand-written homework experienced no significant differences in learning gains comparing to students using the WebAssign system. Dufresne, Mestre, Hart, and Rath, (2002) compared student performance over several years in large introductory physics courses with both pen-and-paper-based and web-based homework system, and they found similar results from the study done by Ployhart et al. (2003) suggesting that automated homework led to higher performance scores.

Studies carried out by the CAPA development team concluded that online homework had a significant, positive effect on student learning (Demirci, 2007; Kashy, Sherrill, Tsai, Weinshank, Englemann, & Morrissey, 1993; Kashy, Morrissey, Tsai, & Wolfe, 1995; Morrisey, Kashy, & Tsai, 1995; Kashy, Thoennessen, Tsai, Davis, & Wolfe, 1998).

Web-based homework is a possible alternative to the traditional pen-and-paper -based approach. It does not bring significantly greater advantage to the students, but neither does it work much worse than standard methods of collecting and grading homework. This supports the opinion that technology itself does not improve or decrease student learning. Automated homework system most likely will help students in courses where homework could not otherwise be assigned.

The current literature does not really answer questions being raised about pen-and-paper-based web-based or otherwise. Homework is important in technical courses such as introductory physics, where problem solving is a major focus, and homework is the main place for practicing. Many student struggles to develop problem-solving skills in physics (Maloney, 1994), although directed instruction and feedback has been shown to be effective (Heller & Reif, 1984; Heller & Hollabaugh, 1992).

A limitation of the study was that online homework was done individually while the pen-paper based homework was done collaboratively with groups of 4/5 students. Individual versus collaborative work itself can be the conditions for other experimental studies. Furthermore, FCI and CSEM test scores thought to be fits and an adequate for measuring students' conceptual understanding and physics achievement. The online course cannot be an example of good pedagogy if technology is used without a student-centered approach to learning (Hiltz, 1990). When online material is submitted, and when it becomes an important student-centered activity and requirement of the class, Bauer and Anderson (2000) recommend three criteria to judge the students' content, expression, and participation. "These can provide a unique perspective from which to view students' formal writings and informal discussions". Besides, "an e-folio can offer students a chance to reflect on their own work and thus become more involved in the assessment process" (Bauer and Anderson, 2000, p.70).

For future study, it would be fruitful to examine such behaviors in relation to other factors associated with learning, such as students' attitudes, possible environmental variables, and different learning strategies and methods. Further work could focus on how online-mediated evaluation affects distance and open learning, how the development of content delivery and assessment tools is directly related to learning styles, how feedback in e-learning environments can be enriched and finally how the evaluation of e-learning methods differs from more traditional ones in great details. Additional contextual factors could reflect on students' some extra-curricular activities. Such inquiries could prove to yield some beneficial results (Kotas & Finck, 2002).

REFERENCES

Altun, E. (2008). 6th, 7th and 8th Graders 'Attitudes towards Online Homework Assignment Sites. *The Turkish Online Journal of Educational Technology,* 7 (4), 5-18–(retrieved on July 19, 2010: URL:http://www.tojet.net/articles/741.pdf).

Bartlett, J. E., Reynolds, K A., & Alexander, M. W. (2000). A tool for online learning. *Journal of Online Learning, 11*(3&4), 22-24.

Bauer, J. F., & Anderson, R. S. (2000). Evaluating Students' Written Performance in the Online Classroom. *New Directions for Teaching and Learning*, 84, 65-71. a Wiley company.

Bonham, S.W., Deardorff, D.L. & Beichner, R. J. (2001). Comparison of student performance using web and pen-and-paper -based homework in college-level Physics*. The Physics Teacher*, 39, 293-296.

Bonham, S.W., Deardorff, D.L. & Beichner, R. J. (2003). Comparison of student performance using web and paper-based homework in college-level physics. *Journal of Research in Science Teaching, 40*, 1050–1071.

Bueche, F. J., & Jerde, D.A. (1995). Principals of Physics (Turkish Translation by Palme Press), Ankara, 2003.

Cooper, H. (1989). Synthesis of research on homework. *Educational Leadership, 47*(3), 85-91.

Cooper, H., Lindsay, J. J., Nye, B., & Greathouse, S. (1998). Relationships among attitudes about homework, amount of homework assigned and completed, and student achievement. *Journal of Educational Psychology, 90*(1), 70-83.

Dash, J. (2000). Computerware introduces remotely hosted software for Internet testing service. *Computenvorld, 34* (88*),* 1- 4.

Demirci, N. (2007). University students' perceptions of web-based vs. paper-based homework in a general physics course*. Eurasia Journal of Mathematics, Science & Technology Education*, 3(1), 29-34.

Dufresne, R., Mestre, J., M. Hart, M. D., & Rath, K. A. (2002). The effect of web-based homework on test performance in large enrollment introductory physics courses *Journal of Computers in Mathematics and Science Teaching, 21*(3), 229-251.

Fagen, A. P., Crouch, C. H., & Mazur, E. (2002). Peer instruction: results from a large classrooms. *The Physics Teacher*, *40,* 206-209.

Fraenkel, J.R., & Wallen, N.E. (1996). *How to design and evaluate research in education*, Mc-Graw-Hill press.

Hake, R.R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66, 64-74.

Heller, J.I. & Reif, F. (1984). Prescribing effective human problem solving processes: Problem description in physics. *Cognition and Instruction,* 1, 177–216.

Heller, P.,& Hollabaugh,M. (1992). Teaching problem solving through cooperative grouping. Part 2: Designing problems and structuring groups. *American Journal of Physics*, 60, 637–644.

Hestenes, D., Wells, M., & Swackhamer, G. (1992). Force concept inventory. *The Physics Teacher*, *30* (3), 141-153.

Hiltz, S. R. (1990) *Evaluating the virtual classroom.* In LM Harasim (ed.) Online Education: Perspectives on a New Environment, Praeger, New York, 133–184.

Gibson, J. W., Tesone, D. V., & Blachwell, C. W. (2001).The journey to cyberspace: Reflections from three on-line business professors. S*.A.M. Advanced Management Journal, 66*(1), 30-34.

Kashy, E., Sherrill, B. M., Tsai, I., Weinshank, D., Englemann, M., & Morrissey. D. J. (1993). CAPA – An integrated computer-assisted personalized assignment system. *American Journal of Physics, 61*(12), 1124–1130.

Kashy, E., Thoennessen, M., Tsai, Y., Davis, N. E., & Wolfe, S. L. (1998). Using networking tools to promote student success in large classes. *Journal of Engineering Education*, Oct. 1998, 385–390.

Keith, T. Z. & Benson, (1992). Effects of manipulability influences on high school grades across five ethnic groups. *Journal of Educational Research, 86*(2), 85-93.

Keith, T. Z & Cool, V. A. (1992). Teaching models of school learning: Effects of quality of instruction, motivation, academic coursework, and homework on academic achievement. *School Psychology Quarterly*, 7, 209-226.

Keith, T.Z. (1982). Time spent on homework and high school grades: A large sample path analysis. *Journal of Educational Psychology, 74*(2)*,* 248-253.

Kotas, P.M., & Finck, J.E. (2002). Collaborative learning and other successful strategies for on-line homework. Proceedings of the international conference on computers in education (ICCE'02).

Mahendra, N., Bayles, K., Tomoeda, C, & Kim, E. (2005). Diversity and learner-centered education. *ASHA Leader, 10* (16), 12-14.

Maloney, D. P. (1994). Research on problem solving: Physics. In Gabel, D.L. (Ed.), Handbook of research on science teaching and learning (pp.559). New York: Macmillan.

Maloney, D., O'Kuma, T., Hieggelke, C., & Heuvelen, A. V. (2001). Surveying students' conceptual knowledge of electricity and magnetism. *American Journal of Physics, 69* (7), 12-19. Physics Education Research Supplement.

Mazur, E. (1997). *Peer Instruction*, Prentice Hall Inc., New Jersey.

Morrisey, D. J., Kashy, E., & Tsai, I. (1995). Using computer-assisted personalized assignments for freshman chemistry. *Journal of Chemical Education, 72*(2), 141–146.

Ogilve, C. (2000). *Effectiveness of different course components in driving gains in conceptual understanding,* Cambridge, Internal report, Department of Physics at MIT [online] URL: http://torrseal.mit.edu/effedtech/

Oregon to Administer Standardized Tests on Computers. (2001). *Electronic education report, 8*(9), 72.

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist*, 36, 89–101.

Paschal, R.A., Weinstein, T., & Walberg, H.J. (1984). The effects of homework on learning: A quantitative synthesis. *Journal of Educational Research, 78*(2), 97-104.

Peters, M., Kethley, B. & Bullington, K. (2002). The relationship between homework and performance in an introductory operations management course. *Journal of Education for Business, 77*(6), 340-344.

Porter, T. S. and Riley, T. M. (1996). The effectiveness of computer exercises in introductory statistics. *The Journal of Economic Education, 27* (4), 291-299.

Shepard, L. A. (2000). The role of assessment in a learning culture. *Educational Researcher*, 29, 4–14.

Thoennessen, M., & Harrison, M. (1996). Computer-assisted assignments in a large physics class. *Computers Education*, *27*(2), 141-147.

Toback, D., Mershin, A., & Novikova, I.(2005). Integrating web-based teaching tools into large university physics courses. *The Physics Teacher, 43* (9), 594-597

Warton, P. M. (2001). The forgotten voices in homework: Views of students. *Educational Psychologist, 36*(3), 155-165.

THE EFFECTS OF INTEGRATING MOBILE AND CAD TECHNOLOGY IN TEACHING DESIGN PROCESS FOR MALAYSIAN POLYTECHNIC ARCHITECTURE STUDENT IN PRODUCING CREATIVE PRODUCT

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ABSTRACT
The purpose of this research is to examine the effect of integrating the digital media such as mobile and CAD technology on designing process of Malaysian polytechnic architecture students in producing a creative product. A website is developed based on Caroll's minimal theory, while mobile and CAD technology integration is based on Brown and Campione's learning with technology theory. This study utilized a quasi-experimental method. Final semester students of four (4) polytechnics are chosen as a research sample where sixty (60) students are in the treatment group and another sixty (60) students are in the control group. Final product is evaluated by an expert in architecture field using the validated instrument developed by researcher based on Creative Product Analysis Model (CPAM). The inferential statistics namely T-Test and Pearson Correlation Analysis with a significant level p = 0.01 were utilized. Research outcome shows that there is a significant difference between the treatment group product (M=79.1) and control group product (M=70.5). This research contributes to the use of real case in the development of an architectural website, in the use of mobile technology as media information sources, the use of CAD technology integration in designing process and in the construction of validated instrument which is used to evaluate creative architectural products.
Keywords: real case, mobile technology, CAD technology, design, creative product

INTRODUCTION

Architectural design is a complex and open process. Design process starts from the abstract stage to solve a design problem until it reaches the design solution in the form of design product. Designing activities is a repetitive problem solving process (Demirkan 1998). Watanabe (1994) describes designing process as a process to fulfill human needs through new idea produced. According to French (1998), architecture design is a response to human special needs which is refuge and comfort. Lawson (1997), states that architectural design is a process where an architect produced a space, place and building which has a big amount of effects on the quality of human life. Most architects agreed with Sanders (1996) whom stated that architectural design is a repetitive process where the process scheme can be recognized, valued, repeated, explored and repaired until the best solution is achieved. In the context of this research, architectural design is a systematic process through few stages in producing a new product that can be valued from physical aspect and providing benefits to human life and environment. For architectures' diploma students in Malaysian polytechnic they will learn on how to design from the architecture modules that being taught in four semesters. Decision making activities in architectural design process happens at sketching stage, schematic design stage and final design stage. At the details stage, design process is focused on producing drawings activity and planned building construction activity. This research concentrates on schematic stage of the design process which involves activities such as collecting the information needs for the design process and producing new ideas. Producing new ideas consist of two main activities which are synthesis and simulation. Technological development nowadays, has given chances for mobile and CAD technology to be integrated in the design process. Mobile technology gives chances for students to have access to the information without time and place limits. Websites referring to real cases provide opportunity to gather quick information for design process purpose. Media variety in design process also can give more choices to designer in creating new ideas. The recent developments in computer technology allow CAD technology to be used in decision making during the design process and not only for producing drawing (Husain 2007). According to Dong & Gibson (1998), CAD technological development in three dimensional drawings, three dimensional digital model and computer simulation can provide new approach for designers to find more solution in schematic design process. This research wanted to see upon how the integration of mobile and CAD technology can help the polytechnic students in learning the architectural design process to produce creative product.

Problem Statement

Schematic design stage is a process involves two important activities which are creating design informations and creating new ideas to solve the design problems. There are some weaknesses for these two activities. According to Yunus et al.(2006) many of the design layout that being produced by the students in polytechnic do not show any maturity. Yunus et al. (2006) also said that majority of the design products do not have any concrete design concept. Hamdan (2005), also mentioned that intellectual values for the design ideas not up to level of the diploma student. The design products from the polytechnic students also do not have a strong creativity element. All the problems mentioned above cause by the students design approached. New approaches in teaching architectural design are needed in order to rejuvenate the students in creating creative design product. New strategy is needed to help the student to get the design information anytime and anywhere while new strategy also needed to help students in creating creative ideas during design process. Web site for design information developed on real case approach based on mobile device can be a good approach to help students to obtain focus information at anytime and anywhere. Digital model offered by the CAD technology can be a good approach to help students to create new ideas in a short period of time. Digital model allows the students to create many design ideas during the design process. Therefore this research want to see the quality of design information produced when web site build on real case based on mobile device being integrated in the design process. This research also wants to study what effects it will have on the design product when CAD technology being integrated into the design process.

Research Purposes

The purposes of the research are as follow:

i. To identify the interest of the student in finding informations need in the design process through web mobile or conventional method
ii. To study the effect of integrating web site based on mobile device at the developing designs' information needs activity in the design process
iii. To study the effect of integrating CAD technology at the synthesis activity in the design process
iv. To study the effect of integrating CAD technology at the simulation activity in the design process
v. To study the effect of integrating mobile and CAD technology in producing the final product of architectural design

Research Questions

The research questions used for this research are as follow:

i. Does the real case web mobile increase the information searching activity?
ii. Does the real case web mobile allow the students to gather the information easily?
iii. Is there any significant different between the informations produce from the treatment group compare to control group?
iv. From the synthesis activity in the design process which group produces more early design ideas?
v. From the synthesis activity in the design process which group produces more 3D models?
vi. Is there any significant different between the new ideas produce from the treatment group compare to control group in the synthesis activity?
vii. Is there any significant different between the ideas produce from the treatment group compare to control group in the simulation activity?
viii. Is there any significant different between the treatment group compare to control group in producing creative product?

