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Prof. Dr. Aytekin İşman
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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, Bogazici University and TUBITAK organized International Educational Technology Conference (IETC) between April 26-28, 2010 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. There were many participants from 19 countries. These countries are Algeria, Argentina, Australia, Croatia, Cyprus, Georgia, Greece, Hungary, Iran, Japan, Lithuania, Malaysia, Netherlands, Nigeria, Portugal, Romania, Serbia, Slovakia, Slovenia, South Korea, Spain, Taiwan, The Former Yugoslav Republic of Macedonia, Turkey, Turkish Republic of Northern Cyprus, United Arab Emirates, United States.

TOJET is interested in academic articles on the issues of educational technology. The articles should talk about using educational technology in classroom, how educational technology impacts learning, and the perspectives of students, teachers, school administrators and communities on educational technology. These articles will help researchers to increase the quality of both theory and practice in the field of educational technology.

The guest editor of this issue was Prof. Dr. Yavuz AKPINAR. TOJET thanks and appreciate the guest editor 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.

TOJET and Istanbul University will organize the 11th International Educational Technology Conference (IETC 2011) in May 2011 in Istanbul - Turkey. The web page of IETC is "www.iet-c.net".

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

With the last organization of IETC 2010 at the Boğaziçi University, Turkey, the IETC completed its 10 years of activities. The IETC and TOJET have benefitted much from each other. Both have bloomed from seeds of their own, got pleasure from steady growth into a respected international academic work. Whilst growing and disseminating knowledge, they both suffered and also enjoyed the multidisciplinary nature of the field of educational technology. However, the help they provided to set a populated academic community around the world is imminent and contributive. Well, to celebrate the tenth anniversary of the IETC, the TOJET board decided to kindly assign two issues of TOJET to the selected paper presentations of the IETC 2010. Thirty-five papers, out of 150 papers presented in English, of the IETC 2010 were selected to be invited for submission to TOJET. After the invited author(s) completed the development of the manuscripts, each manuscript was sent to at least two reviewers. Some of the manuscript-reviews were completed and they became ready for publishing in July 2010 issue, the other works are either still with the reviewers or under development. In fact, some are now re-reviewed. Those papers developed for TOJET July 2010 issue may be outlined as follows:

Tam Shu Sim and her colleagues in their work attempted to provide evidence of the effect of the computer-mediated environment on the linguistic output of low proficiency learners, they titled their study as "*Low proficiency learners in synchronous computer-assisted and face-to-face interactions*". Another study is within an educational technology curriculum; Andreja Istenic Starcic developed a competence framework for fostering the use of ICT in helping special needs pupils. In this study titled "*educational technology for the inclusive classroom*", learning objectives of autonomy, inquiry, creativity and innovation were to be accomplished. A second study headed for helping special needs pupils was the work conducted M. G. A. D. Reis and nine other friends. They reported a case study of employing information technology based mathematics exercises for pupils with *cerebral palsy and mental retardation.* The study provides encouraging evidence on the effectiveness of multimedia design in the context of mathematics for the severely handicapped children at primary level.

Hamdi Erkunt's study, *titled Emergence of epistemic agency in college level educational technology course for pre-service teachers engaged in CSCL,* aimed at identifying particular epistemic agencies in learning within a computer supported collaborative learning environment. He designed his experiments on the Knowledge Forum, an online discussion and sharing platform, and presented promising results from careful set-up of blended learning environments.

Emrah Baki Başoğlu and Ömür Akdemir reported a comparison study on one of the hot topics in educational technology, mobile learning. Their paper is titled as *"a comparison of undergraduate students' English vocabulary learning: Using mobile phones and flash cards".* Their comparison revealed that using mobile phones as a vocabulary learning tool is more effective than one of the traditional vocabulary learning tools, namely flashcard.

I would like to thank all IETC 2010 presenters and the authors of this special issue, and the following reviewers whose help was precious to prepare this special IETC 2010 section in TOJET: *Ahmet Eskicumalı; Ali Şimşek; Andrew Sturc; Arif Altun; Aytekin İşman; Eralp Altun; Erol Karakırık; Fahriye 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.*

Hopefully the works reported in this issue will, at least partially, reflect state-of-the-art on practice and theory, and open new avenues for arguments and research in the field.

All the best

Yavuz AKPINAR (Guest Editor)
July 2010

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A COMPARISON OF UNDERGRADUATE STUDENTS' ENGLISH VOCABULARY LEARNING: USING MOBILE PHONES AND FLASH CARDS

Emrah Baki BAŞOĞLU
Zonguldak Karaelmas University, Turkey
emrahbaki@hotmail.com

Ömür AKDEMİR
Zonguldak Karaelmas University, Turkey
omurakdemir@gmail.com

ABSTRACT
Knowing a foreign language has become crucial to reach information. Learning vocabulary is the fundamental step to learn a foreign language. New devices are invented everyday to fulfill the needs of citizens of the twenty-first century. Increased use of mobile phones has made them popular for not only communication, but also entertainment and learning purposes. Mobile phones have provided remarkable advantages in learning process. They provide opportunity for learning to occur outside the classroom walls in anytime and anyplace. The effects of using vocabulary learning programs in mobile phones on students' English vocabulary learning are investigated using the mixed-method research design with sixty students studying in the Undergraduate Compulsory Preparatory Program of a public university located in the Black Sea region of Turkey. Results indicated that using mobile phones as a vocabulary learning tool is more effective than one of the traditional vocabulary learning tools.

Keywords: mobile learning; language learning; vocabulary learning; instructional technology; higher education

INTRODUCTION
As technology is developing at a great speed today, the importance of knowing a foreign language turned out to be important in an environment where information is so crucial. Learning vocabulary is the fundamental step to learn a foreign language. Hence, many studies are carried out in order to increase efficiency in vocabulary learning (Akın & Seferoğlu, 2004; Bruton, 2007; Erten & Tekin, 2008; Genç, 2004; McCarten, 2007; Moras, 2001; Newton, 2001; Tang & Nesi, 2003). In spite of various studies in vocabulary learning, learners show very little effort to deal with their problems about newly learned words (Meara, 1982). During the lesson, teachers often tend to have an attitude to make the students deal with this problem outside the class on their own (Baykal & Daventry, 2000). However, learners do not have enough knowledge about the vocabulary learning techniques and they have difficulty in dealing with this problem themselves (Akın & Seferoğlu, 2004). One of the most widely used techniques in language learning is flashcards, which is available for the students both in the class and outside in their extracurricular time.

With the importance given to foreign language, the development of Information and Communication Technologies (ICTs) has evoked innovations in educational activities. Additionally, mobile technology is getting more and more popular and mobile tools; such as Personal Digital Assistants (PDAs), tablet computers, and mobile phones have begun to gain more importance. These tools have provided great advantages in e/m-learning process and have taken away the problems about learning time and place, two of the factors preventing learning process (Chen-Chung, 2007). In a review of European Union about mobile learning, it is stated that mobile phones are the most frequently used devices in the projects, followed by PDAs (Pecherzewska & Knot, 2007). Recently, mobile phones are less expensive, lighter and more powerful and they have become more important part of language learning. As mobile phones become increasingly popular, new examples of language learning experiences in everyday surroundings are expected to be seen more often. Learning via mobile phones can create different learning opportunities for students. Even though studies about the use of mobile phones in language learning are recent and limited, results show that they have positive effects on the learning process.