REVIEW OF RELATED LITERATURE

Real Cases as a Design Educational

With architecture being a much more complex career, real case approach as a lecturing method has starts to be an effective method among architectural lecturers. According to Vijayalakshmi (1997), real architecture cases involve construction and designing process of completed buildings. Oren (1990) says that information usage based on real project will helps student to analyse, make comparison and validate important aspects from studied buildings. With the use of real case method, researcher will develop a web site which is related to the same buildings type that will be designed by students. Important links from this web site will be connected to additional information for students. According to Oren (1990), links from a web site can increase students' knowledge towards issues that being studied. For this research, the use of real case in the development of the web site is expected to make the student information searching activity ease and focus to the project needs.

Focused in searching information is suitable to be used in a web site based on a mobile technology with regards to the proven ability of the mobile device to be used at anytime and any place.

Web site Based on Mobile Device

There were different opinions in defining mobile learning process. Lehner and Nosekabel (2002) describe mobile learning as a service that provides electronic information generally and educational content which helps information searching without time and places limits. Vavoula and Sharples (2002) explains that there are three ways where learning can be mobile which is learning is mobile in a space, learning is mobile in different aspect of life and learning is mobile without time and places limits. According to Anna et al. (2003) education based on mobile technology is a learning method using small media, mobile and did not produce inconvenience in every aspect of life. From definition above, a conclusion can be made that education based on mobile technology is an educational approach that are capable of conveying information at every time and places based on student needs. Learning activities can be achieved even when students and lecturer are in mobile position. Refering to Chen and Kinshuk (2005), educational service based on mobile technology is a movable learning sources and can be access by students without time and places constraints. In order to make a dynamic mobile technology based learning atmosphere, learning system has to be made ready in providing information without time and places constraints (Chen and Kinshuk 2005). Learning system also has to be designed, where the information provided can be chosen by students according to their needs. Educational system design based on mobile technology has to be dynamic, can be changed easily and can be used at every time and places. According to Bottentuitista et al. (2007), web site usage through mobile technology can attracts more students to use the internet. The effective use of web site based on mobile device in developing information has been supported by the studies of Catangay (2009) which showed on how students in selected schools in Philiphine acquire more new informations for science subject when web site based on mobile device being integrated in the learning process. In conclusion, if interactive multimedia web site that refers to real case is developed using mobile technology, information searching process will be easier where information can be reached by students without time and places constraints. Through faster information reaching process, students creativity can be generate with sufficient amount of information and it can also fasten the student skills for creating new ideas in design process.

Computer Aided Design

Computer aided design or CAD technology capability in producing architectural design are gaining importance because there were so many benefits including cost and time reduction in designing process. CAD technology also enables people who involves in architectural design industry to sketch and develop their work on computer screen, it can be saved and printed for future use in making changes and editing. According to Husain (2007), nowadays CAD is recognized as computer aided design not as computer aided drawings anymore. This is because of the facts that CAD technology can actually did more than drawings. CAD technology also enables the producing of high visual impact digital model and gives freedom to the architect to think about object, space and shape in the same screen. Refering to Salman (2004), rapid development for CAD technology has changed the concept shaping from two dimensional to three dimensional. CAD technology development nowadays has proved that the real strength on today's technology is not towards drawings process but in creating new ideas using visual CAD technology impact (Dong & Gibson 1998). CAD technology existence in architecture has two primary objectives which are to applied human cognitive design process through the computing smart technology and to become an idea representative media in architectural design process (Koutamanis 2003).

Three Dimensional Digital Models

Three dimensional digital models is another representation media that can be built using CAD technology. According to Wei Dong and Gibson (1998), digital model gives chances for architect to think, pictures, communicate and making assumptions in designing process. At concept development stage, digital model can be used to analyse overall shape, space planning and to decide space height. In schematic design stage, digital model can be used to study the suitable type of construction material, colour and lighting for the designed buildings. At the final stage of schematic design, digital model can be used to produce a high visual impact design representation. Digital model with the use of CAD technology can produce a visual impact similar to real environment in construction sites. According to Jiangyin (2003), digital model has the ability to represent photo realistic situation with regards to environment details. As a conclusion, compared to conventional model, digital model give chances for architectural students to study about the designed building component in details, suitable finishing materials for each space designed and lighting condition for building's interior. With the CAD technology capabilities, designing process will be simpler, faster and it will give more chances for students to develop their ideas in the design process.

Computer simulation

Simulation is a popular teaching technic amongst educators. According to Micheal (2000), simulation helps student to understand a situation, a process and the replication of real situation activities. Menn (1993) says that 90% of the students learned by doing the activities himself even with the helps of simulation methods. In architectural context, computer simulation brings in the real situation in building design. With the capability of CAD technology nowadays, student can use software such as 3D Studio Viz to observe building detailed effect, lighting and movement in a space through animation just like in a real situation. 3D Studio Viz software capabilities is predicted as it can increase students' visual capabilities towards space. Computer simulation eases students to choose suitable building details, lighting and space arrangement for the designed building. The advantages of computer simulation in designing process is that it can boost designers visual capabilities towards space and helps designers to quickly evaluate the quality of designed space. If computer simulation is integrated in learning design process at polytechnic, it is predicted that students can produce a much more creative space design. There was not much empirical research which can proves that computer simulation can increase student's creativity. However, there are several researchers such as Betz (1996), Gokhale (1996), Harkow (1996), Micheal (2000) and Lawson (2007) whom has made an assumption that computer simulation can increase student creativity. Through this paperwork, researcher hopes that it can strengthens previous research outcomes on computer simulation capabilities via three dimensional digital models which can produce a much more creative architectural design product.

RESEARCH METHODOLOGY

Research Design

This research consists of two main activities in the design process which is designs' informations development activity and creating new ideas activity. Information searching for design purposes on web site based on real case is provided by researcher using mobile device while for creating new ideas activity, CAD technology is used. The web site used in this research developed by the researcher using Caroll's minimal theory. In applying Carroll's Minimalist theory when developing the web site the researcher follows the recommendations by Kearsley (1994) as shown below:

i. Allow learners to start immediately on meaningful tasks.
ii. Minimize the amount of reading and other passive forms of training by allowing users to fill in the gaps themselves
iii. Make all learning activities self-contained and independent of sequence.

The web site that being developed for this research can be referred at the address http://www.kajian_senireka.param.mobi. The integration of the web mobile and CAD technology in the design process for this research is based on Brown and Campione (1996) learning with technology theory. With this theory the integration should be done with the latest equipments required to get the accurate results. Through this study, researcher wants to see the differences in final product designed using mobile and CAD technology integration with the final product build using conventional method. Researcher also wants to see upon how is the effect of integrating web site based on mobile device in the design information development activity. This is a quantitative research to study the effects of mobile and CAD technology integration in the design process to produce architectural creative product. Quasi experimental method is used to study mobile and CAD technology integration effects in design process.

Research Samples

Research has been made on final semester students of diploma architecture from four (4) polytechnics in Malaysia. All the students selected have the same basic understanding of the design process. The students also have the basic skill for using ACAD 2007 and 3D Studio viz software. Both skills have been learned from previous semester. Research duration is for six weeks involving one hundred twenty students (120) students as research samples. In this research, research samples have been asked to design a kindergarten building. Sixty (60) students from POLIPD and PMM were selected to design with the integration of mobile and CAD technology and they are used as treatment group while the other half of the students are from PUO and POLISAS perform the design process using conventional method and they are used as control group. All the four polytechnics selected are using the same curriculum for diploma in architecture which being developed by the Malaysian ministry of higher education. This research has been conducted by two lecturers from each polytechnic selected. Design process for treatment group and control group has been conducted simultaneously. Products for every activity from both of the design processes have been evaluated by selected lecturers using the research instruments provided.

Research Instruments

To evaluate the product for each activity in the design process three instruments have been developed by the researcher. For information analysis product instrument for analysis activity being developed based on requirements being put by Laseau (2001) and Ching (1979), while for product from synthesis activity instrument being developed based on requirements being put by Laseau (2001) and Koberg & Bagnall (1981) and for product from simulation activity instrument being developed based on requirements being put by Laseau (2001) and Mills (2005). The evaluation instrument for the final product is developed by researcher based on Creative Product Analysis Matric (CPAM) model (Besemer and Treffingger 1981). Researcher has been using CPAM model as a guide to evaluate the creative architectural design product. Based on CPAM model the creativity of the design product is based on three main criteria which are uniqueness, practicality and product's detail

Pilot Survey and Reliability of Research Instrument

A pilot test was carried out from 27th October 2008 to 8th December 2008 with 30 students from POLIPD. The reliabilities coefficients of the instrument are shown in Table 1. Data from this pilot test not being used for the final analysis. All the instruments used have high reliabilities coefficients.

Table 1 Reliability Coefficients of Researchs' Instruments

No	Instrument	Items	Cronbach's Alpha Coefficients
1	Information Analysis Product	20 Items	0.9242
2	Synthesis Product	18 Items	0.9201
3	Simulation Product	20 Items	0.9570
4	Final Product Based on CPAM Model	31 Items	0.9577
5	Questionnaire	48 Items	0.9652

Analysis of Data

The main data analysis based on the instruments evaluation forms using inferential statistics (Independent t-tests) and being supported by the data from questionnaire being analysed using descriptive statistics (Means, Standard Deviations, and Frequencies). Raw data from lecturers was used and analyse via computer. The analysis is done using Statistical Package for Social Sciences (SPSS) version 11.5.

FINDINGS

The finding for this research being divided into five categories which are identifying students interest in finding design information, inferential data to compare design information created through analysis activity, inferential data to compare design product from synthesis and simulation activity and inferential data to compare final design product through conventional method compare to integrated method.

Student interest in finding information

In identifying student interest to find information needed in designing process whether it is via mobile technology based website or via conventional method, research outcomes show in Table 2.

Table 2 Descriptive statistics in finding information activity

No	Name of polytechnic	Finding information activities (Frequency)
1	POLIPD	204
2	PMM	188
	Total	392
	Mean	6.53
1	PUO	80
2	POLISAS	98
	Total	178
	Mean	2.97

Research outcomes shows that the total number of student searches in treatment group is 392 (M=6.53) and total searches in control group is 178 (M=2.97). This outcome clearly shows that student searching activities increased with web site integration related to real case based on mobile technology.

Comparing the product of analysis activity

This outcome comparing the quality of designs' information being created from analysis activity consists of two methods which are design information created through conventional method and design information created through integrated method. Research outcome shows in the Table 3.

Table 3 Finding on comparing design information produced in analysis activity

t-test	n	mean	s.d	t	p
Analysis Activity					
Treatment	60	81.2	5.13	18.369	0.000
Control	60	65.5	4.19		

In analysis stage, inferential data shows that there is a significant difference between the mobile technology integrated data (M=81.2) and conventional method (M=65.5), t (118) = 18.369, significant. The significant different on the product being produced in analysis activity proves that the integration of web site based on mobile technology helps the students to produce quality design informations in analysis activity.

Creating new ideas in synthesis activity

In determining student skills at synthesis stage in design process with CAD integration, research has been made to decide whether students using CAD technology integration in synthesis stage has made more idea changes from two dimensional to three dimensional compared to students using conventional method in synthesis stage. The research outcomes of the synthesis activity in the design process show in Table 4.

Table 4 Finding on ideas produced in synthesis activity

No	Name of polytechnic	Conceptual diagram	Early ideas	2D to 3D
1	POLIPD	110	132	126
2	PMM	119	111	109
	Total	229	243	235
	Mean	3.82	4.05	3.92
1	PUO	69	70	61
2	POLISAS	81	80	66
	Total	150	150	127
	Mean	2.50	2.50	2.12

Research outcomes show that conceptual diagram produced for treatment group is 229 (M=3.82) while conceptual diagram produced by control group is 150 (M=2.50). Research outcomes also show that sketching changes from 2D to 3D for treatment group is 235 (M=3.92) while total number of sketching changes from 2D to 3D for control group is 127 (M=2.12). It shows that treatment group is actively involved in synthesis activity compared to control group.

Comparing the product of synthesis activity

The inferential finding data for synthesis activity are shown in Table 5. This inferential data will determine whether there is a significant different between the product being produced by treatment group at the synthesis stage compare to the product being produced by control group at the synthesis stage.

Table 5 T-test finding to compare mean between treatment group and control group product for synthesis activity in design process

t-test	n	mean	s.d	t	p
Synthesis Activity					
Treatment	60	80.6	3.72	17.184	0.000
Control	60	67.1	4.80		

Inferential data shows significant difference between initial idea created in synthesis activity using CAD technology integration (M=80.6) compared to initial idea created in synthesis activity using conventional method (M=67.1), t (118) = 17.184, significant. This proves that the initial ideas being produced from integrated method better than the initial ideas being produced from conventional method.

Comparing the product of simulation activity

The inferential finding data for simulation activity are shown in Table 6. This inferential data will determine whether there is a significant different between the product being produced by treatment group at the simulation stage compare to the product being produced by control group at the simulation stage. The creative and quality product being produced at the simulation stage helps the students to produce a quality final design product.

Table 6 T-test finding to compare mean between treatment group and control group product for simulation activity in design process

t-test	n	mean	s.d	t	p
Simulation Activity					
Treatment	60	80.5	5.46	12.267	0.000
Control	60	66.9	6.68		

Inferential data shows there is a significant difference between final design idea produced in simulation activity using CAD technology integration (M=80.5) compared to final design idea produced in simulation activity using conventional method (M=66.9), t (118) = 12.267, significant. This proves that the design idea that being produced from integrated method is better than the design idea being produced from conventional method.

Comparing the final product

In this research the creativity of the design product being determined based on CPAM model which are unique, practicality and detail. This inferential data will determine whether there is a significant different between the final product being produced by treatment group in the design process compare to the final product being produced by control group in the design process. The inferential finding data for comparing design product between treatment group and control group are shown in Table 7. This finding can prove positive effects on the integration of mobile and CAD technology in the design process for producing creative product.

Table 7 T-test finding to compare mean between treatment group product and control group product based on CPAM model

t-test	n	mean	s.d	t	p
Unique Aspect					
Treatment	60	78.0	7.07	7.134	0.000
Control	60	68.5	7.63		
Practical Aspect					
Treatment	60	78.0	4.69	6.901	0.000
Control	60	73.1	5.97		
Detailing Aspect					
Treatment	60	81.5	4.57	11.076	0.000
Control	60	71.9	4.85		
Overall Creative Aspect					
Treatment	60	79.1	4.27	10.610	0.000
Control	60	70.5	4.61		

Inferential data shows that there is a significant difference between design process integrated with mobile and CAD technology (M=78.0) compared to conventional method (M=68.5) in producing unique design product, t (118) = 7.134 significant. Inferential data also shows that there is a significant difference between design process integrated with mobile and CAD technology (M=78.0) compared to conventional design process (M=73.1) in producing a practical design product, t (118) = 6.901 significant. Inferential data also shows that there is a significant difference between design process integrated with mobile and CAD technology (M=81.5) compared to conventional design process (M=71.9) in producing high details architectural product, t (118) = 11.076, significant.

As a conclusion, final product comparison from creativity aspect between treatment and control group show significant differences. Research outcomes also show that there is a significant difference between final product produced through the design process that being integrated with mobile and CAD technology (M=79.1) compared to final product produced using conventional method (M=70.5) from creativity aspect, t (118) = 10.610 significant. Overall, inferential outcomes show that there is a concrete effect on mobile and CAD technology integration in producing a creative architectural design.

This research shows on how the integration of web site being built using the real case approach based on the mobile device help the students to get more design information at anytime and any place. The integration of mobile technology in the design process generates students' interests to be more active in searching design information during the design process. More design informations being gathered by the students makes it easy to produce creative products. The integration of CAD technology makes it easy for the students to change their designs' ideas from two dimensional to three dimensional. Three dimensional models in the form of digital model make it easy for the students to get the overall view of the building they want to design at the early stage of the design process. CAD technology also allows the students simulate the real situation in their design

process. This simulation activity makes it easy for the students to generate ideas in creating their final design products to solve the problem being given to them.

THE PRODUCTS

From this research, the integration of mobile technology and CAD technology help the students to produce quality product of architectural works. The final students' products from the treatment groups had its own identities. The products from the treatment group also show qualities of creatives products based on CPAM model. Some samples from the students' products are shown in the figures below.

Figure 1: Product 1

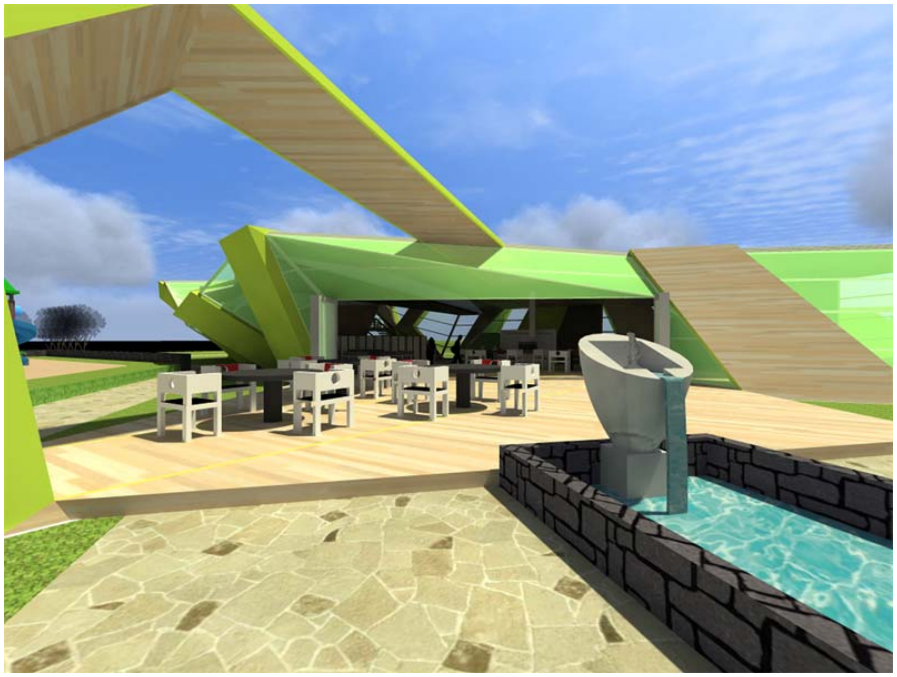

Figure 2: Product 2

Figure 3: Product 3

CONCLUSION AND DISCUSSION

In this research, positive research results for mobile technology based website shows that learning approach using mobile technology can be a good replacement for computer based learning approach. Students and lecturer can gain benefits from easier and faster access of information sources. When it is easier for the students to get the design informations it will create interest to them to involve actively in the searching designs' informations activity. Web site being built by a real case approach also will make the students activity to search for design information become focus and easier. As a conclusion the integration of web site built on a real case based on mobile device will make the searching information activity in the design process become focus and occur at anytime and any place. Rapid development in mobile technology has contribute in growth of faster and higher memory mobile equipment, so that these mobile equipments can be used to download data faster than before and it can also save a lot of informations in the memory. Mobile technology offers a practical educational approach in providing a unique learning community based on technology for the betterment of future polytechnic. Still, there has to be a lot more qualitative and quantitative research to obtain suitable guidance for mobile technology integration in learning process. In the future, graphic resolution and screen size for mobile equipment is expected to be better build. Furthermore, if internet surfing cost can be cut to a lower price, this mobile technology will definitely be useful for higher education students or out-campus students. From CAD technology design aspects, it is proven that CAD technology are able to give comfort for student to produce three dimensional digital model and also increases students understanding of space through good visual effect. This is because CAD technology enhances student creativity and it also encourages student to appreciate interior space when student are doing simulation using different details and lighting in the same space. Students also get excited with produced space via simulation increment with different details and lighting towards their three dimensional digital models. Students understanding toward space are increased with the ability to run a simple simulation into their designed interior spaces. With the animation, student can look at the space from a different perspective. Students give good response towards three dimensional digital model usage to produce good quality interior space designs. Overall, CAD technology via three dimensional digital models helps students to produce a creative final product design. Three dimensional digital model effects based on the finding from this research can be strengthen with the research done towards NBBJ firm by Mark Von Wodtke (2000) which shows that three dimensional digital model can give good design idea and it also helps designer to validate the space, building shape and details of designed buildings. This research outcomes is also strengthen by Lawson (2007) research outcomes which states that architect Ian Ritchie has produced a creative gallery space in London Museum with the help of CAD technology integrated design. Lawson (2007) also says that the kindergarten design produced by kindergarten teachers with the help of CAD technology has higher esthetic value than the one produced by an architect using conventional method. From this research, it is concluded that CAD technology are able to help architectural students to produce much more creative product design. CAD technology, specifically via three dimensional

digital models can boost students' understandings towards space while they are in designing process through the use of good visual impact.

Overall, mobile and CAD technology integration in design process proved to have increased the quality of the final product designed by architectural students which has been achieved in the learning process via architectural design module. As a conclusion this research contributes to the use of real case approach in the development of architectural information sources, in the use of mobile technology as media information sources, the use of CAD technology in synthesis and simulation activity in the architectural design process and in the development of instrument based on CPAM model to evaluate creative architectural design products.

REFERENCES

Anna Trifonova and Marco Ronchetti., 2003. Where is Mobile Learning Going? Dipartimento di Informatica e Telecomunicazioni, Universita degli Studi di Trento Italy.*E-Learn 2003*

Besemer, S.P., & Treffingger, D. 1981. Analysis of creative products: Review and synthesis. *Journal of creative behavior, 15*, 158-178.

Betz J.A. 1996. *Computer simulation: An Integrated Tool.* Paper presented at the SAGE 6th Canadian Symposium, The University of Calgary.

Bottentuitista Junior, Joao Batists dan Coutinho Clara. 2007. Virtual Laboratories and MLearning: learning with mobile devices. *Proceedings of International MultiConference on Society, Cybernetics and Informatics*. p 275-278, Orlando, EUA.Julho.

Brown, A., & Campione, J. (1996). *Psychological theory and design of innovative learning environments: On procedures, principles, and systems*. In L. Schauble & R. Glaser (Eds.), Innovations in Learning: New Environments for Education. P 289-325. Mahwah, N.J.: Erlbaum.

Catangay, M. 2009. Use of mobile phones for quality education. *Philippine Daily Inquirer*.4th April.

Chen J. & Kinshuk.2005. Mobile Technology in Educational Services. Journal of Educational Multimedia and Hypermedia, 14 (1), 91-109.

Ching, Francis.D.K. 1979. Architecture: Form, Space and Order. New York : Van Norstrand. Inc

Demirkan, H. 1998. Integration of Reasoning Systems In Architectural Modeling Activities. *Automation in Construction.* 7. 229-236

Dong, W & Gibson, K. 1998. *Computer Visualization: An Integrated Approach for Interior Design & Architecture*, 1 St. Ed, USA: McgrawHill.

French, H. 1998. Architecture : A Crash Course. New York. Watson Guptill Pub.

Gokhale, A.A. 1996. Effectiveness of computer simulation for enhancing higher orderthinking. *Journal of Industrial Teacher Education, 33* (4), 36-46.

Harkow, R.M. 1996. *Increasing creative thinking skills in second and third grade gifted students using imagery, computers and creative problem solving*. Unpublished master's thesis. NOVA Southeastern University.

Hamdan, A. 2005. Laporan Panel Penilai Hari Produk JKA 2005. *Unit Senibina*. 29 Nov – 01 Dis 2005

Husain Jahit, 2007. Penghasilan produk lebih mantap. Harian Metro. 25 Julai 2007.

Jianying, Jin. 2003. Computer 3d visualization technology – A Dynamic Design Representation Tool In Solving Design and Communication Problems In The Early Phases of Architectural Design Process. Mississippi State, Mississippi.

Kearsley, G. 1994. Minimalism (J. M. Carroll). (Online). http://www.gwu.edu/~tip/carroll.html (19 April 2008)

Koberg, D & Bagnall, J. 1981. Universal Traveler : A Soft Systems Guide to : Creativity, Problem Solving and The Process of Reaching Goals. California: William Kaufmann Inc.

Koutamanis, A. 2003. CAAD's Seven Arguable Virtues, International Journal of Architectural Computing, 2 (1) pp.51-65.

Laseau, Paul, 2001. *Graphic Thinking For Architects and Designers*. 3rd Ed. McGraw Hill.

Lawson, Brian. 2007. CAD and Creativity: Does the Computer Really Help? *ISAST,* Vol. 35, No. 3, pp. 327–331.

Lehner, F. and Nosekabel, H. 2002. The Role of Mobile Devices in E-learning First Experience with a E-learning Environment. In M. Milrad, H. U. Hoppe and Kinshuk (Eds.), *IEEE International Workshop on Wireless and Mobile Technologies in Education* (pp.103-106). Los Alamitos, USA: IEEE Computer Society.

Mark Von Wodtke. 2000. *Design with Digital Tools – Using New Media Creatively.*

McGraw-Hill.

McBride, Jacquelin. S. 1984. Case Study as a Teaching Tool Intergrating Design, Energy and Economic Analysis, M.Arch. Thesis, MIT, Jun. p10

Menn, D. 1993. Multimedia in education. *PC World*, M52-M60. Oktober

Michael, Kurt Y. 2000. A Comparison of Students' Product Creativity Using Computer Simulation Activity Versus A Handson Activity In Technology Education. Virginia Polytechnic Institute. Doctorate Dissertation. p 14 – 15.

Mills, C. B. 2005. *Designing with models : A studio guide to making and using architectural design models*. 2nd Ed. USA. John Wiley and Sons Inc.

Oren, Tim. 1990. Cognitive Load in Hypermedia : Design for the Exploratory Learner. Learning with Interactive Multimedia. Ed. Redmond, WA : Microsoft Press. p127.

Salman H.S., 2004. CAAD Impact on the Early Stages of the Architectural Design Process.Thesis (MSc). University of Wolverhampton.

Sanders, K. 1996. The digital architect : a common sense ; guide to using computer technology in design practice. 1st ed. New York : John Wiley & Sons. Inc

Vavoula, G. N. and Sharples, M. (2002). KleOS: A personal, mobile, Knowledge and Learning Organization System. In M. Milrad, H. U. Hoppe and Kinshuk (Eds.),

IEEE International Workshop on Wireless and Mobile Technologies in Education. August 29 - 30, (pp. 152). Washington, DC, USA: IEEE Computer Society.

Vijayalakshmi Koti. 1997. Hypermedia in Architectural Education : The World Wide Web as a Learning Tool. University of Washington. Jun 9.

Watanabe, S .1994. Knowledge Intergration for Architectural Design. Automation In Construction. 3. 149-156

Wei Dong & Kathleen Gibson, "Computer Visualization – An Integrated Approach for Interior Design & Architecture", McGraw-Hill, 1998

Yunus Baharom, Harris Zamzairie & Hafiz Noh. 2006. *Laporan Penilaian Projek Semester Enam Sesi Jun 2006*. Unit Senibina. 30 November 2006.

THE INFLUENCES OF THE SIXTH GRADERS' PARENTS' INTERNET LITERACY AND PARENTING STYLE ON INTERNET PARENTING

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ABSTRACT
This study aims to explore the sixth grade students' parents' Internet literacy and parenting style on Internet parenting in Kaohsiung County in Taiwan. Upon stratified cluster sampling, a total of 822 parents from 34 classes in 28 schools participated in this study. The descriptive statistics and chi-square test were used to analyze the responses of the "Internet parenting questionnaire." The findings of this study include: (1) the current situations of the sixth grade students' parents' behavior of Internet usage, Internet literacy, parenting style, and Internet parenting are explored and analyzed, and (2) there are significant correlations among the students' parents' behavior of Internet usage, parenting style, Internet literacy, and Internet parenting.
Keywords: Internet literacy, Parenting style, Internet parenting

INTRODUCTION

According to "Survey on current broadband, mobile and wireless applications and demands in families in Taiwan" of ACI-FIND (Foreseeing Innovative New Digiservices) by Institute for Information Technology in 2006, the current popularity rate of personal computers per household in Taiwan is 79.3%. In average, each family has 1.5 computers and family Internet connection popularity rate is 71.7%, indicating that broadband and Internet popularity is 60%. With the prevailing of family Internet, Internet becomes an important entertaining and social tool for children due to the convenience, privacy, and interaction of Internet. Many of children spent plenty of time on Internet which significantly influences their mental and physical development as well as results in social and family problems (Wen & Shih, 2008). In addition, according to "Survey on junior high and elementary school students' digital capacity and opportunity" by UDN Marketing Research (2006), e-popularity rates of junior high and elementary school students are high, and it is as popular as national education.