In Saran, Çağıltay and Seferoğlu's (2008) study, results showed that students specified positive feedback to the use of mobile phones in language learning. Students stated that they were delighted to use the instructional materials in their mobile phones. In another study about mobile learning, Thornton and Houser (2005) used e-mails to send English vocabulary lessons to the mobile phones at specific times. The researchers wanted to find out whether mobile learning promoted learning for Japanese university students. They found that students using mobile phones in learning became more successful in compared to the students who used identical materials on paper or web and they concluded that using mobile phones was a valuable teaching method. In a similar study, Cavus and İbrahim (2009) used a mobile learning tool to investigate the use of wireless technologies in learning English vocabulary using Short Message Service (SMS) text messaging. The results showed that students

expressed positive attitudes while learning new words via mobile phones. In another study, McConotha, Praul and Lynch (2008) conducted a research giving the students the opportunity to use an m-learning product for the purpose of assisting them in preparation of two scheduled exams. Practice and review questions were made available on m-learning devices. The results showed that by using mobile devices in the learning process, students made better scores while they were reviewing and practicing for the exams.

Investigating the effectiveness of using a mobile phone while browsing WAP sites to learn listening skills and students' attitudes towards using a mobile phone, Nah, White and Sussex (2008) found that while using mobile phones for this purpose, the students expressed positive attitudes to the activities and they found the activities convenient and interactive. The students could study at anytime and anywhere spontaneously so it was a student-centered learning process. As seen from the findings of the studies, mobile phones offer many opportunities in language learning and learning in other domains since they are widely used and have various features; such as personalization, localization and mobility.

Similar to mobile phones, when students' needs are taken into consideration, PDAs which also offer features such as personalization, localization and mobility can be used in more flexible and extended ways for language learning. Song and Fox (2008) investigated undergraduate students' dictionary use of PDAs to boost their vocabulary learning in English. The study signified that the students produced positive attitudes towards the use of mobile devices in learning. Additionally, they accepted uses of the tools on both the PDAs and the computers for vocabulary learning. The study also pointed out that using PDAs and computers in an integrated way formed the vocabulary learning activities. Mobile learning creates a flexible, novel and extended atmosphere for English as a Foreign Language (EFL) vocabulary teaching and learning in higher education. In another study, Chen and Chun (2007) presented a study about personalized mobile English vocabulary learning system in PDAs providing appropriate English vocabulary for learning. The research findings showed that the vocabulary learning system promoted the performance and the interest of the students because of the effective and flexible vocabulary learning process. Moreover, most learners believed that the proposed system was very helpful in English vocabulary learning and it promoted their learning interests and English vocabulary abilities without time or place constraint.

It is understood that using mobile phones and PDA's as learning tools has many potential benefits to the language learning and takes learning out of the classroom walls, often beyond the reach of the teacher (Kukulska-Hulme, 2009). On the other hand, in Stockwell's (2007) study investigating mobile-based intelligent vocabulary learning system, learners completed vocabulary activities through either their mobile phones or personal computers. Results of the study revealed that mobile phones were less preferred than computers in vocabulary learning and students achieved better scores on computers. Similarly, in a year-long pilot study conducted by Okunbor and Retta (2008) to investigate the use of mobile phones to enhance student learning, students were able to manage their academic and social lives using customized packages of applications developed by the wireless company for university students and made available to students on the national mobile phone network. The results of the study revealed that most of the students using the mobile-based applications found them insignificant.

Results of limited number of studies are conflicted. It is still not clear whether using a mobile phone as a language learning tool is effective on undergraduate students' vocabulary learning. Moreover, although many studies related to mobile phone use in language learning are carried out in the world, the number of studies in Turkey is not satisfactory. Therefore, more studies should be carried out to understand the effectiveness of using mobiles phones in language learning. In this respect, this study was designed to determine the effectiveness of mobile phone use in vocabulary learning. Four research questions investigated are:

- Is there a difference between the vocabulary learning level of the students using vocabulary learning program in mobile phones before and after the study?
- Is there a difference between the vocabulary learning level of the students using flashcards before and after the study?
- Is there a difference between the gain scores of the students who used the vocabulary learning program in mobile phones and the gain scores of the students who used the flashcards?
- What are the experiences of the students using English vocabulary program on mobile phones as a vocabulary learning tool?

METHOD

Context

The study was conducted at a public university located in the Black Sea region of Turkey with undergraduate students enrolled in the Undergraduate Compulsory Preparatory Program. A multifunctional language learning program was applied to make students acquire the lessons in the language structure throughout their university education. Students were required to attend speaking, writing, video and grammar lessons and acquire the skills necessary for learning English as a second language. At the end of the academic year students were aimed to reach B1 level in European Language Portfolio "Global Scale" and attend English courses covering 30 percent of the total education period in their departments.

Participants

The participants were 60 students studying in the Undergraduate Compulsory Preparatory Program of a public university in the Black Sea region of Turkey. The students were selected to the university according to their scores and preferences in the university entrance exam. Within the student group having the same characteristics, students whose mobiles phones were compatible and incompatible with the vocabulary learning program were determined. Among the student groups, 30 students whose mobile phones were compatible with the vocabulary learning program were assigned to the experimental group and the other 30 students who would use the traditional vocabulary acquisition techniques to learn vocabulary were assigned to the control group.

Research Design

In order to conduct the study, the effects of using vocabulary learning programs in mobile phones on students' vocabulary learning were investigated using the mixed method research design. Mixed-method research design was used to collect quantitative and qualitative data. Therefore, weak points of quantitative and qualitative methods were minimized.

Quantitative data were collected using the pre-test post-test with control group experimental research design. New words were taught to the experimental and control groups in the six-week period. Before the experimental process was started, a vocabulary acquisition program to be operated on students' mobile phones was selected. The program, ECTACO Flash Cards, is especially made to run on mobile phones. After the content was scanned, vocabulary lists suitable for the students' level were selected from the ECTACO Flash Cards application and made available for student use. Among various topics; such as business, general, law and medicine, the most suitable one for the students' level, General 2 level (see Figure-1) available in the program was chosen. The application helped the users memorize approximately 1000 words under this topic.
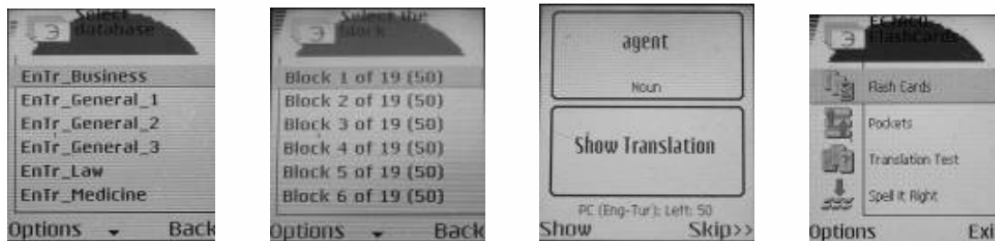
Figure 1: Screen Views of Vocabulary Learning Program Executing on Mobile Phones

Before the application, the purpose of the study and expectations from the students during the experiment process were explained to the students. During the six-week period, students were expected to use the vocabulary program on their mobile phones in their extracurricular times. Students in the control group were given the vocabulary flashcards including words available in the mobile phones and they were expected to use the traditional vocabulary learning techniques. Using these vocabulary flashcards, students in the control group studied the new words on paper for six weeks. Students in the control group were not able to interact with the vocabulary acquisition program in mobile phones. A multiple-choice test to assess experimental and control groups' English vocabulary acquisition was administered before and after the study. After the quantitative part of the study, qualitative data were collected using semi-structured interview questions. Eight interviews were conducted with randomly selected students from the experimental group and they were recorded using the digital voice recorder.