O'Hanlon also reported that there's no difference between race, gender and academic background in student's Internet usages (2002). The average earliest age approaching computers is 7.9 years old (around 3rd grade). The findings of the survey are similar to findings of foreign studies (Mokhtar, Majid & Foo, 2008). Thus, the potential problems, such as students' Internet indulgence and addiction are concerned. Additionally, modern parents' parenting style is different from those of in the past. Some studies suggest that positive parenting will positively influence children's life adjustment; inappropriate parenting style would negatively influence children's complete life development (Kong & Li, 2009). However, elementary school students' mental development is not mature yet and if they wallow in online games, how will they return to the reality? It is an important issue for parents, educators, and policy makers.

Family education thus becomes critical. Elementary school students access Internet at home mostly (Kuiper, Volman & Terwel, 2008). Lin (2000) reported that in Taiwan, only 27% of parents will monitor their children's online activities and this result is extremely different from American parents (78%). Regarding the monitoring dimensions, most of parents in Taiwan concern about the influence of Internet usage time on children's daily schedule and neglect their online content. Shih (2003) indicated that parents' attitude toward children's Internet usage would directly influence children' Internet addiction. In order to avoid the unfortunate incidents, parents' Internet management and attitude will be extremely important. Family is the main growth and learning environment for children. Children's safe learning and

growth will rely on parents' care and monitoring. Thus, the influence of parents' Internet literacy and parenting style on Internet parenting should be concerned and cannot be neglected. The purposes of this study are to explore current situations of the sixth grade students' parents' behavior of Internet usage, Internet literacy, parenting style and Internet parenting, and to examine the relationship between the sixth grade students' parenting style, Internet literacy and Internet parenting.

LITERATURE REVIEW

The prevalence of Internet poses great threat to the safety of children, especially to their psychological and behavioral development. Many scholars have investigated parental responsibility of children's online behavior and parents' influence on children's attitudes towards Internet as well as positive behavioral development. Related literature on children's online behavior and parents' Internet literacy is illustrated as follows:

Elementary School Students' Online Behavior

As the Internet becomes widespread, the users' age tends to be lower than before. Studies on global information website of Taiwan elementary school students' learning showed that the elementary school students performed better in using browsers and data searching, and performed worse in acquiring and organizing data. In addition, the sixth grade students' learning efficacy is significantly higher than that of their fifth grade counterparts. However, there is no gender difference in learning efficacy (Huang, Lin & Lv, 2006, 2007; Hong & Liu, 2007). Furthermore, the features of the elementary school students' online behaviors are listed as follows:

1. The most common place for using the Internet is home (Huang, 2002; Ye, 2003; Valcke, Bonte, De Wever & Rots, 2010). However, Li (2004) suggested that students in different school scales have different usage sites of Internet.
2. Playing online games and collecting information are the main purposes for students to use the Internet (Huang, 2002; Liu, 2003). Li (2004) suggested that boys and girls as well as students from different residential areas have different purposes for using the Internet. Chang (2003) presented a contradictory research finding that gender and residential areas show no impact on students' online behavior.
3. Students' online hours were between 1 and 3 hours (Liu, 2003). Huang (2003) found there is not much difference in students who use Internet under 1 hour per day. Li (2004) suggested that since students spent 8.95 hours on online games only weekly, the overall Internet hours should be higher.
4. Among all types of online activities and behaviors, parents who permit children playing online games constitute the largest population, followed by those who permitted collecting data.
5. Students' "Internet addiction" phenomenon has become more and more serious (Hansen 2002; Block, 2008).

According to the literature, children's online behavior is more "entertainment-oriented," which is mainly for playing computer games. Since the sites of using Internet are mainly private homes, parents should discipline and instill their children with proper online behavior and safety (Colley & Comber, 2003; Blais, Craig, Pepler & Connolly, 2008).

Types of Parenting Styles

Sears, Macobby & Levin (1957) suggested that parental discipline is essentially interacted and correlated by parental attitudes, faith, and interests, which forms different behavioral types (Allen, 2000; Martinez, Garcia & Yubero, 2007). Ang also found that father and mother's parenting style are completely different (2006). Parenting styles can be divided into three types: one-dimensional, two-dimensional, and multi-dimensional (Koohang, 1987, Greenwood & Hickman, 1991). Definitions are stated as follows:

1. One-dimensional parenting style

Parenting style is considered as the most effective way to exercise family socialization. The three major types of the one-dimensional parenting style: authoritarian, authoritative, and permissive.

2. Two-dimensional parenting style

In reality, parents parenting styles should have different dimensions. And parental personality traits are assumed to play a role in the parenting behaviors (Huver, Otten, Vries & Engels, 2010; Winsler, 2005). The influence of each dimension of the parenting styles on children will interact with other dimensions (Soward, 2006). Two independent dimensions constitute four quadrants. For example, William (1958) broadly categorized parenting styles as authoritarian and caring with various degrees, namely high authoritative and high caring, high authoritative and low caring, low authoritative and high caring, low authoritative and low caring. Roe & Siegelman (1963) proposed ten types of parenting styles based on dimensions of caring-rejection and negligence-demands. Schaefer (1959) proposed 14 types of parenting styles based on dimensions of caring-hostility and autonomy and control. Maccoby & Martin (1983) categorized parenting types as authoritative, lax and non-interfering, authoritarian, negligent and aloof. Generally speaking, two-dimensional classification is used more frequently than the others.

3. Multi-dimensional parenting style

In categorizing types of multi-dimensional parenting styles, the most prominent one is proposed by Becker (1964). He classified parenting styles into three dimensions: restrictiveness-permissive indulgence, warmth-hostility, and anxious emotion involvement-calm detachment. Based on these dimensions, Becker subdivides them into eight types, which are permissive, democratic, anxious neurotic, neglecting, strict control, authoritative, organized effective, and overprotective. Hetherington and Frankie (1967) divided parenting styles into dimensions of warmth, dominance, and conflict. Although their classification is more complete, it is less practicable due to its complexity.

Internet Literacy

The Internet and the World Wide Web (WWW) play significant roles in revolutionizing access to location and use of information. The Internet, a network of networks, provides access to remote computers, electronic mail, file transfer, global bulletin boards, discussion lists, web blogs wikis, and a variety of tools to share and disseminate information. The concept of "Internet literacy" emerges in the era of Internet technology (Saranto & Hovenga, 2004). Some researchers suggested that Internet literacy is significantly correlated with student's achievement. Some don't think so. (Bayram & Comek, 2009). Internet literacy involves basic computer literacy and concepts about Internet (McClure, 1994; Revercomb, 2005). Bawden (2001) suggested that Internet literacy is part of information literacy, which is constituted by traditional literacy, computer literacy, library literacy, network literacy, and digital literacy (Bawden & Robinson, 2002).

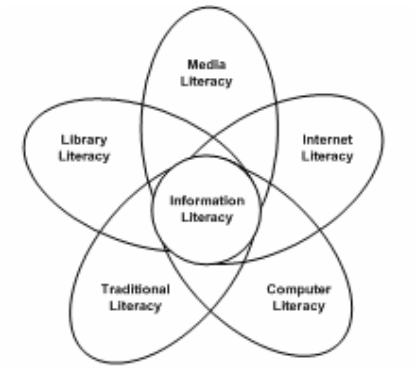

Figure 1. Conceptual map of Information literacy (Bawden, 2001; Bawden & Robinson, 2002).

Reviewing studies on the relationship between elementary school student and parental Internet literacy (Chen, 2002; Li, 2004; Hsu, 2005) found that:

1. Internet access at homes, longer Internet hours, and parental Internet literacy could increase students' Internet literacy and skills.
2. Family and personal variables, such as grade, years of Internet use, parental Internet literacy, parental support, parental intervention, location and time of Internet use, have significant influence on elementary school students' Internet literacy and digital literacy.

Parenting Behaviors and Attitudes

1. Internet parenting

According to the data, when parents discipline children's use of Internet, they would establish use standard, and rely on the length of time and permission to use Internet as common disciplines Also parents will attempt to manage children's access to and use the Internet in the family all the time. (Livingstone, 2007; Magid, 1998). Therefore, based on Liao's (2006) "Survey on elementary school students' online behavior and parental involvement in children's online activity" and Yen's (2002) "Survey on elementary school students' Internet use," this study organizes parental discipline of children's online behavior into the following types:

(1) Frequency of discipline on children's online behavior: 1) usually; 2) sometimes; 3) seldom; 4) non-interfering.
(2) Ways of discipline: 1) establishing norms; 2) restriction on the length of Internet use; 3) location of Internet use; 4) applying for the web connect system.
(3) Disciplining children's online activities: going to Internet cafes, chat rooms, making friends, online games, online shopping, downloading illegal software and files.
(4) Managing children's online content: checking websites that children have browsed
(5) Restricting children's Internet activities: chat rooms, making friends, playing online games, and online shopping

2. Attitudes of Internet parenting

Huang (2003) found that, regarding Internet activities, students' whose parents "encourage their use of Internet and instructing them" have higher exposure to the information learning than those with parents who "neglect and never ask" and "strictly forbid the use of Internet." According to a report released by the National School Boards Foundation

(NSBF, 2000), most parents recognize the positive use of Internet, many of whom expect their children to use Internet for their education, and believe that Internet is safe for children. Most parents support their children's use of Internet and think that Internet brings their children positive gains (Yen, 2002; Jones, 2006).

In addition, with respect to supporting attitudes, most studies reveal that, parental support has positive effect on children's attitudes toward computers, which confirm the general belief that these two attitudes are interlinked (Na and Chia, 2008;Van, 2010). As a result, parental support will prompt children to learn, get in touch with Internet, and improve their Internet literacy. This study directs at parents' attitudes toward children's use of Internet and categorizes these parental attitudes in "survey on Internet parenting." Statements of Internet parenting are presented as follows:

1. Frequency of instructing children to use Internet: "every time," "once in a while," "seldom," and "never"
2. Frequency of encouraging children to use Internet: "every time," "once in a while," "seldom," and "never"

Based on the previous statement and literature, the study constructs a survey of parental discipline of children's Internet use, and uses it as a foundation for the study.

RESEARCH METHODOLOGY

Research Subjects

This study adopted questionnaire survey method and treated elementary school grade 6 students' parents in Kaohsiung County as research subjects. By stratified cluster sampling, according to Bureau of Education of Kaohsiung County Government, the researcher divided the administrative districts into Fengshan District, Gangshan District and Chishan District and extracted the parents of grade 6 students in 1~3 classes in 15 elementary schools in Fengshan District, 10 elementary schools in Gangshan District and 3 elementary schools in Chishan District as the participants according to proportion of number of the elementary grade 6 students. Participants included the parents in 34 classes and 28 schools. A total of 1020 questionnaires were distributed with 822 valid responded. The return rate was 80.58%.

Research Tools

The research tool was a self-designed questionnaire: "the Survey on influence of parents' Internet literacy and parenting style on Internet parenting." It was a Likert 5-point scale. The content of the questionnaire includes current Internet usage, parents' Internet literacy, parenting style, and Internet parenting. After the experts' review, the draft of questionnaire was properly modified. The researchers then conducted pretest and obtained .947 of Cronbach's α. In addition, the researchers tested the construct validity of the questionnaire through factor analysis. The cumulative explained variance of common factor was 66.765%. As to parents parenting style, the overall Cronbach's α was 0.819. Regarding the validity, its total variance explained was 58.146%. It demonstrated that the questionnaire obtained fine construct validity.

Research Procedures

There are four major stages in the study: 1) the preparation stage: started from browse and collect related information, clarified research concepts and defined the research title, and review literature; 2) the research tool design stage: based on the theoretical framework, the researchers designed the questionnaire and conducted expert validity test and the pretest prior to modify the questionnaire; 3) the implementing stage: included choosing participants to carry out the formal survey; and 4) complete the research: included data analysis, discussions of the results, and conclusion writing.

Limitations of the study

This study may be limited by several factors, such as economic and time constraints as well as the availability of resources. For instance, through the cluster sampling approach, the subjects of this study were 1020 sixth graders' parents in Kaohsiung County in Taiwan from 34 classes, 28 schools. Although there were 822 responses returned with a high return rate, due to the limit size of sampling, the results may not be able to represent the entire population and thus the potential bias on the findings may merge. Additionally, students' parents may not be fully sincere or willing to fill out the survey questionnaire under any certain circumstance. Thus, the validity and reliability of the responses from the parents may be biased.

DATA ANALYSIS AND RESULTS

All collected data were analyzed by SPSS for windows 12.0 version. The statistical methods included descriptive statistics, t-test, and chi-square test. The analysis and discussion of the results are presented as follows:

Analysis of the Sixth Grade Students' Parents' Behavior of Internet Usage

The statistical results show that about 76% of the six grade students' parents used Internet and spent less then 1 hour using Internet (46%). Regarding the Internet content, most of the parents used Internet to search information or download data (60%), followed by sending and receiving emails. Regarding types of information searched or downloaded, 90% of the parents used Internet to search or download work related information. And most of the families placed the computers in the study room (29%), followed by living room. In terms of Internet system, most of them had broadband home (76%).

Table 1: The Sixth Grade Students' Parents' Behavior of Internet Usage

Question	Item	No.	%
Do you know how to use an Internet?	eq \o\ac(○,1)1 yes	607	76.2 %
	eq \o\ac(○,2)2 no	189	23.8 %
Frequency of Internet usage:	eq \o\ac(○,1)1 more than 8 hours a day	32	5.3 %
	eq \o\ac(○,2)2 ranging from 5 to 8 hours a day	43	7.1 %
		61	10.0 %
	eq \o\ac(○,3)3 ranging from 3 to 5 hours a day	190	31.3 %
	eq \o\ac(○,4)4 ranging from 1 to 3 hours a day	281	46.3 %
	eq \o\ac(○,5)5 less than 1 hour a day		
Major purposes for using Internet:	eq \o\ac(○,1)1 searching for information or downloading data	363	60.0 %
		18	3.0 %
	eq \o\ac(○,2)2 chatting online or making net friends	105	17.4 %
		24	4.0 %
	eq \o\ac(○,3)3 sending and receiving emails	65	10.6 %
	eq \o\ac(○,4)4 online shopping	30	5.0 %
	eq \o\ac(○,5)5 playing online games		
	eq \o\ac(○,6)6 other_____		
Location of family computer in your household: (multiple-choice)	eq \o\ac(○,1)1 living room	224	26.4 %
	eq \o\ac(○,2)2 parent's room	168	19.8 %
	eq \o\ac(○,3)3 children's room	140	12.5 %
	eq \o\ac(○,4)4 study room	246	29.0 %
	eq \o\ac(○,5)5 other_____	69	8.1 %
Internet connection:	eq \o\ac(○,1)1 no connection	63	7.9 %
	eq \o\ac(○,2)2 dial-up	86	10.8 %
	eq \o\ac(○,3)3 broadband	605	76.0 %
	eq \o\ac(○,4)4 other_____	13	1.6 %
	Missing data	29	3.6 %

Analysis of the Sixth Grade Students' Parents' Internet Literacy

Speaking of Internet literacy of parents (as shown in Table 2), as to Internet knowledge, most of the parents recognize meaning of electronization, Internet devices, and keyword searching. With regard to Internet skills, most of the parents are able to add their favorite or commonly used websites to "My Favorites" folder, to search for online information and upload and download pictures, words or files. However, the parents thought website or blog construction was rather difficult. In terms of attitudes toward Internet usage, the parents thought that respecting for intellectual property rights and protecting the students' Internet security were important. The researchers split the subjects into high-score, medium-score, and low-score groups based on the total scores of the three domains. About 27% above and below percentile of scores are the criterions for dividing high-score and low-score groups. The findings indicate that the highest ratio is the subjects with medium literacy (39.2%), the next is low literacy (31.3%), and high literacy (29.5%) is the least (as shown in Table 3).

Table 2. The Sixth Grade Students' Parents' Internet Literacy

Internet knowledge	Mean	SD
1. I understand that Internet requires TCP/IP network protocols	3.43	.898
2. I understand the necessary equipment for connecting to the internet.	3.62	.889
3. I know types of broadband services provided by ISP (Internet Service Provider).	3.41	.864
4. I understand the meaning of "electronization," For example: e-government, e-generation.	3.63	.921
5. I understand the meaning of "www," "edu," and "tw" in http:// www.npust.edu.tw	3.45	.951
6. When I use key words to search for information, I understand the meaning and usage of "and," as well as "or."	3.49	.958
7. I know about common anti-virus software.	3.38	.930
8. I know about management software for rating internet sites.	3.43	.948
Internet skills		
9. I know how to add websites that I like or frequently use into "my favorite."	3.91	1.006
10 I know how to input internet address to link to websites that I need.	3.82	0.977
11 I can download pictures, articles or files, and store them in my computer.	3.71	1.018
12. I can use internet to look for information, and to solve personal or work issues	3.89	0.960

13. I know how to search for information by key words, and use them to narrow down the scope.	3.79	0.984
14. I know how to apply for free mailbox on certain websites (such as yahoo) .	3.60	1.097
15. I know how to create personal blogs on certain websites (such as Wretch).	3.05	1.086
16. I know how to write and reply emails.	3.51	1.133
Internet Attitude		
17. I think that sharing files or using online articles, images or pictures without permission could potentially violate intellectual property rights.	3.83	1.009
18. I like to use internet to search for information and to solve my problems.	3.97	0.905
19. I think that internet could update my knowledge and help me catch up with time.	3.98	0.908
20. I think that schools should install internet filters (fire walls) to prevent students from browsing uncensored websites.	4.26	0.920

Table 3. The Sixth Grade Students' Parents' Internet Literacy Group

Internet Literacy Group	No.	%
low literacy	249	31.3 %
medium literacy	312	39.2 %
high literacy	235	29.5 %

Table 4. The Sixth Grade Students' Parents' Parenting Style

Parenting Style	No.	%
neglectful and indifferent parenting	19	2.4
laisser-faire	33	4.1
autocratic	197	24.7
open-minded and authoritative	547	68.7

Analysis of the Sixth Grade Students' Parents' Parenting Style

In terms of parenting style (as shown in Table 4), the results of analysis of the survey questionnaire show that "open-minded and authoritative (68.7%)" obtained the highest ratio, followed by "autocratic (24.7%)" and "laisser-faire (4.1%)". Only a few parents responded "neglectful and indifferent parenting (2.4%)." Over 90% of the parents are "Open-minded and authoritative" and "autocratic parenting."

Analysis of the Sixth Grade Students' Parents' Internet Parenting

Regarding parents' management of children's frequency of Internet usage (as shown in Table 5), occasional management takes the most portions (37.9%), followed by frequent management. About 92.6% of the parents prohibited their children from going to Internet cafe. Most of the parents set the rules of Internet usage at home (72%) for their children. As to parents' management approaches of children's Internet usage, most of the parents turn off the power (26.8%), followed by verbal warning (21.2%). Very few of them used corporal punishment (2.1%). As to parents' instruction of children's Internet usage frequency, occasional instruction is the most (34.9%) and the next is no instruction (26.4%). The reasons for no instruction are the parents did not know how to use Internet and the parents were too busy with jobs or housework. Regarding parents' encouragement of children's Internet usage, occasional encouragement is the most (44.2%); regarding the reasons of no encouragement, most of the parents worried of their children's Internet addiction (51.5%) and the next is the parents did not possess knowledge of using Internet. In terms of Internet content, educational websites (31.8%) and online games (27.5%) are the most and the next are MSN or blog. Few parents allowed children to have online shopping or browsing foreign websites. As to children's use time of Internet, most of the parents allowed children to use Internet for one hour on weekdays. On weekends, most of the parents allowed their children to use Internet for about 2 to 3 hours per day. In winter and summer vacations, children were allowed to use Internet for 2 to 3 hours every day. In addition, most of the parents prohibited children to use Internet in the time of sleeping, doing homework, before examinations, or eating indicating that most of parents concerned about children's regular daily schedule, and did not want children to be disturbed by Internet in their daily schedule.

Table 5. The Sixth Grade Students' Parents' Internet Parenting

Internet Parenting	Item	No.	%
Frequency of internet parenting:	eq \o\ac(○,1)1 every time	146	18.3 %
	eq \o\ac(○,2)2 frequently	292	36.7 %
	eq \o\ac(○,3)3 occasionally	302	37.9 %
	eq \o\ac(○,4)4 never	56	7.1 %
Do you permit your children to use internet in internet cafes?	eq \o\ac(○,1)1 Yes	59	7.4 %
	eq \o\ac(○,2)2 No	733	92.6 %
Do you establish norms regarding internet usage at home?	eq \o\ac(○,1)1 Yes	573	72.0 %
	eq \o\ac(○,2)2 No	223	28.0 %
Ways that you control children's website browsing behaviors:	eq \o\ac(○,1)1 no management at all.	139	17.5 %
	eq \o\ac(○,2)2 communicating with children regarding contents that could and could not be viewed.	285	35.8 %
	eq \o\ac(○,3)3 determining website contents that could be viewed by circumstances	285	35.8 %
	eq \o\ac(○,4)4 installing website rating management software	87	10.9 %
Have you ever taught children how to use internet?	eq \o\ac(○,1)1 never	210	26.4 %
	eq \o\ac(○,2)2 rare	207	26.0 %
	eq \o\ac(○,3)3 from time to time	278	34.9 %
	eq \o\ac(○,4)4 always	101	12.7 %
What is the major reason that you don't teach your children to use internet?	eq \o\ac(○,1)1 because I know nothing about it	133	45.2 %
	eq \o\ac(○,2)2 no computer and internet facilities installed in the household	36	12.1 %
	eq \o\ac(○,3)3 too busy in work or housework	66	22.1 %
	eq \o\ac(○,4)4 economic constraints	5	0.2 %
	eq \o\ac(○,5)5 because they are taught at schools	48	16.1 %
	eq \o\ac(○,6)6 others _____	13	4.3 %
Have you encouraged children to use internet?	eq \o\ac(○,1)1 never	163	20.5 %
	eq \o\ac(○,2)2 rare	173	21.7 %
	eq \o\ac(○,3)3 from time to time	352	44.2 %
	eq \o\ac(○,4)4 always	108	13.6 %
Reasons why you don't encourage your children to use internet?	eq \o\ac(○,1)1 knowing little or nothing about internet	51	18.8 %
	eq \o\ac(○,2)2 no computer and internet facilities installed in the household	37	13.9 %
	eq \o\ac(○,3)3 afraid that internet will cause children's behavioral problems	37	13.9 %
	eq \o\ac(○,4)4 worries and doubts about internet addition	142	51.5 %
	eq \o\ac(○,5)5 economic constraints	6	0.6 %
	eq \o\ac(○,6)6 others _____	14	1.0 %
Under such circumstances you would prohibit your children from using internet: (multiple choices)	eq \o\ac(○,1)1 homework time	584	17.7 %
	eq \o\ac(○,2)2 dinning time	552	16.8 %
	eq \o\ac(○,3)3 sleeping time	585	17.8 %
	eq \o\ac(○,4)4 class day	413	12.5 %
	eq \o\ac(○,5)5 holiday	35	1.1 %
	eq \o\ac(○,6)6 before test	584	17.7 %
	eq \o\ac(○,7)7 ill performance (for example: making mistakes, disobedient)	466	14.2 %
	eq \o\ac(○,8)8 they could use internet at any time	73	2.2 %
Length of time children are permitted to use internet every day after class:	eq \o\ac(○,1)1 prohibit to use internet	346	43.5 %
	eq \o\ac(○,2)2 less than 1 hour	362	45.5 %
	eq \o\ac(○,3)3 between 2 and 3 hours	84	10.6 %
	eq \o\ac(○,4)4 more than 3 hours	4	0.5 %
Length of time children are	eq \o\ac(○,1)1 prohibit to use internet	118	14.8 %

permitted to use internet every day during holidays:	eq \o\ac(○,2)2 less than 1 hour	227	28.5 %
	eq \o\ac(○,3)3 between 2 and 3 hours	355	44.6 %
	eq \o\ac(○,4)4 between 3 and 4 hours	66	8.3 %
	eq \o\ac(○,5)5 more than 4 hours	30	3.8 %
Length of time children are permitted to use internet every day during summer and winter vacation:	eq \o\ac(○,1)1 prohibit to use internet	176	22.1 %
	eq \o\ac(○,2)2 less than 1 hour	169	21.2 %
	eq \o\ac(○,3)3 between 2 and 3 hours	327	41.1 %
	eq \o\ac(○,4)4 between 3 and 4 hours	85	10.7 %
	eq \o\ac(○,5)5 more than 4 hours	39	4.9 %
Parents' management approaches of children's Internet usage（Multiple Choice）	eq \o\ac(○,1)1 turn off power of computers	359	26.8 %
	eq \o\ac(○,2)2 internet connecting system	267	19.9 %
	eq \o\ac(○,3)3 website rating management	209	15.6 %
	eq \o\ac(○,4)4 do not apply for internet connecting system (such as ADSL)	68	5.1 %
	eq \o\ac(○,5)5 physical punishment	28	2.1 %
	eq \o\ac(○,6)6 no computer facilities installed	49	3.7 %
	eq \o\ac(○,7)7 verbal warning but no actions	284	21.2 %
	eq \o\ac(○,8)8 delegating disciplining responsibilities to teachers and schools	76	5.7 %
Which website contents do you allow your children to view? (multiple choices) :	eq \o\ac(○,1)1 MSN or chat room	242	11.7 %
	eq \o\ac(○,2)2 online games	570	27.5 %
	eq \o\ac(○,3)3 online shopping	62	3.0 %
	eq \o\ac(○,4)4 adult websites	5	0.2 %
	eq \o\ac(○,5)5 educational websites	659	31.8 %
	eq \o\ac(○,6)6 international websites	56	2.7 %
	eq \o\ac(○,7)7 blog	264	12.7 %
	eq \o\ac(○,8)8 video websites (such as TV, movie)	214	10.3 %

Analysis of the Correlation between Internet Literacy and Internet Parenting

The results of chi-square test and Post hoc comparison analyses show that there is a significant correlation between the parents' Internet literacy and Internet parenting frequency ($\chi^2_{.95(6)} = 48.804$, $p < .01$, $Vc = 0.175$). Parents with low Internet literacy tend to frequently manage children's Internet usage. Parents with high Internet literacy tend to hardly manage it. Additionally, there is significant correlation between allowing children to go to Internet Café and parents with three different kinds of Internet literacy ($\chi^2_{.95(2)} = 12.544$, $p < .05$, $Vc = 0.089$). More parents prohibit their children to go to Internet cafe. Also, there is significant correlation between setting rules of Internet usage and parents with three different kinds of Internet literacy ($\chi^2_{.95(2)} = 15.014$, $p < .05$, $Vc = 0.137$). More parents setting the rules than the no rule setting. In addition, there is significant correlation between management of children's Internet usage and Internet literacy ($\chi^2_{.95(6)} = 52.204$, $p < .01$, $Vc = 0.181$) indicating most of parents with "high Internet literacy" do not manage children's Internet usage. Furthermore, there is significant correlation between instructions of children's Internet usage and Internet literacy ($\chi^2_{.95(6)} = 156.477$, $p < .01$, $Vc = 0.314$) indicating most of parents with "high Internet literacy" do not instruct children's Internet usage. Moreover, there is significant correlation between parents' Internet literacy and encouragement of children's Internet usage ($\chi^2_{.95(6)} = 72.829$, $p < .01$, $Vc = 0.214$) indicating most of parents with three kinds of Internet literacy occasionally encourage their children to use Internet. Generally speaking, parents with "high Internet literacy" show lower frequency of managing than those of "low Internet literacy" regarding Internet parenting frequency, management, and instruction.

Analysis of the Correlation between Parenting Style and Internet Parenting

The results of chi-square test and Post hoc comparison analyses show that this study demonstrates the analytical results below: the parents' different parenting styles do not show significant difference on management ($\chi^2_{.95(9)} = 14.064$, $p > .05$), instruction($\chi^2_{.95(9)} = 10.875$, $p > .05$) or encouragement($\chi^2_{.95(9)} = 16.766$, $p > .05$) of children's Internet usage. However, it shows significant difference on the parenting of children's Internet usage frequency($\chi^2_{.95(9)} = 32.406$, $p < .01$, $Vc = 0.116$), allowing children to go to Internet café (χ^2 .95(3) = 17.860, p <.01,Vc = 0.106), and setting Internet

usage rules ($\chi^2_{.95(3)} = 22.252$, $p < .01$, $Vc = 0.167$). For the parents with "neglectful and indifferent" or "laisser-faire" parenting styles, their management frequency of children Internet usage: "occasional management" shows more significant than the "management every time." On the contrary, "never manage" on children's Internet usage was rarely exercised by the parents with "autocratic" parenting style. The parents with "open-minded and authoritative" parenting style showed "frequently manage" and "occasional manage" respectively on managing their children's Internet usage. The parents with "neglectful and indifferent" parenting style obtained higher significance than the parents with "open-minded and authoritative" parenting style on the "no rules on Internet usage."