Data Collection Instrument

Students' English vocabulary learning was measured through a multiple-choice test. Initially an 80-item multiple-choice test containing frequently used vocabularies in the mobile phone program was constructed. The test was administered to 50 students taking the same course to find the measure of internal consistency. Point

Biserial values of items falling below 0.3 were removed and the measure of internal consistency of the multiple choice test was found as 0.783. The final version of the test had 25 items, with four choices for each item. This 25-item multiple-choice test was administered to the experimental and control groups before and after the study.

Data Analysis
Students in the study received four points for each of their correct answer in the pre-test and post-test. Scores of the students ranged from 0 to 100 in the multiple-choice test. In order to answer research questions, descriptive statistics, independent and dependent t-tests were used for the analysis of quantitative data. One participant from each of the experimental and control groups was excluded from the data analysis since they did not take the post-test. After transcribing the semi-structured interviews involving eight students, a descriptive qualitative analysis was carried out in order to identify the use of mobile phones for English vocabulary learning. Using the questions of the semi-structured interviews as a framework, three categories were generated. These categories are the time devoted for using mobile phone for learning, the place preferences for the use of mobile phones for learning, and perceived effectiveness of using mobile phones for English vocabulary learning.

RESULTS
The descriptive analyses of pre-test and post-test results of participants are presented in the Table-1.

Table-1: The Descriptive Analysis of Pre and Post-test Results of Participants

		N	Mean	Std. Deviation	Std. Error Mean
Pre-test	Experimental Group	29	24.82	16.33	3.03
	Control Group	29	26.27	18.07	3.35
Post-test	Experimental Group	29	38.62	22.07	4.09
	Control Group	29	34.89	21.08	3.91

The first research question investigated whether there was a difference between the vocabulary learning level of the students using vocabulary learning program in mobile phones before and after the study. The result of the paired-samples t-test has shown that post-test score of the experimental group (M= 38.62) is statistically higher than the pre-test score of the experimental group (M=24.82) ($t_{(28)}$= -7.6; p<0.05) (See Table-2). Students in the experimental group used the vocabulary learning program in their mobile phones outside the school and students' active participation was expected to complete the levels in the vocabulary learning program. This finding shows that the use of vocabulary learning program in the mobile phone improves students' vocabulary learning.

Table-2: Pre-Post Test Comparison of the Experiment Group

	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pre-Post Test	-13.29	9.77	1.81	-17.51	-10.07	-7.6	28	0.000

The second research question investigated whether there was a difference between the vocabulary learning level of the students using flashcards on papers before and after the study. The result of the paired-samples t-test has shown that post-test score of the control group (M= 34.89) is statistically higher than the pre-test score of the control group (M=26.27) ($t_{(28)}$= -5.7; p<0.05) (See Table-3). Students in the control group achieved better scores on the vocabulary acquisition test at the end of the study in compared to their pre-test scores. The control group was given the vocabulary lists on paper and they memorized them through self-study. This finding shows that the extracurricular activity used for the control group also enabled students to improve their vocabulary learning.

Table-3: Pre-Post Test Comparison of the Control Group

	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pre-Post Test	-8.62	8.12	1.5	-11.71	-5.5	-5.7	28	0.000

The third research question investigated whether there was a difference between the gain scores of the students who used the vocabulary learning program in mobile phones and the gain scores of the students who used the flashcards on papers. The gain score was calculated for the control and the experimental groups and compared. There is a statistically significant difference between the mean score of the experimental group (M= 13.79) and the mean score of the control group (M= 8.62) ($t_{(56)}$= 2.191, p<0.05) (See Table-4). This finding indicates that using vocabulary learning programs in mobile phones improves students' achievement more than the use of vocabulary flashcards to learn vocabulary.

Table-4: The Comparison of the Mean Gain Scores

Groups	N	Mean	Std. Deviation	df	t	p
Experimental group	29	13.79	9.77	56	2.191	0.033
Control group	29	8.62	8.12			

The last research question investigated the experiences of the students using English vocabulary program on mobile phones as a vocabulary learning tool. The descriptive qualitative analysis resulted in three categories namely the time devoted for using mobile phone for learning, the place preferences for the use of mobile phones for learning, and perceived effectiveness of using mobile phones for English vocabulary learning.

Interviewed participants for the time devoted for using mobile phone indicated that their use of the program on the mobile phone increased in compared to the beginning. One participant said;
> "Initially I used for one hour but afterwards, I spent up to two hours in the dormitory everyday to use vocabulary program on the mobile phone."

However, some participants also said that their use of program dropped lately. One participant indicated;
> "Initially I used 5 to 10 minutes, but then, it increased up to one or two hours, but lately it dropped."

It was understood that participants used the program increasingly, but when the end of the semester was reached, their use diminished.

Interviewed participants for the place preferences to use the mobile phones indicated that the program on the mobile phone was mostly used in their leisure time. One participant said;
> "I used the mobile phone with friends during the daytime when we got bored and also I used it before sleeping" Another participant indicated that
> "I used the mobile phone when travelling on the bus."

Interviewed participants for the perceived effectiveness of using mobile phones for English vocabulary learning indicated;
> "I preferred to use mobile phones for vocabulary learning rather than as a dictionary. I really believe that mobile phone is beneficial for vocabulary learning."

Another participant said;
> "Studying vocabulary on paper is boring for me. On the other hand, studying with mobile phone is more effective and fun for me since it is available all the time."

It is seen that effectiveness, availability and entertaining use of mobile phones have made them a preferred mean for English vocabulary learning in compared to the hardcopy counterparts.

DISCUSSION
This study has four findings. The first result indicated that the use of vocabulary learning program in the mobile phone improved the acquisition of students' vocabulary learning and students' attitudes towards the use of mobile phones for English vocabulary learning. The second finding indicated that students' vocabulary learning was also improved when flashcards on paper were used. The third finding of the study indicated that using vocabulary learning programs on mobile phones is more effective to improve students' vocabulary learning than using flashcards on paper. The last finding indicated that participants found learning English vocabulary on mobile phones effective and entertaining. These findings are discussed with the results of the studies found in literature.

Result indicated that not only did mobile phones improve students' vocabulary learning, but students also showed positive attitudes towards the use of mobile phones for English vocabulary learning. Similarly, using mobile devices to investigate the value of dictionary use on mobile devices for incidental vocabulary learning in

higher education, Song and Fox (2008) found out that students produced positive attitudes towards the use of mobile devices in learning. Additionally, they accepted uses of the tools on both mobile devices and computers for vocabulary learning. The study also pointed out that using mobile devices and computers in an integrated way formed the vocabulary learning activities. Besides accessing vocabulary programs in mobile phones whenever and wherever they preferred, students could have developed a positive attitude in using mobile phones for language learning (Saran, Cagiltay and Seferoglu, 2008). Cavus and Ibrahim (2009) also found out that as a mobile learning tool to learn English vocabulary using Short Message Service text messaging, students expressed positive attitudes to their learning. The combination of these factors might have contributed to achieve such results with increased vocabulary learning in this study when mobile phones are used.

In addition to the findings showing that using mobile devices in language learning is an effective learning tool, results also manifest that students' English vocabulary learning has improved after the use of flash cards. Findings in the literature also support the benefits of flashcards use. In a study conducted by Tan and Nicholson (1997), results showed that flashcard training groups were significantly better than the control group in speed of reading words and reading comprehension. Students said that they enjoyed their lessons and flashcards could be fun. Results of Stutz's (1992) study also support that flashcards are fast and fun to use and they are effective since they have multi-sensory appeal and occupy only a short time within the lesson. The article concludes that there are various ways to use flashcards; such as writing, speaking, testing and having fun. Fun and ease of use of flashcards could be the reason for effectiveness of flashcards in improving students' English vocabulary learning.

This study also demonstrated that utilizing vocabulary learning programs running on mobile phones improved students' acquisition of English vocabulary more than traditional vocabulary learning tool, flash cards. Thornton and Houser (2005) also found similar results when comparing students' scores studying vocabulary materials on mobile phones with paper. Mobile phone users received better scores than students using identical materials on paper. Therefore, it was concluded that mobile phone use for language learning is more effective than its paper counterparts. Increased use of mobile phones has made them a popular device for not only communication, but also for entertainment and learning purposes. Accessibility and portability of mobile phones promoted students to use them as an English vocabulary learning tool in their leisure time. Therefore, vocabulary learning gain of students using mobile phones might be found higher than flashcard users.

CONCLUSIONS
Nowadays, mobile phones have already become a routine part of our lives. Increased features and decreased cost of mobile phones have made them popular devices not only for communication, but also for educational purposes. Similar to the popularity of mobile phones, the need for knowing a foreign language is increasing. Learning vocabulary is the fundamental step to learn a foreign language. As the mobile phone use becomes more common and vocabulary programs running on phones become more appealing, students seem to use mobile phones more often as an instructional tool for language learning. However, it should be remembered that the data were collected from undergraduate students who have to pass the final exam at the end of the academic year. Therefore, high motivation of participating students learning vocabulary to pass the exam might have influenced the effect of interventions used by students in the control and experimental group. This limitation of the study should be remembered before attempting to generalize the result of the study for other groups. Although a simple and primitive form of English vocabulary learning program executing on mobile phones was used as an intervention, this study has demonstrated that using such a program on mobile phones is more effective in English vocabulary learning than a traditional vocabulary learning technique. Therefore, it is concluded that a vocabulary learning program executing on mobile phones can be used to learn English vocabulary as an effective mean. This study demonstrates that mobile language learning is an effective tool for Turkish undergraduate students to learn English vocabulary.

IMPLICATIONS AND RECOMMENDATIONS
The results of this investigation could have important implications for English vocabulary learning and mobile learning. English vocabulary programs executing on mobile phones can be employed as an extracurricular activity for undergraduate students in teaching English vocabulary. Students can have opportunity to practice anytime and anywhere since they carry their mobile phones almost all the time. This enjoyable experience can make learning fun even for undergraduate students who are 17 to 24 years old. Results also suggest that mobile devices provide tremendous opportunities for learning, especially outside the class since they are available all the time.

Another implication of this study is that in the absence of English vocabulary programs running on mobile phones, flashcards can also be used to teach English vocabulary since they also improved the vocabulary gain of

students. However, it should be noted that using a mobile phone is more effective than using flashcards in English vocabulary learning. Therefore, flashcards should be considered as a second alternative in the absence of a mobile learning option.

It is recommended that further studies should investigate the effects of using vocabulary learning programs which have visually appealing screens and multimedia features; such as pictures and sound since only the text-based vocabulary learning program executing on mobile phones was used in this study. Also non-random sampling of the study group is one of the constraints of the study. Further works with randomly chosen samples should be conducted to make findings more generalizable.

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COMPUTER USE BY SECONDARY SCHOOL PRINCIPALS

Mojgan AFSHARI, Kamariah Abu BAKAR, Wong Su LUAN, Marjan AFSHARI, Foo Say FOOI, & Bahaman Abu SAMAH
Faculty of Educational Studies, Universiti Putra Malaysia
mojganafshari@yahoo.com

ABSTRACT
The purpose of this study was firstly to identify the extent to which Iranian secondary school principals used computers and secondly to explore the relationship between a number of variables related to the use of information and communications technology (ICT). Findings indicated that four factors played a role in explaining the level of computer use by principals. These factors included high level of computer access, strong perceptions of the attributes of ICT, high level of computer competence, as well as the high level of transformational leadership behaviors, all contributed significantly to the level of computer use by principals. All four constructs are equally important but have varying impacts on computer use. Therefore, all four constructs should be viewed in an integrated manner in accordance to the conceptual model proposed in this study.

Keywords: ICT, Secondary school principals, Computer use

INTRODUCTION

One developing country that is currently pursuing the technological track in education is Iran. Based on Iran's National philosophy of Education, education should develop individuals' potential in an integrated manner and produce individuals who are spiritually, intellectually, and emotionally balanced and compatible(Kousha & Abdoli, 2004). Technology is the catalyst for this massive transformation and foster the development of a workforce prepared to meet the challenges of the next century. With respect to this vision, Ministry of Education provided ICT related workshops and courses for principals and teachers. The plan emphasized that they should acquire seven fundamental digital computing skills (Kousha & Abdoli, 2004). Although several institutions have completed the training programs of their staff, research studies have not been done to measure the efficiency of this plan, as well as the knowledge, skills, and attitude that principals and teachers acquire during these courses. In fact, national programs in developing countries are not based on research. Hence, the success of these programs is limited (Albirini, 2006a).

In addition, the Ministry of Education in Iran has invested a great deal of funds to facilitate the integration of ICT in schools. In spite of this large expenditure of funds, the potential for ICT to alter principals' use of computer for instructional and administrative purposes, teachers' teaching methods and students' learning process in Iranian schools have not been fully realized. The reason is that many Iranian schools do not use ICT in teaching and learning and administrative tasks (Jahangard, 2003) owing to that fact that the use of computer was provided with no supplementary measures to enable principals and teachers to develop positive attitudes toward ICT in education and to use them in their schools (Albirini, 2006a). Also, in reviewing the literature about the use of ICT in schools, the part which is evidently missing in research on ICT use and integration is the role of the school principals as the technology leaders. Although, some research studies have shown that ICT has a huge impact on the ways in which principals work (Yuen, Law & Wong, 2003; Schiller, 2003), the ICT research literature has largely ignored the role of principals as technology leaders (Schiller, 2003; Michael, 1998). This gap in the research literature is rather strange because many research studies related to school improvement, school effectiveness, and change showed that school principals play an important role in creating successful changes in schools (Schiller, 2003).

According to Schiller (2003), school leaders are key factors in ICT implementation in schools. They have to shoulder the heavy responsibility for creating changes in schools through the use of ICT and facilitating the process of making complicated decisions to integrate it in schools (Schiller, 2003). Although the role of the principal in supporting technology integration is very important, there are a few researches conducted by Iranians on the role of the principal in ICT implementation. Also, little is known about the use of ICT by principals and the factors that are related to their level of computer use. This article will discuss on these issues through an analysis of data collected from Iranian secondary school principals.

REVIEW OF THE LITERATURE

One of the important factors to implementing changes in the schools is effective leadership (Calabrese, 2002). Anderson and Dexter (2005) collected data of more than 800 schools in the USA to identify technology leadership characteristics. Their findings indicated that "although technology infrastructure is important, for educational technology to become an integral part of a school, technology leadership is even more necessary" (p.