DISCUSSIONS

Based on the analyses of the results, most the parents in this study were around 30 to 40 year old labors from the middle socioeconomic class with only high school or vocational school education; some of them had college education. These results are in accordance with the current distribution of human resources in Taiwan.

In terms of behavior of internet usage, around 76% of the parents knew how to use the Internet. Home Internet equipment is mainly ADSL. Motives for using the Internet are usually due to job needs, searching for information and downloading data. The prevalence of Internet use and the development of information industry as well as 3C industry all accelerate the improvement of home facility and information literacy in addition to use internet at work.

Speaking of internet literacy, this study concludes that parents' Internet literacy is primary for obtaining knowledge, such as searching for information, downloading data, and less for sharing knowledge or knowledge transfer, such as website construction and designing blogs. This is probably because the latter involves more hardware and software knowledge, most parents are afraid to utilize it. Meanwhile, to many X-generation parents, leaving messages on the message board or sharing life experience and knowledge online tend to be very difficult or not easy to get used to. In recent years, due to Taiwanese government's efforts in strengthening of intelligence property right and combating Internet crimes, the parents especially respect intelligence property rights and students' online safety, which also confirms Taiwan government's success in the promotion of information policy and implementation. This great success can be provided to other countries for their information education development.

In terms of parenting style, the findings of the study indicate that the authoritative parenting is the most common type among all the parenting styles, while negligence is the most uncommon type. Compared to other types, the authoritative parenting is the best discipline style. Parents who prefer the authoritative parenting value parenting education, and are willing to devote more care and love. It is assumed that the parents will encourage students to be independent and simultaneously restrict their lifestyle, learning and safety with authoritative and responsible attitudes (Maccoby & Martin, 1983). Since most parents possess proper parenting styles, their impact on children's learning would be positive and profound, which can be beneficial for cultivating children's accurate behavior and attitudes of internet usage.

Regarding the internet parenting, the results of the study indicate that 90% of the parents disciplined children's online behavior, and most parents would communicate with their children to establish norms. This result confirms Magid's (1998) investigation that parents would discipline the length of time children spending on the Internet and the restricted them only to view educational websites and online games. Controlled the computer power supply and the Internet connection were the most two simple and effective ways for the parents. Meanwhile, 90% of the parents opposed their children to go to Internet cafe because computers were installed with both good and bad software there and its customers vary in a wide range. The parents are worried that children may be affected negatively. Thus, all internet cafes should be managed effectively and have set up regulations and restricts for the children.

In terms of the relationship between internet literacy and internet parenting, the findings also suggested that parents' Internet literacy had significant correlated on their Internet parenting. The lower Internet literacy the parents' have, the more they encourage their children to use the Internet. With respect to controlling and supervising children's use of Internet, they tend to show concern, to teach or to regulate children's online behavior. By contrast, the parents with high Internet literacy tended to trust their children and did not regulate their children's online behavior. Also, they seldom taught or encouraged their children to use the Internet. This phenomenon is probably because this type of parents are familiar with the usage of computer technology, such as firewalls and safety secure software, and were able to use them to prevent bad influence of Internet. Thus, they appear to be less controlling in this matter.

Regarding the relationship between parenting style and internet parenting, the results of this study also indicate that different parenting styles are significantly and positively correlated with the frequency of online parenting. Parenting styles are also significantly and positively correlated with establishing norms for children and parental permission for going to Internet cafes. With respect to the difference between the "neglecting" and "permissive" parenting, the number of the parents who "never discipline" was more than those who "usually discipline"; while the number of "authoritarian" parents who "always discipline" was more than those who "never discipline." On the other hand, the "authoritative" parents tended to "discipline children regularly" than "discipline very time children use Internet." Huang

(2002) suggested that parenting attitudes will affect children's information learning. Positive encouragement and appropriate guidance will promote children's information learning. On the contrary, overindulgence or strict forbiddance will hinder children's development in information learning. Hsu (2005) surveyed the sixth grader students, and found that a higher percentage of children were addicted to the Internet due to neglecting parenting. This study found that the "neglecting" and "permissive" parenting parents seldom disciplined their children's online behavior, so that their children might be less resistant to Internet addiction. Thus, how to educate and cultivate parents' positive parenting styles and internet parenting has become an important lesson for the development of information education worldwide.

CONCLUSIONS

1. The parents' current Internet parenting: the "occasional management" is the most frequent and the next is "frequent management" for the sixth grade students' parents' management of children's Internet usage. Over 90% of the parents prohibit children to go to Internet café and over 70% of parents set up Internet usage rules at home. Educational websites and online games were mostly allowed for browsing. In addition, controlling the power of the computer is the most common managing approach for parents. In addition, over 50% of the parents allow children's playing online games but limit other Internet activities, particularly meeting online friends or going to their gatherings, indicating most of the parents are more open-minded about students playing online games than other Internet activities.

2. Correlations between the parents' Internet usage and Internet parenting: the parents' average Internet usage time is less than one hour every day. Acquiring and downloading information for work are the most common activities. In addition, the parents' Internet usage, Internet usage time, and Internet content are significantly related to Internet parenting. Internet parenting attitude, such as instructing and encouraging children to use Internet, is also significantly related. Thus, the more familiar with Internet the parents are, the more concerns on the rules for children's Internet usage and attention on their behavior the parents have.

3. Correlations between the parents' Internet literacy and children Internet parenting: there is a significant correlation between the parents' Internet literacy and Internet parenting. The parents with low Internet literacy are significantly higher than those with high Internet literacy in terms of Internet parenting frequency and instruction and encouragement of children's Internet usage. The parents with high Internet literacy tend to trust their children and do not manage them and hardly guide and encourage children's Internet usage. In contrast, the parents with low Internet literacy who do to not use Intent often or cannot use it agree that Internet would enhance children' learning. They will encourage children to use Internet. Additionally, the parents tend to manage and monitor children's Internet usage. The parents with high Internet literacy who are familiar with Internet environment and using skills are less aware of Internet security and tend to trust children or to be laisser-faire. However, they still worry about children's Internet addiction, and do not encourage children's Internet usage.

4. The relationship and influence between the parents' parenting style and Internet parenting: the parents' parenting styles show a significant correlation with their management of children' Internet usage frequency, allowing children to go to Internet café, and setting Internet usage rules. The parents with "neglectful and indifferent" and "laisser-faire" parenting styles show more significant in "no management" than "frequent management." The parents with "autocratic" parenting style show more significant "management every time" than "no management." The parents with "open-minded and authoritative" parenting style tend to be more significant "frequent management" than "management every time." Also, only the parents with "laisser-faire" parenting show significant different attitudes. In addition, both encouragement and instruction of children's Internet usage and the parents' different parenting styles are not correlated. Thus, the parents with different parenting styles only regulate children's behavior of Internet usage, such as regulation of using time and setting rules but not significantly influence children's Internet use, such as content browsed and attitude.

RESEARCH SUGGESTIONS

1. Internet contents browsed by children should be monitored: the parents with different levels of Internet literacy or different parenting styles hardly concern about children's browsed Internet content. Therefore, the parents should not only regulate children's Internet usage time, but also should instruct and assist with Internet usage and content in order to establish the children's positive concepts and habits.

2. The parents with open-minded and authoritative parenting style can stably and positively enhance children's Internet usage behavior: most of the parents with "open-minded and authoritative" parenting style encourage the children to be independent with open-minded and responsible attitude. They also regulate the children's life, learning, and safety. Additionally, the parents with "neglectful and indifferent" and "laisser-faire" parenting styles reveal low Internet parenting frequency. In order to avoid students' Internet addiction, the parents should possess "open-minded and authoritative" parenting style to ensure children's safety learning and growth.

3. Website classification software should be used: only few parents used website classification software at home. Most of parents allow their children to play online games. Thus, the authority should fulfill the management of computer software classification for parents. In addition, the government, educational units, and schools should provide more classified online games for children.

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REFERENCES

Allen, B. P. (2000). Personality theories: Development, growth, and diversity. Boston, Allyn & Bacon.

Ang, R. P. (2006). Effects of Parenting Style on Personal and Social Variables for Asian Adolescents. *American Journal of Orthopsychiatry, 76*(4), 503-511.

Bawden, D. (2001). Information and digital literacy; A review of concepts, *Journal of Documentation, 57*(2), 218-259

Bawden, D & Robinson, L. (2002) Promoting literacy in a digital age: approaches to training for information literacy, *Learned Publishing, 15*(4), 297-301.

Bayram, H. and A. Comek (2009). "Examining the relations between science attitudes, logical thinking ability, information literacy and academic achievement through internet assisted chemistry education." *Procedia - Social and Behavioral Sciences 1*(1): 1526-1532.

Block, J. J. (2008). "Issues for DSM-V: Internet Addiction". *American Journal of Psychiatry*, *165*(3), 306-307.

Blais, J. J., Craig, W. M., Pepler, D. & Connolly, J. (2008).Adolescents Online: The Importance of Internet Activity Choices to Salient Relationships. *Journal of Youth & Adolescence, 37*(5), 522-536.

Chang, W. L. (2003). A study of information-seeking behavior among senior-level elementary school students in the area of I -Lan. Unpublished master's thesis, Fo Guang University, Taiwan

Chen, P. N. (2002). A Study of the Network Literacy of Pupils and Its Correlative Factors. Unpublished master's thesis, National Pingtung University of Education, Pingtung, Taiwan

Colley, A. & Comber, C. (2003). Age and gender differences in computer use and attitudes among secondary school students: what has changed? *Educational Research, 45*(2),1 55-165.

Greenwood, G. E., & Hickman, C. W. (1991). Research and practice in parent involvement: Implications for teacher education. *The Elementary School Journal*, *91*(3), 279-288.

Hansen, S. (2002). "Excessive Internet usage or Internet Addiction'? The implications of diagnostic categories for student users." *Journal of Computer Assisted Learning*, *18(*2).232-236.

Hetherington, E. M. & Frankie, G. (1967). Effects of parental dominance, warmth, and conflict on imitation in children. *Journal of personality and social psychology, 6*(2), 19-125.

Hong, S. M. & Liu, M. S. (2007). A Study on the Correlation among Parenting Styles, Emotional Awareness and Interpersonal Relations in Elementary School Students at the Senior Grade. *Journal of Far East University*, *24*(1), 77-96.

Hsu, Y. H. (2005). A Study on the Network Usage and Network Literacy of Fifth and Sixth Graders in Remote Areas of Taipei County. Unpublished master's thesis, National Taipei University of Education, Taipei, Taiwan.

Huang, W. W. & Lin, J. H. (2006). A Study of Gender Attitude and Internet Behaviors of Taiwan's Students. The Age of Digital Creation: E-generation and Digital Communication Symposium. National Chengchi University, Taipei, Taiwan.

Huang, W. W., Lin, J. H. & Lv, J. H. (2007). A Research on Network classification and Security for Taiwan's Students. The Age of Digital Creation: E-generation and Digital Communication Symposium. National Chengchi University, Taipei, Taiwan.

Huang, Y. P. (2002). A Study on the Network Literacy and Network Usage of Elementary School Students. Unpublished master's thesis, University of Tainan, Tainan, Taiwan

Huver, R. M. E., Otten, R., de Vries, H. & Engels, R. C. M. E. (2010). Personality and parenting style in parents of adolescents. Journal of Adolescence, 33(3), 395-402.

Jones, P. J. (2006). Resources for Promoting Online Citizenship. *Educational Leadership, 63* (4), 41-41.

Kong, S. C. & Li, K. M. (2009). Collaboration between school and parents to foster information literacy: Learning in the information society. *Computers & Education, 52*(2), 275-282.

Koohang, A. A. (1989). A study of attitudes toward computers: anxiety, confidence, liking, and perception of usefulness. *Journal of Research on Computer in Education Computing Research*, *22*(2), 237-250.

Kuiper, E., Volman, M. & Terwel, J. (2008). Students' Use of Web Literacy Skills and Strategies: Searching, Reading and Evaluating Web Information. Information Research: *An International Electronic Journal*, *13*(3). http://informationr.net/ir/13-3/paper351.html.

Li, C. C. (2004). The Digital Divide among Elementary School Students in Taipei, Taiwan. Unpublished master's thesis, National Taipei University of Education, Taipei, Taiwan.

Li, W. C. (2004). The Study for Junior High School Students' Literacy in Computer Network of Taipei County. Unpublished master's thesis, National Taiwan Normal University, Taipei, Taiwan.

Liao, Y. Y. (2006). A Study on the Current Situation of Internet Use behaviors and Parent participation in Children's Internet Activities for Elementary School Students. Unpublished master's thesis, University of Tainan, Tainan, Taiwan.

Lin, Y. P. (2000). Total Exam on Information Education in Taiwan, Special Edit for Education, Common Wealth Magazine, p52-60.

Livingstone, S. (2007). Strategies of parental regulation in the media-rich home. *Computers in Human Behavior, 23*(2), 920-941.

Liu, W. S. (2003). A study of internet addiction and internet literacy on elementary school students. Unpublished master's thesis, University of Tainan, Tainan, Taiwan

Maccoby, E. E. & Martin, J. A. (1983). Socialization in the context of the family: Parent-child interaction. In P. H. Mussen, & M. E. Heatherington (ed.), *Handbook of Child Psychology, 4*, pp 1-101. John Wiley & Sons: New York.

Magid, L. J. (1998). Child safety on the information highway. Retrieved November 1, 2004,from: http://www.safekids.com/child_safety.htm#Whatever

Martinez, I., Garcia, J. F. & Yubero, S. (2007). Parenting styles and adolescents' self-esteem in Brazil. *Psychological Reports, 100*（3）, 731-745.

McClure, C. R. (1994). Network literacy: a role for libraries? *Information Technology and Libraries, 13*(2), 115-125.