74). The educational potential of information and communications technology will not be realized without the support of school leaders, specifically the principal (Schiller, 2003). Principals play various roles such as change agent, lifelong learner, main supporter, and resource provider in relation to ICT implementation in schools (Han, 2002). If principals want to lead effectively their school in technology integration, they should accept technology and realize the role that technology can play in the teaching-learning process. In fact, "it is difficult to imagine a leader who does not use technology trying to convince teachers that it is important" (Cafolla & Knee, 1995, P.3). Therefore, principals need to understand the capacities of the new technologies, to have a personal proficiency in their use, and be able to promote a school culture which encourages exploration of new techniques in teaching, learning and management (Schiller, 2003).

According to Albirini (2006a), access to computer resources has often been one of the most important barriers for technology integration in both developed and developing countries. Norris, Sullivan, Poirot and Soloway (2003) reported on the analysis of data from the snapshot survey of more than 4,000 K-12 schools in the USA and concluded that there was a significant relationship between level of access to computer and level of computer use. Also, Rogers (2003) stated that the perceived attributes of an innovation are one of the important factors in explaining the rate of adoption of an innovation. A large amount of the variance in the rate of adoption of innovations, from 49 to 87 percent, is explained by five attributes: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). The five attributes refer respectively to: (1) 'the degree to which an innovation is perceived as better than the idea it supersedes; (2) the extent to which an innovation is perceived as consistent with the existing values, past experience, and needs of potential adopters; (3) the degree to which an innovation is perceived as relatively difficult to understand and use; (4) the extent to which the results of an innovation are visible to others; and (5) the degree to which an innovation is experimented with on a limited basis'(Rogers,2003,p.16). Regarding the relationship between perceived innovation characteristics and computer technology adoption, Al-Gahtani (2003) conducted a quantitative research in Saudi Arabia and found that relative advantage, compatibility and observability were positively related to the adoption of technology, whereas complexity was negatively correlated. Hence, 'innovations that are perceived by individuals as having greater relative advantage, compatibility, observability, and less complexity will be adopted more rapidly than other innovations' (Rogers, 2003, p.16).

Individuals' attitudes toward ICT have been recognized as an important factor for the success of technology integration in education (Akbulut, 2008; Bebetsos & Antoniou, 2009; Hashim, Ahmad, & Abdullah, 2020). Han (2002) conducted a case study on pre-school leaders' practices in the use of ICT and found that principals who have positive attitudes toward technology are very helpful and supportive in introducing these new technologies into the school. For example, they encourage their colleagues to have ICT training, equip the school with sufficient computers and ensure that staff has access to relevant technology. Ajzen and Fishbein (2005) indicated that attitudes consist of three elements: affect, cognition, and behavior. The affective element refers to the individual's emotional feelings or liking of a person or an object. The cognitive element refers to the person's knowledge about a person or an object. The behavioral element refers to the person's overt behavior towards a person or an object. A complete description of attitude requires that all three components be assessed by obtaining measurements of all the three response classes (Ajzen & Fishbein, 2005).

According to Rogers (2003), innovation-decision process consists of five steps which are knowledge, persuasion, decision, implementation, and confirmation. These five steps usually follow each other in a time-ordered manner. Knowledge is the first stage of the successful adoption of computer technologies and it is essential for other steps in the innovation-decision process. If principals do not have enough competent in computer use, they may not adopt computer technologies into their instructional and administrative tasks (Afshari et al., 2008). Without the knowledge and skill of computer technology, principals might have a high level of uncertainty that influence their opinions and beliefs about the innovation (Rogers, 2003). In line with this idea, Felton (2006) stated that competence is a key to the use of computers by principals on a daily basis. In fact, competence in operating a computer and in utilizing software may improve the quality and efficiency of administrative performance in schools (Felton, 2006). Improved quality could lead to improve decision-making. It is clear that effective training is crucial if principals are to use ICT effectively in their work (Kirkwood, 2000). If training is inadequate or inappropriate, then principals will not be sufficiently prepared, and perhaps not sufficiently confident, to make full use of technology. Hence, lack of principals' competence and lack of quality training for principals can be barriers to principals' use of ICT.

Many technology experts have indicated that "the integration of ICT in education should occur in the light of the cultural conditions of the country and the prevailing school culture" (Albirini, 2006b, p.50). In fact, cultural barriers, either societal or organizational, are very important among the barriers to the adoption of technology. Societies and organizations can overcome most of the technical barriers through different means of support, but

cultural barriers are harder to deal with. In the field of education, it has been noticed that principals' reactions to technology innovations are mediated by their cultural perceptions (Felton, 2006). According to Rogers (2003), a cultural perception is a very general idea of social system norms. In other words, it refers to the cultural suitability of computers (Thomas, 1987). Albirini (2006a) carried out a study examining the factors relating to the teachers' attitudes toward ICT. He collected evidence from high school English teachers about their perceptions of computer attributes, cultural perceptions, computer competence, and computer access. The sample consisted of 63 male and 251 female teachers. The results showed that computer attributes, cultural perceptions, and computer competence are factors that explain the greatest amount of variance in computer attitudes. Also, he stated that cultural perceptions toward different computer-related technologies are key factors related to both the initial acceptance of these technologies as well as future behavior regarding their usage. Similarly, Lee, Choi, Kim and Hong, (2007) conducted a study on the relationship between users' cultural profiles and technology adoption in the context of the mobile Internet. Their findings of large-scale on-line surveys in Korea, Hong Kong, and Taiwan indicated that cultural factors have a significant influence on users' adoption perceptions of mobile Internet services. So, they concluded that cultural differences are a contributing factor in the adoption of technology, particularly in third world countries.

According to Flanagan and Jacobsen (2003), leadership plays a key role in the success of technology utilization in education. Thomas (2001) stated that there is a strong link between educational technology and school leadership. Leadership style is exhibited by the leader could help or hinder technology infusion (Flanagan & Jacobsen, 2003; Thomas, 2001). One of the best styles of leadership that can change and transform individuals is transformational leadership (Northouse, 2001). Transformational leadership occurs when one or more persons engage with others in such a way that leaders and followers raise one another to higher levels of motivation and morality (Bass & Riggio, 2006). In other words, transformational leadership is a process that both the manager and followers should change themselves (Northouse, 2001). Although the transformational leader plays an essential role in precipitating change, followers and leaders are inextricably bound together in the transformation process (Northouse, 2001). This type of leadership is becoming more and more important to organizations, as workforces become more diverse, technology improves and international competition heightens (Jobs, 2002).

Transformational leadership is comprised of four distinct dimensions: charismatic leadership or idealized influence, inspirational motivation, intellectual stimulation and individualized consideration (Bass & Riggio, 2006). Idealized influence (attribute) demonstrates attributes of principals that motivate respect and pride and display a sense of power and confidence; idealized influence (behavior) refers to the principals' behavior to communicate values, purpose, and importance of mission; inspirational motivation refers to leaders that motivate and inspire others by challenging them to exert effort; Intellectual stimulation stimulates followers' efforts to be innovative and creative by questioning assumptions, reframing problems, and approaching old situations in new ways; and individualized consideration focuses on development and mentoring of followers and attends to individual needs(Bass & Riggio, 2006). Beatty and Lee (1992, as cited in Thite, 2000) conducted several case studies of the implementation of CAD/CAM systems in numerous British and Canadian companies in an effort to investigate the linkage between leadership and technological change in organizations. Through semi-structured interviews and using a critical incident approach to assessing leadership abilities, the researchers tracked managerial involvement throughout the implementation process. The outcome of their qualitative research suggests that a transformational approach to leadership is likely to be more effective in overcoming barriers to change than a transactional leadership approach that concentrates on technical problem solving to the neglect of people and organizational issues.

According to Burns (2003), transactional leadership involves exchanging one thing for another. In fact, the effective transactional leaders are expert in giving and taking. This style is useful for stable situations but is less useful for organizations that are facing environmental turbulence or rapid change (Kirkbride, 2006). Transactional leadership was measured by contingent reward and management-by-exception (active and passive). Contingent reward leaders explain the expectations of followers and the compensation they will receive if they meet their performance expectations. Management-by-exception-active leaders attend to followers' mistakes and failures to meet standards and management-by-exception-passive leaders react to correct action after problems become serious enough (Bass & Riggio, 2006).

Regarding the importance of transformational leadership as an influence on principals' use of technology, Christopher (2003) conducted a study at the University of Virginia. A self-designed instrument was used in this study. Leadership items were taken from Bass and Avolio's Multifactor Leadership Questionnaire Leader Form. Surveys were sent to a random sample of 397 principals throughout the Commonwealth of Virginia, and 185 principals participated in the survey. Her analysis indicated that the overall extent that principals used decision support technologies was significantly correlated with their perceptions of all four transformational leadership

behaviors (individual influence, inspirational motivation, intellectual stimulation, and individual consideration). Also, she suggested that educational leadership programs should be provided to train principals to use technology as a management tool. If principals do not use technology on a consistent basis; they should not expect the faculty to use technology regularly. Modeling the use of technology provides an effective method for exposing teachers to new strategies and demonstrating to the staff that it is acceptable to take risks and make mistakes, without the fear of retribution (Dawon & Rakes, 2003)

THE STUDY
The purpose of this study was to identify the extent to which secondary school principals use computers in Tehran (a large province in Iran) and to explore factors related to the level of computer use by principals. Selected factors used in this study were based on Rogers' (2003) diffusion theory, Technology Acceptance Model, and previous researches which include perceived computer attributes; computer competence; computer access; principals' attitude toward computers; leadership style of principals; and cultural perceptions. Principals' profiles (gender, age, and administrative experience, type of school, and academic degree, as well as information regarding their background in computer training) were also included in order to ensure maximum possible control of extraneous variables by building them into the design of the study (Gay & Airasian, 2000). More specifically, this study addresses the following questions:

1. What is the level of computer use by secondary school principals?
2. What are the principals' attitudes toward computers?
3. What are the principals' perceptions of:
   a. Computer attributes?
   b. Their level of computer competence?
   c. Cultural relevance of computers to Iranian society and schools?
   d. Their level of access to computers?
4. What is the leadership style (transformational and transactional leadership) of principals?
5. What is the relationship between the level of computer use by secondary school principals and their perceptions of each of the above variables?
6. What is the proportion of the variance in the level of computer use by secondary school principals that can be explained by the selected independent variables and the relative significance of each independent variable in explaining the dependent variable?

METHOD
This was a descriptive study of an exploratory nature. Creswell (2003) stated that exploratory studies are most advantageous when ''not much has been written about the topic or the population being studied'' (p. 30).The target population in this study was Iranian secondary school principals in the province of Tehran during the 2007-2008 school years. The list of principals was based on the secondary principals' Directory. The Directory is maintained and updated on a quarterly basis by Tehran Department of Education. The total number of secondary school principals was 1312 in the Directory of the Department of Education in Tehran.

Furthermore, a set of questionnaire was used to obtain the required data for this study. The questionnaire was divided into two parts. Part A measured the perceived level of computer use by principals. Factors that were related to it were measured in part B. Questionnaires were distributed to 320 sample principals selected randomly from the population. In this study, stratified sampling was used because Tehran is one of the biggest cities in Iran and consists of 19 educational areas. Also, the population to be sampled was not homogeneous but, in essence, consisted of several subpopulations (Wiersma, 1995). When sub-populations vary significantly, it is advantageous to sample each subpopulation (stratum) independently**.** Researcher used this stratified sampling method to have less variability in selection.

Two indispensable characteristics of measurement that must be considered in establishing the appropriateness and usefulness of measurement instrument are reliability and validity. Although theses instruments were valid, face and content validity of these instruments were established again by a panel of expert. To ensure that Iranian secondary school principals had a complete comprehension of the instrument used in the study, the survey was translated from English into Persian using the double back translation method to ensure the accuracy of the Persian version.

Furthermore, Cronbach's alpha was used to measure internal consistency and calculated via the SPSS 15 statistical package. Cronbach alpha is the most common form of internal consistency reliability coefficient. The Cronbach's alpha coefficients for these scales were: Computer Access Scale=0.867, Computer Attributes Scale =0.909, Attitude toward ICT Scale =0.92, Computer Competence Scale=0.97, Cultural Perceptions Scale=0.611,

Transformational leadership style Scale=0.812, Transactional leadership style Scale=0.596 and Level of computer use Scale=0.917.

To carry out this study, first, approval was obtained from the Ministry of Education and also contact was made with the research department of Tehran's Ministry of Education. A meeting was arranged to discuss the proposed study. Furthermore, a letter of introduction and a questionnaire packet were delivered to the superintendent in the research department for review. Finally, approval was received from the superintendent and permitted the researcher to attend the principals' meeting in each educational area of the Ministry of Education. A total of 350 packages were distributed among all members of the sample in these sessions. In the packages, there were some materials. These materials included a cover letter, the questionnaire, and a stamped, addressed return envelope was enclosed for some respondents' convenience in returning the completed questionnaires. The completed questionnaires were collected at the end of these sessions. Principals who could not fill their questionnaires completely were given approximately three weeks from that date to return the questionnaires by mail. In all, 350 surveys were distributed, 320 were returned, resulting in a return rate of 91.4%. All of the returned surveys, a total of 320, were used in the analysis. In this study descriptive statistics were used to describe and summarize the properties of the mass of data collected from the respondents (Gay & Airasian, 2000). Correlation analysis was used to determine the relationship between each of the independent variables and the level of computer use by secondary school principals in Tehran. Furthermore, multiple regression was used to measure the degree to which the independent variables would explain the proportion of variance in the dependent variables and to identify the relative significance of each independent variable in explaining the dependent variable. By convention, an α level of 0.05 was established a priori for determining statistical significance.

FINDINGS & DISCUSSION
The findings indicated that about 51.6% of the respondents were males and more than half of the respondents (50.3%) were within the 45-54 age range. About 44.7% of the respondents had 21 or more years of experience. More than half of the respondents (53.1%) worked in private schools, and approximately 60.3% of the respondents held bachelor's degrees. Moreover, the majority of the participants (95.5%) reported that they had computer training, and 83.8% of them had more than 60 hours of training. In terms of the type of training, more than half of the principals participating in the study (52.8%) reported that they received their training through in-service training.

Computer Use by Principals
The dependent variable, level of computer use, was quantified by the score of 39 items using a five-point Likert scale. Each item was rated by respondents from 1 ("Never use") to 5 ("use daily"). According to Table 1, the principals' perceptions of the level of computer use were moderate; with an overall mean score of 3.32 (SD= 0.76). Also, findings indicated that principals spent a few times a week working on their computers. It would seem that Iranian principals need effective and extensive trainings to raise their proficiency in computer use and to integrate technology into their schools.