Mokhtar, I. A., Majid, S. & Foo, S. (2008). Information literacy education: Applications of mediated learning and multiple intelligences. *Library & Information Science Research, 30*(3), 195-206.

Na, J.-C. & Chia, S. W. (2008). Impact of online resources on informal learners: Parents' perception of their parenting skills. *Computers & Education, 51*(1), 173-186.

National School Boards Foundation (2000). Research and guidelines for children's use of the internet. National Prentice-Dunn, S. & Rogers, R. W. (1982). Effect of public and private self-awareness on deindividuation and aggression. *Journal of Personality and Social Psychology, 8,* 657-670.

O'Hanlon, N. (2002). Net knowledge: Performance of new college students on an Internet skills proficiency test. *The Internet and Higher Education, 5*(1), 55-66.

Revercomb, P. L. (2005).Internet information literacy: A study of older adults, Syracuse University：PhD

Roe, A. & Siegelman, M. (1963). A parent-child relations questionnaire. *Child Development, 34,* 355-369.

Saranto, K. & Hovenga, E. J. S. (2004). Information literacy--what it is about?: Literature review of the concept and the context. *International Journal of Medical Informatics, 73*(6), 503-513.

Sears, R. R., Macobby, E. E. & Levin, H. (1957). Patterns of child rearing. Evanston 111: Row Peterson.

Shih, S. R. (2003). Network characteristics of the virtual world and its influence on the young. *Student Counseling Bimonthly. 89,* 80-89.

Soward, K. W. (2006). Resilience and self-control in at-risk preschool children: Influences of maternal parenting style and self-control. Dissertation Abstracts International: Section B: The Sciences and Engineering, 67(2-B), 1169.

UDN Marketing Research. (2006, 09). Survey Report on Digital Ability and Digital Learning Opportunity for k-12 Students. [Online]. Available:2010.05.30. http://www.rdec.gov.tw/public/Attachment/774935671.pdf.

Valcke, M., Bonte, S., De Wever, B. & Rots, I. (2010). Internet parenting styles and the impact on Internet use of primary school children. *Computers & Education, 55*(2), 454-464.

Van de Vord, R. (2010). Distance students and online research: Promoting information literacy through media literacy. *The Internet and Higher Education, 13*(3), 170-175.

Wen, J. R. & Shih, W. L. (2008). Exploring the information literacy competence standards for elementary and high school teachers. *Computers & Education, 50*(3), 787-806.

Winsler, A., Madigan, A. L. & Aquilino, S. A. (2005). Correspondence between maternal and paternal parenting styles in early childhood. *Early Childhood Research Quarterly, 20*(1), 1-12.

Ye, S. J. (2003). A Study of Elementary School Student's behavior and cyberethics on the Internet. Unpublished master's thesis, National Pingtung University of Education, Pingtung, Taiwan

Yen, T. H. (2002). Research on The Relationship between background, behavior of using Internet and psychological characteristics for elementary school students. Unpublished master's thesis, University of Tainan, Tainan, Taiwan.

WHAT IS THE PREDICT LEVEL OF WHICH COMPUTER USING SKILLS MEASURED IN PISA FOR ACHIEVEMENT IN MATHEMATICS

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ABSTRACT
This study aims at determining the extent to which computer using skills specified in Project for International Students Evaluation (PISA) 2006 predict Turkish students' achievement in mathematics. Apart from questions on mathematics, science and reading competencies, a student questionnaire, a school questionnaire and a parent questionnaire were also given prior to the exam to gather information on various social, cultural and economic factors that might be related to the students' academic achievement. Self-reliance in performing the operations requiring high level of computer skills, self-reliance in performing internet-related operations, using computers for internet and entertainment purposes, and using computers for programme and software purposes were examined as variables affecting mathematical achievement in this research. Multiple regression analysis was conducted so as to determine the degree to which independent variables predicted achievement at mathematics. The analysis results showed that the model constructed was statistically significant ($F=240.45$; $p< 0.01$). The independent variables accounted for aproximately 17.7% of the overall variance. The research findings showed that students' self-reliance in performing the operations requiring high level of computer skills, using the word processor, using electronic tabulating programme in drawing graphs, preparing presentations, preparing multi-media presentations, and designing web pages affected the mathematics achievement scores in a negative way. Based on those results, it might be said that students' using computers in line with their needs, parents' controlling the time their children use computers, the internet and computer for entertainment purposes would be beneficial.

INTRODUCTION

Educational systems should constantly be controlled so that Turkish society could become a society who can generate and export information in the future. Turkey participated in The Project for International Students Assessment (PISA) conducted by the Organisation of Economic Cooperation Development (OECD), of which Turkey was a charter member, in 2003 in order to continue the activity of measuring and evaluating students' achievement, which is already done in Turkey (Ministry of Education, 2005).

PISA is a survey which is conducted with fifteen years old children in leading industrialised countries quarterly. In this survey, which is a product of cooperation set up between the member countries of OECD and which is conducted via OECD, international expertise services are made use of in order to be able to make valid comparisons between countries and cultures (Ministry of Education, 2005). PISA is a programme which is conducted with the participation of all the OECD member countries as well as some non-membering countries and which aims to determine the extent to which fifteens years old students are raised as prepared to solve problems that they are to encounter in their future lives. The reason for selection of the fifteen years old is that in most countries of the OECD member fifteen years old students come to the end of their compulsory education and that a certain amount of knowledge, skills and attitudes is formed in students at the end this a decade period of education (OECD, 2006a).

The property that is tried to be measured with PISA project is not the extent to which students learn the topics handled in the curriculum content, but their ability to use their knowledge and skills in real life situations, their analysing their own thoughts, their reasoning, and whether or not they use the science and mathematics concepts learnt at school and thus attain a skill of communication (OECD, 2004).

Projects for comparing students' achievement such as TIMMS-R, PIRLS, and PISA can enable countries to evaluate their system of education and to pursue their students in the fields of mathematics, science and reading by years rather than being projects for competition between countries. What is expected of countries is to carry out reforms across the country required on the basis of consequences, to ensure participation in the projects in question, and thus monitor the effects of those reforms (Ministry of Education, 2005).

PISA completed the first tour of a survey of fifteen-year old-students' knowledge and skills in 2006 in OECD countries composing the 90% of world economy and in participant countries (OECD, 2006b). In the first cycle of the PISA project, which contained the period of 1997-2000, tests of mathematics, science, and reading skills were applied; yet the most emphasised field was reading skills. Since our country was applying the TIMSS-R and PIRLS projects of International Association for the Evaluation of Educational Achievement (IEA) – of which Turkey is a member, she could not join the first cycle of PISA project. The second cycle of the PISA project, in which Turkey also participated, was between the years 2000 and 2003. Students' knowledge and skills were measured in this period in the fields of science studies, reading, and problem-solving with special emphasis on mathematics. 41 countries including Turkey participated in this project. Of those countries, 30 were OECD members whereas 11 were not members. In the third cycle of the PISA project, which was conducted between the years 2003 and 2006, the fifteen year old students' skills in mathematics, science studies and reading were measured on international dimensions; yet the emphasis was shifted to the field of science studies (Ministry of Education, 2005). Fifty-seven countries which were OECD members and non-members took part in PISA 2006 applications. The tests were applied to samples of 4500-10 000 students formed in each country. PISA 2006 was composed of competence in the fields of reading, mathematics and science; and the emphasis was placed on science.

Pen and paper test was applied to the students in the exams, and two hours' time was allocated. The questions were designed in a manner so as to encounter in real life situations. Apart from questions on mathematics, science and reading competencies, a student questionnaire, a school questionaire and a parent questionaire were also given prior to the exam to gather information on various social, cultural and economic factors that might be related to the students' academic achievement.

Mathematical achievement, one of the features measured in PISA alongside the properties of schools, students and teachers, was investigated in a great deal of researches (Akinsola & Animasahun, 2007; Altun, 2007; Aypay, 2010; Bohannon, 1998; Cossa, 2000; Çiftçi, 2006; Duke, 2007; Duman, 2006; Duran, 2005; Güven & Kosa, 2008; Herron, 2007; İş, 2003; Khalid, 1997; King, 1998; Nonoyama, 2006; Papanastasiou, 2000; Papanastasiou, 2002; Papanastasiou and Ferdig, 2006; Park, 2005; Paton, 2010; Rakap, 2010; Ram, 2006; Sullivan, 2005; Xu, 2006; Yılmaz, 2006;). It is seen that the most frequently studied properties in researches are knowledge about information technologies, reaching and using those technologies. It was observed that a great number of investigations into the relations of possessing a computer in particular, self-confidence in matters related to computers, computer using skills, and frequency of computer using to mathematical achievement were conducted. In some of those studies (Akinsola & Animasahun, 2007; Altun, 2007; Güven & Kosa, 2008; İş, 2003; Papanastasiou, 2000; Papanastasiou, 2006; Rakap, 2010; Yılmaz, 2006) possessing a computer and using it were usually found to increase achievement at mathematics whereas findings implying that those affected achievement negatively were found in others (Aypay, 2010; Bohannon, 1998; King, 1998; Papanastasiou, 2002; Paton, 2010; Sullivan, 2005). While Papanastasio found in 2000 that computer affected mathematical achievement in a positive way, the same researcher obtained evidence in 2002 to show that it had negative effects on mathematical achievement. Some research, on the other hand, found that computer related properties had differing effects, and some of those affected mathematical achievement in a positive way, some of them affected this in a negative way (King 1998; Duke, 2007).

The number of studies concerning the data of PISA 2006 is small in Turkey. Moreover, Turkey obtained score averages lower than other participant countries in the fields of mathematics, science and reading in PISA 2003 application (OECD, 2006b; Ministry of Education, 2005). Additionally, valuable data are obtined in this way about the responses given to the survey questions, which will provide feedback to our educational system (Ministry of Education, 2005).

The fact that investigations concerning possessing a computer, computer using skills, and computer using frequency produced different results, the special importance attached to the PISA exams by the Ministry of Education, expecting that information to be obtained following the research would be beneficial in terms of educational policies and maths teaching motivated us to conduct this research. The aim of this research, on whose completion all those effects were influential, is to predict the extent to which computer use affected Turkish students' mathematical achievement in PISA 2006 application in Turkey. Self-reliance in performing the

operations requiring high level of computer skills, self-reliance in performing internet-related operations, using computers for internet and entertainment purposes, and using computers for programme and software purposes were examined as variables predicting mathematical achievement in this research.

METHOD

The Population and The Sample

Due to the fact that the systems of pre-school education of countries participating PISA 2006, the age of starting formal education in those countries, and the educational sytems were different; this was done on the basis of grade level rather than age level. Accordingly, the population was composed of students aged between 15 years and 3 months 16 years and 2 months who were registered in a school at the beginning of PISA assessment (OECD, 2007). And the sample of Turkey was composed of students chosen from 51 provinces of the 7 geographical regions, and the students were stratified on the basis of regions and school types. Thus, Turkey sample was composed of 4942 students chosen at random from 160 schools in the strata (Ministry of Education, 2007). Table 1 shows detailed information concerning the population and the sample.

Table 1. 15 year old students Population in Turkey and the population participating in PISA 2006 Application

The number of 15 year olds in Turkey	1 423 514
The number of 15 year olds registered in the 7th or higher grade	800 968
The number of those who do not fit conditions of assessment	970
Research population	*782 875*
The number of students participating in the application (sample)	*4 942*

Data Collection

The PISA 2006 examination, which contained the fields of science studies, reading skills, and mathematics, was a 2-hour examination. Beside multiple choice questions, there were also open-ended questions to which students had to write their own answers in the exam. The questions were comprised of written texts or graphs students were probable to encounter in daily life (OECD, 2007). Apart from questions on mathematics, science and reading competencies, a student questionaire, a school questionaire and a parent questionaire were also given prior to the exam to gather information on various social, cultural and economic factors that might be related to the students' academic achievement. The student questionaire contained questions about students and their families, students' views on various issues, the environment, occupations, and duration of education. The students were given 30 minutes to answer the questions. School quesionaire was designed to obtain information about the features of the school, the school students' characteristics, the resources of the school, school staff, the organisation of the school, the topic of environment in the curriculum, the students' preparation for further education, and vocatioanal guidance. The school questionaire is completed by the school principal in 30 minutes.

Information on students' activities in the past, parents' views of the school principal, professions students would like, skills required in labour market, parents' views concerning the environment, the cost of education services, parents' level of education and their occupations was obtained through parents questionaire. The data based on mathematics scores of 4942 students from 160 schools of 51 provinces of 7 geographical regions, responses given to the students' questionaire, the school questionaire completed by the principals, and parents questionaire completed by parents were used in the research.

Data Analysis

Dependent Variable: *Mathematics achievement score* is the scores obtained from the responses students give to 48 mathematics questions. Plausible value 1, of five mathematical plausible values showing the students' mathematical performances based on the previous studies and in line with expert opinions, is used as the mathematics achivement score in this research.

Independent Variables: Some variables in PISA studies were evaluated on the basis of responses that students, parents and managers gave to a series of questions, and were given as indices. The indices' meeting the expectations and the validity of international comparability were confirmed with structural equality model. Indices containing many questions and students' answers were scaled using the weighted maximum likelihood estimate (WLE), and analyses were performed with a parametered item response theory. Negative index values do not mean that students gave negative answers to the questions constituting the index. The case in which a student's value in an index is negative means that only this score of his is lower than the OECD average. As the index value increases in the plus direction, averages tend to climb above the OECD averages; and as the index value decreases in the minus direction, the averages tend to fall below the OECD averages (OECD 2007).

The independent variables used in the research are:

The index of self-reliance in performing the operations requiring high level of computer skills: This is an index formed on the basis of answers the students give to the question "How good are you at performing each of the following operations on computer? a)Using the software in detecting and disabling computer viruses, b) shaping digital photos or other graphic images, c) forming a database (for instance with Microsoft Access), d) using the word processor (for instance, writing an essay for school), e) using the electronic tabulating programme to draw a graph, f) preparing presentations (for example, by using the Microsoft Powepoint), g) preparing multi-media presentations (with audio, photos, and videos), designing a web page".

The index of self-reliance in performing internet-related operations: This is an index formed on the basis of answers the students give to the question "How good are you at performing each of the following operations on computer? a) Chatting in the internet, b) searching for information in the internet, c) downloading files or programmes from the internet, d) attaching files to the e-mail messages, e) downloading a song from the internet, f) writing and sending e-mails" in the students' queatinaire.