Table 1. Distribution of Mean Scores on the Computer Use Scale

Scale	Percent (%)			Mean	S.D.
	Low	Moderate	High		
Internet use	10.3	43.8	45.9	3.49	0.79
Hardware and software use	11.9	51.9	36.3	3.27	0.66
Instructional use	16.6	39.4	44.1	3.36	0.93
Administrative use	17.2	47.8	35.0	3.23	0.90
Overall Computer Use	12.2	55.0	32.8	3.32	0.76

Moreover, analysis of collected data on the computer use scale indicated that among the subscales of the level of computer use, Internet use had the highest mean (M = 3.49). Also, findings indicated that nearly all the respondents used the Internet at home and at school , and the most frequent use of the Internet was for sending and receiving e-mails (46.9% "2 or 3 times a week"). It would seem that e-mailing was the most accepted application among principals who were surveyed. In fact, there may be several reasons for this—e-mail is efficient, widely available, and effective. Thus, it is not surprising that email was accepted and used far more by the sample population of this study.

Principals can increase their professional knowledge in the form of knowing current research, new technologies, and the best teaching practices through the use of the Internet. Findings of this study pointed out that most of the respondents used a web browser a few times a week to explore professional and educational resources. Three

reasons may underline the obtained results. The first possible reason is that "low telecommunication density and very low bandwidth during peak hours sometimes makes it impossible to download files or software" (Uddin, 2003, p.225). Furthermore, most of the principals had little Internet experience to find useful professional and educational resources. Lastly lack of knowledge and skill for searching and downloading the valuable professional and educational resources also limit the use of the Interne. In fact, the Internet can be an avenue for researching information and data. It helps principals to find information regarding their profession and educational subjects in order to develop processes for effective decision-making and problem solving which result in better accountability (Felton, 2006). Therefore, trainings should be provided for principals to learn all possible Internet resources together with underlying techniques of strategic browsing to enhance their Internet literacy (Atkinson & Kydd, 1997).

As for the hardware and software use subscale, the main use for computers was in word processing, whereas construction of spreadsheets, databases and presentations (such as Powerpoint) were used "never" or "a few times a month". Only 2.5 percent of principals stated that they read spreadsheets "daily" at work with 20.0 percent indicating 2 or 3 times reading in a week, while 56.9 percent indicated that they had "never" read or had read "a few times a month" a spreadsheet. These results are consistent with Schiller's (2003) study. He found that the word processing was the most frequently utilized software among the principals and they used it to create documents and slides.

Regarding the instructional use domain, the majority of participants indicated that they two or three times a week used computers for recording observation; monitoring student achievement for specific objectives and grades; creating master schedules; recording discipline referrals; writing up classroom observations; monitoring achievement test data; locating curriculum resources; developing or writing curriculum; and creating graphs and charts. Plomp and Pelgrum (1992) stated that one way in which computers might work their way into the school is through administrative use and that this might lead to the use of computers in instruction. An examination of data indicated that mean score of the administrative use subscale was lower than another subscales, and computer use for instructional purposes was generally ahead of administrative uses. Moreover, findings indicated that within the area of administrative uses, communicating with staff, and members of the wider school, initiating and sustaining collaborative activities with colleagues within and outside their school were the areas of greatest use, while financial matters, maintaining administrative records about students, using a program to analyze information for solving problems, using technology to support levels of professional collaboration, and using technology to engage new kinds of professional development were the least used areas. Therefore, the early assumption that the introduction of computers into schools for administrative purposes would spread to their use for instructional purposes was not supported by the data.

Principals' Attitudes toward ICT in Education
Attitude scale contained 23 items that asked respondents to describe their attitudes towards ICT. This scale was developed by Albirini in 2006a and comprised of three subscales: affective domain; cognitive domain, and behavioral domain. Respondents' attitudes were measured on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicated positive attitudes towards ICT while lower scores indicated less positive attitudes.

Table 2.Distribution of Mean Scores on the Attitude toward ICT Scale

Scale	Percent (%)			Mean	S.D.
	Negative	**Moderate**	**Positive**		
Affect	0.0	24.1	75.9	4.11	0.53
Cognition	0.0	20.3	79.7	4.05	0.45
Behavior	0.0	29.1	70.9	3.97	0.59
Overall Attitude	0.0	21.3	78.8	4.05	0.44

As Table 2 illustrates, principals' attitudes towards ICT were positive, with an overall mean of 4.05 and a standard deviation of 0.44. Principals' positive attitudes towards ICT exhibit their initiation into the innovation-decision process (Rogers, 2003). It seems that Iranian principals have already gone through the Knowledge and Persuasion stages (Rogers, 2003) and are probably proceeding to the Decision phase. As many theorists have indicated, attitudes can often foretell future behaviors (Ajzen & Fishbein, 2005). Thus, it can be concluded that principals who have positive attitudes towards ICT in education, use computer in their administrative and instructional tasks once computers become more available to them. At this stage, principals' expertise in computer use and the social support from others (colleagues, peers, etc.) might affect their attitudes toward computer use. Furthermore, findings of this study indicated that the affective domain has the highest mean score (M= 4.11) among the three subscales of attitude scale. This implies that principals had positive emotional feeling

of computer in education. So, the majority of respondents reported that they like, enjoy, and feel comfortable using ICT in general and in education. This was followed by the cognitive attitudes (M=4.05, SD=0.45). The vast majority of principals stated that they have realized the impact of technology on their life and society in general. Regarding the behavioral subscale, participants indicated that they have the intention to buy computers, to learn about them, and to use them in the near future.

Computer Attributes

This study examined key attributes of ICT to determine the extent to which it has successfully been diffused and adopted in the Iranian educational system by principals. Only four of the perceived attributes of ICT were examined among a sample of Iranian principals. These attributes were relative advantage, compatibility, simplicity (in this study non-complexity of ICT was measured), and observability. The Computer Attributes Scale was developed by Albirini (2006a) and contained 25 items. Since respondents rated their perceptions of computer attributes on each item from "strongly disagree" (1) to "strongly agree" (5), the range of possible mean scores was between 1 and 5, with higher scores indicating more positive perceptions of computer attributes.

Table 3.Distribution of Mean Scores on the computer attributes scale

Scale	Percent (%)			Mean	S.D.
	Low	Moderate	High		
Relative Advantage	0.0	35.6	64.4	3.85	0.62
Compatibility	2.5	35.6	61.9	3.74	0.71
Complexity	1.3	40.3	58.4	3.77	0.69
Observability	0.0	29.4	70.6	3.95	0.66
Overall Attributes	0.0	35.6	64.4	3.82	0.62

As shown in Table 3, the respondents' perceptions of the attributes of ICT were somewhat positive, with an overall mean score of 3.82 and a standard deviation of 0.62. Among the four categories of computer attributes, observability has the highest mean value (M=3.95, SD=0.66), indicating positive observed advantage of ICT. This was followed by the relative advantage subscale, with a mean score of 3.85 and standard deviation of 0.62. Most of the principals taking part in this study believed that computers offer an advantage over previous ways of performing their task in that they can assist in acquiring and evaluating information to manage work-related problems. In fact, computers can lead to adequate and intelligent solutions for on-the-job problems (Felton, 2006). Also, they can have a positive impact on the productivity of principals as managers and instructional leaders and can be perceived as a valuable tool.