The index of using computers for internet and entertainment purposes: This is an index formed on the basis of answers the students give to the question "how often do you use the computer for the following purposes? a) Surfing the internet to obtain information on people, objects, or views, b) playing games, c) using the internet for cooperation with a team or group, d) downloading software (including games) from the internet, e) downloading music from the internet, f) communicating (for instance, through e-mails or chat rooms)".

The index of using computers for programme and software purposes: This is an index formed on the basis of answers the students give to the question "how often do you use the computer for the following purposes? a) Writing a document (for instance, by using the Word or Wordperfect), b) electronic tabulating (for instance, by using Lotus 1, 2, 3, or Microsoft Excel), c) using the drawing, paint, and graphic programmes, d) using the educational software such as maths programmes, e) preparing computer programmes".

The multi-regression analysis programme was used so as to determine the effects of independent variables on mathematical achievement score (Büyüköztürk, 2007). The assumptions required for performing the regression analysis were tested, and the data were found to meet the assumptions (levin and Fox, 2007; Triola, 2005: Özdamar, 1997; Neter et al., 1985). Correlations between the dependent variable and the independent variables as well as descriptive statistics concerning the variables are shown in Table 2.

Table 2. Correelations Between Dependent and Independent Variables

	1	2	3	4	5
1. Mathematics achievement score	1,000				
2. self-reliance in performing the operations requiring high level of computer skills	.066**	1.000			
3.self-reliance in performing internet-related operations	.289**	.732**	1.000		
4. using computers for internet and entertainment purposes	.004	.525**	.536**	1.000	
5. using computers for programme and software purposes	-.170**	.544**	.352**	.650**	1.000
Means	431.41	-.26	-.59	-.04	.41
Standard deviation s	93.89	1.11	1.17	1.12	1.23

**p < .01

Table 2 makes it clear that the highest correlation holds between mathematics achievement score and the index of self-reliance in performing internet-related operations; which is followed by the index of using computers for programme and software purposes, and this is in a negative way. Those are followed by the index of self-reliance in performing the operations requiring high level of computer skills, and the index of using computers for internet and entertainment purposes ranking last and having a slight correlation. Since correlations do not exceed

the value of 0.80 according to the table, it was concluded that multi-colinearity was not available (Büyüköztürk, 2007; Özdamar, 1997).

FINDINGS AND INTERPRETATIONS

According to the results of the regression analysis given in Table 3, it may be said that the model constructed with the variables of the index of self-reliance in performing the operations requiring high level of computer skills, the index of self-reliance in performing internet-related operations, the index of using computers for internet and entertainment purposes, and the index of using computers for programme and software purposes is statistically significant (F=240.45; $p < 0.01$). The independent variables account approximately for 17.7% of the total variance in mathematical achievement. According to standardized regression coefficient (β), the relative order of importance of predictive variables on mathematics achievement score is the index of self-reliance in performing internet-related operations, the index of using computers for programme and software purposes, the index of self-reliance in performing the operations requiring high level of computer skills, and the index of using computers for internet and entertainment purposes, respectively. According to the t-test results concerning the statistical significance of regression coefficients, it becomes evident that the index of using computers for internet and entertainment purposes is not a significant predictor. Since the t-values of all other variables are statistically significant, they may be said to be significant predictors of mahematics scores.

Table 3. The Results of Regression Analysis Concerning computer Using Skills Affecting Mathematical Achievement

Model	unstandardised		Standardised Regression coefficient (β)	t	F
	B	Std error			
Constant	459.43	1.59		288.63**	
self-reliance in performing the operations requiring high level of computer skills	-13.07	1.89	-.16	-6.93**	
self-reliance in performing internet-related operations	40.41	1.72	.50	23.48**	240.45**
using computers for internet and entertainment purposes	-1.85	1.67	-.02	-1.11	
using computers for programme and software purposes	-18.97	1.49	-.25	-12.77**	

R =0,421 R^2 =0,177 ** p < 0,01

According to the sign of regression coefficients, the indices of self-reliance in performing the operations requiring high level of computer skills, using computers for internet and entertainment purposes, and using computers for programme and software purposes were found to have negative effects on students' mathematics achievement scores. In other words, as the scores in those indices rose, students' mathematical achievement scores tended to fall. And the index of self-reliance in performing internet-related operations affected mathematical achievement scores positively. Accordingly, students' mathematical achievement scores are closely related with self-reliance in performing the operations requiring high level of computer skills, self-reliance in performing internet-related operations, and using computers for programme and software purposes.

The finding of this research demonstrating that students' slef-reliance in performing internet-related operations have a positive effect on their mathematical achievement scores supports the work done by Papanastasiou and Ferdic (2006) suggesting that using computers for internet purposes affects children's mathematical achievement scores positively. Yet, what is important here is that time students spend on computer should be limited. Students spending excessive time in the internet may come up with a fall in sucess at their classes. In a similar vein, the finding that students' using computers for programme and software purposes has a negative effect on their mathematical achievement score is compatible with the conclusions reached by Papanastasiou and Ferdic (2006) suggesting that using computers for programme and software purposes contributes to children's mathematical achievement scores in a negative way. This is because students concentrate on programme and software matters excesively, and they do not allocate sufficient time for other matters such as mathematics. No significant effects were determined for using computers for internet entertainment purposes on mathematical achievement. The findings obtained support conclusions reached by Güven and Kosa (2008), Rakap (2010), Akinsola and

Animasahun (2007), İş (2003), Yılmaz (2006), Altun (2007), and Papanatasiou (2000: 2006) in terms of the variable of self-reliance in performing internet-related operations on the computer whereas the findings in terms of other variables support conclusions reached by Apay (2010), Paton (2010), Bohannon (1998), King (1998), Sullivan (2005), and Papanatasiou (2002). When the findings for all the variables are concerned, it could be said that conclusions similar to the ones reached by King (1998) and Duke (2007) were reached. In this research, the variable of self-reliance in performing internet-related operations affected mathematical acievement positively whereas the effect of the variable of using computers for internet and entertainment purposes was not found to be significant. On the other hand, it was concluded that the variables of self-reliance in performing the operations requiring high level of computer skills and using computers for programme and software purposes affected mathematical achievement in a negative way and at a considerable level.

CONCLUSIONS

The research findings showed that students' self-reliance in performing the operations requiring high level of computer skills (using the software for detecting and disabling computer viruses, shaping digital photos orother graphic images, forming a database – for instance with Microsoft Access), using the word processor (for instance writing an essay for school), using electronic tabulating programme in drawing graphs, preparing presentations (for instance by using Microsoft powerpoint), preparing multi-media presentations (audio, photos, videos), and designing web pages affected the mathematics achievement scores in a negative way. In order to learn such advanced computer skills, students may need to spend most of their time at computer. Therefore, because they could not allocate sufficient time for their lessons, their scores might have fallen.

Based on those results, it might be said that students' using computers in line with their needs, parents' controlling the time their children use computers, the internet and computer for entertainment purposes would be beneficial. Besides, the time students spend at computer should be determined, and studies in which independent variable and mixer variables are considered separately should be performed. Thus, the effect of time spent at computer on mathematical achievement and the effects of independent variables independently of the time can be specified.

REFERENCES

Akinsola, M. K. & Animasahun, I. A. (2007). The effect of simulation-games environment on students achievement in and attitudes to mathematics in secondary schools. *TOJET: The Turkish Online Journal of Educational Technology*, 6, 3. Retrieved July 4, 2010 from http://www.tojet.net/

Altun, A. (2007). *Effects of student and school related factors on the mathematics achievement in Turkey at eight grade level*. Unpublished master thesis. Ankara: Meddile East Technical University.

Aypay, A. (2010). Information and communicatıon technology (ICT) usage and achivement of Turkish students in PISA 2006. *TOJET: The Turkish Online Journal of Educational Technology*, 9, 2. Retrieved July 4, 2010 from http://www.tojet.net/

Bohannon, H. G. (1998). T*he relationship between frequency of computer use and student performance among fifth grade students*. Unpublished Doctoral Thesis. University of South Florida. Retrieved April 2, 2008 from UMI.

Büyüköztürk, Ş. (2007). *Data analysis handbook for social sciences*. Ankara: PegemA.

Cohen, J. (1988). S*tatistical power analysis for the behavioral sciences*. New Jersey: Lawrence Erlbaum Associates, Publishers.

Cossa, R. D. (2000). *Determinants of schooling attainment in Argentina: an ampirical analysis with extensions to policy evaluation*. Doktora Tezi. The University of Chicago. 02 Nisan 2008 Erişim : UMI.

Çifçi, A. (2006). Acoording to mathematics subtest results of PISA 2003 investigation of some factors' effect on student achievement in Turkey. Unpublished master thesis. Ankara: Hacettepe University.

Duke, V. C. (2007). *Technology and Math: The relationship between using computers in the fifth grade and demonstrating math competencies*. Unpublishede doctoral thesis. School of Education Capella University. Retrieved April 2, 2008 from UMI.

Duman, A. (2006). *Evaulation of the factors which effect on mathematics achievement of primary school students for students and teachers (Eskişehir sample)*. Unpublished master thesis. Eskişehir: Osmangazi University.

Duran, N. (2005). *An investigation about mathematical thinkink skills.* Unpublished master thesis. Ankara: Hacettepe University.

Güven, B. & Kosa, T. (2008). The effect of dynamic geometry software on student mathematics teachers' spatial visualization skills. *TOJET: The Turkish Online Journal of Educational Technology*, 7, 4. Retrieved July 4, 2010 from http://www.tojet.net/

Herron, J. (2007). *Culturally relevant word problems: The effects on second graders'mathematics achievement*. Unpublished doctoral thesis. Utah State University. Retrieved April 2, 2008 from UMI.

İş, Ç. (2003). *A cross-cultural comparison of factors affecting mathematical literacy of students in programme for international student assessment (PISA).* Unpublished master thesis. Ankara: Meddile East Technical University.

Khalid, N. (1997). *Factors affecting mathematics achievement in malaysian schools.* Unpublished doctoral thesis. Indiana University. Retrieved 2 April, 2008 from UMI.

King, M. J. (1998). *The effects of frequency of technology use on high school students' mathematics and science achievement*. Unpublished doctoral thesis. Faculty of the Collage of Education. University of Houston. Retrieved 2 April, 2008 from UMI.

Levin, J., Fox, J.A. (2007). *Elementery statistics in social research. The Essentials.* Boston: Pearson Education,Inc.

Milli Eğitim Bakanlığı. (2005). *PISA 2003 projesi ulusal nihai raporu*. Ankara: Milli Eğitim Basımevi.

Milli Eğitim Bakanlığı. (2007). *PISA 2006 uluslararası öğrenci başarılarını değerlendirme programı ulusal ön rapor.* Ankara : Milli Eğitim Basımevi.

Neter, J., Wasseman, W., Kutner, M.H. (1985). *Applied linear statistical models: Regression, analysis of variance and experimental designs.* Illinois: Richard D. Irwin, Inc.

Nonoyama, Y. (2006). *A cross-national, multi-level study of family background and school resource effects on student achievement.* Unpublished doctoral thesis. Columbia University. Retrieved 6 July, 2007 from UMI.

Organisation for Economic Co-Operation and Development. (2004*). Learning for tomorrow's world. First results from PISA 2003.* Paris: OECD Publications.

Organisation for Economic Co-Operation and Development. (2005). *PISA 2003 Technical report.* Paris: OECD Publications.

Organisation for Economic Co-Operation and Development. (2006a). *Assessing scientific, reading and mathematical literacy: A Framework for PISA 2006*. Paris: OECD Publications.

Organisation for Economic Co-Operation and Development. (2006b). PISA. *The OECD program for international student assessment.* Paris: OECD Publications.

Organisation for Economic Co-Operation and Development. (2007). *PISA 2006-science competencies for tomorrow's world: Volume 1.* Paris: OECD Publications.

Özdamar, K. (1997). Statistical data analysis with packaged software *I. MINITAB, SPSS, SYSTAT.* Eskişehir: Anadolu Universty Faculty of Science Publications.

Papanastasiou, C. (2000). Internal and external factors affecting achievement in mathematics: Some finding from TIMSS. *Studies in Educational Evaluation,* 26, 1-7. Retrieved 5 April, 2008 from ERIC.

Papanastasiou, E. (2002). Factors that differantiate mathematics students in Cyprus, Hong Kong, and the USA. *Educational Research and Evaluation, 8,* 129-146. Retrieved 5 April, 2008 from ERIC.

Papanastasiou, E. C. ve Ferdig R. E. (2006). Computer use and mathematic literacy: An analysis of existing and potential relationships. *Journal of Computers in Mathematics and Science Teaching, 25 (4)*, 361-371. Retrieved 6 December, 2007 from ERIC..

Park, H. (2005). *Cross-national variation in the effects of family background and schools on students achievement: The Relevance of Institutional and Policy Contexts.* Unpublished doctoral thesis. University of Wisconsin-Madison. Retrieved 6 July, 2007 from UMI.

Paton, G. (2010). *Home computers harm children's test results*. Retrieved July 4, 2010 from http://www.telegraph.co.uk/education/educationnews/7844273/Home-computers-harm-childrens-test-results.html

Rakap, S. (2010). Impacts of learning styles and computer skills on adult students' learning online. *TOJET: The Turkish Online Journal of Educational Technology*, 9, 2. Retrieved July 4, 2010 from http://www.tojet.net/

Ram, A. (2006). *A multilevel analysis of mathematics literacy in Canada and Japan: The effects of sex differences, teacher support, and the school learning environment.* Unpublished master thesis. The Department of Educational Psychology and Leadership Studies. University of Victoria. Retrieved 5 December, 2007 from ProQuest.

Sullivan, A. W. (2005). *The relationship among selected teacher quality characteristics, teacher resource use and nathematics achievemet in selected mississippi public high schools*. Unpublished doctoral thesis. The Department of Curriculum and Instruction Mississippi State University. Retrieved 2 July, 2008 from UMI.

Triola, M. F. (2005). *Elementary statistics*. New York: Pearson Education, Inc.

Xu, J. (2006). *Families, investments in children and education: A Cross-national approach*. Unpublished doctoral thesis. Indiana University Department of Sociology. Retrieved 5 July, 2007 from UMI.

Yılmaz, E. T. (2006). *The factors which effect on mathematics achievement of Turkish students in PISA 2003.* Unpublished master thesis. Ankara: Hacettepe University.