The simplicity subscale had the mean score of 3.77 and the lowest mean score, 3.74, was from the compatibility subscale. These results indicated that Iranian principals were roughly comfortable with using computers and easily made the transition to using one at school. Their level of comfort with the innovation was somewhat high which enabled them to adopt the innovation quickly. In fact, these two factors (the comfort level of the participant with the innovation and the compatibility of the innovation with the participants' values, beliefs, and educational background) have the most impact on adoption of the innovation (Rogers, 2003).

Computer Competence

The Computer Competence Scale was used to measure secondary school principals' beliefs about their computer knowledge and skills. This scale was developed by Flowers and Algozzine in 2000. According to this questionnaire, eight domains of the perceived ICT competencies of principals (basic computer operation skills; setup, maintenance, and troubleshooting of equipment; word processing; spreadsheets; database; networking; telecommunication; and media communication) were measured. Principals' computer competence was quantified by the score of the 34 items on a four-point scale, ranging from 1 (No Competence) to 4 (Much Competence). The responses were reduced to a mean score that demonstrated the level of each respondents of their computer competence, with higher scores indicating greater competence.

Table 4.Distribution of Mean Scores on the Computer Competence

Scale	Percent (%)				Mean	S.D.
	No competence	Little competence	Moderate competence	Much competence		
Basic computer operation skills	0.0	5.0	22.2	72.8	3.60	0.52
Set up, maintenance, and troubleshooting of equipment	11.6	23.1	35.9	29.4	2.88	0.81
Word processing	0.0	9.1	22.5	68.4	3.51	0.60
Spreadsheets	18.1	38.1`	27.5	16.3	2.44	0.81
Database	18.8	36.9	29.4	15.0	2.45	0.87
Networking	10.9	17.5	34.7	36.9	2.96	0.80
Telecommunication	5.3	15.6	30.0	49.1	3.19	0.81
Media communication	12.2	20.3	47.5	20.0	2.80	0.80
Overall computer competence	4.7	15.0	41.3	39.1	2.99	0.62

As shown in Table 4, the mean score of the participants' responses on basic computer operation skills (3.60) was the highest among the eight subscales, indicating much competence in this skill. More than two-thirds of the respondents (72.8%) had much competence, 22.2% had moderate competence, and the remainder had little competence (5.0%) in basic computer operation skills. it seems that basic computer operation skills have not been the major educational needs among the principals. Furthermore, study results indicated that most of the principals were competent in using basic word processing (M= 3.51) and a few of them were proficient in constructing spreadsheets, databases and presentation software (M= 2.44, M= 2.45). In fact, "by increasing the availability of computers at school and home, it is not surprising that basic computer operation skills and word processing are skills that most principals are competent in. These skills are not seen as important for principals as other staff can assist them and therefore the principals can spend more time on other aspects of ICT. On the other hand, the relatively low proficiency of principals in creating and using spreadsheets and databases are essential for those in leadership positions where use and interpretation of data is increasingly becoming a critical skill" (Schiller, 2003, p.179).

In addition, principals taking part in the study stated that they have moderate competence in using telecommunications; networking; set up, maintenance and troubleshooting of equipment; and media communication. In Iran, these innovations are still new and only certain people know how to operate the equipment. The development of Internet technology also might be the reason why principals did not have much competence in telecommunications system. Today, in Iran, the use of basic Internet skills has become more common especially in Tehran's schools. According to Starr (2001), competence in using computers requires a positive attitude, practice time, and staff development in computer use. Hence, considerable continuing professional development opportunities should be provided for principals to learn how to use hardware and software applications within the context of their administrative and instructional responsibilities. Consistent and continuous training can increase the proficiency of principals.

Cultural Perceptions
Principals were asked to respond to 16 Likert-type statements dealing with their cultural perceptions of computers and the impact of computer use on Iranian society and schools. This questionnaire was developed by Albirini (2006a). Based on this questionnaire, respondents can rate their cultural perceptions on each item from "strongly disagree" (1) to "strongly agree" (5), the range of possible mean scores is between 1 and 5, with higher scores indicating more positive cultural perceptions.

Table 5. Distribution of Mean Scores on the Cultural Perceptions

Scale	Percent (%)			Mean	S.D.
	Low	Moderate	High		
Cultural Perceptions	0.0	26.3	73.8	4.00	0.53

As can be seen from Table 5, the overall mean on the cultural perceptions scale was 4.0, with a standard deviation of 0.53, indicating that principals' perceptions of the cultural relevance of computers were positive. In

other words, principals had positive perceptions of the value, relevance, and impact of ICT as it relates to the cultural norms in Iranian society and schools. So, principals did not feel ICT as a threat for Iranian culture.

Computer Access
Respondents were asked to rate their level of access to computers. The access questions covered: (a) the location of computers used by principals (home, office, and school), and (b) the frequency of access (never, once a month, once a week, two to three times a week, and daily). Computer access of principals was represented by a mean score on a 5-point scale ranging from 1 (Never) to 5 (Daily).

Table 6. Distribution of Mean Scores on the Computer Access Scale

Scale	Percent(%)					Mean	S.D.
	Never use	Once a month	Once a week	2 or 3 times a week	Daily		
Home	6.9	9.7	28.8	32.8	21.9	3.53	1.13
Office	3.4	7.2	10.3	32.2	46.9	4.12	1.07
School (Computer lab or Library)	18.8	16.6	25.9	24.7	14.1	2.99	1.31
Overall Access Level	10.0	9.1	23.4	26.6	30.9	3.55	1.05

According to Table 6, the mean score of the overall Computer Access Scale was 3.55 (SD = 1.05), which implies that, on average; secondary school principals had access to a computer almost two or three times a week. Furthermore, findings of this section indicated that only 30.9% of principals had access to computers daily. Many school districts communicate vital information daily to administrators, and they expect communications, reports, and other documents to be transmitted in the same way. In fact, frequent and immediate access to computer to get data (e.g. student files and grades, arrange class schedules, track discipline problems, and evaluate teachers) is important for principals. They can use these data to develop processes for effective decision-making and problem solving which result in better accountability (Felton, 2006). Moreover, principals reported high levels of computer access in more personalized spaces such as in their offices (M=4.12) and at their homes (M=3.53). The high level of computer access for administrators can be a positive sign. It shows that the importance of computers as a management and instructional tool has been understood by decision makers.

Leadership Style
In this study, the leadership style of principals was measured by the Multifactor Leadership Questionnaire. The MLQ5x was developed by Bass and Avolio in 2000. The Multifactor Leadership Questionnaire 5x is the most recent version of the Multifactor Leadership Questionnaire, which is the instrument most commonly used to measure transformational, transactional and laissez-faire leadership. In this study laissez-faire leadership was not examined because this style is extremely passive, where a leader avoids decision making and supervisory responsibilities (Lewin, Lippitt, & White, 1939). Moreover, laissez faire leadership indicates a complete abdication of leadership (Bass, 1985).

Transformational Leadership Style
Transformational leadership questions are in the questionnaire categorized as: idealized influence (attributed) idealized influence (behavior), inspirational motivation, intellectual stimulation, and individualized consideration. The transformational leadership score is the average score of 20 items making up transformational leadership. The range of possible mean scores was between 0 and 4, with higher scores indicating a greater level of perceived transformational leadership.

Table 7.Distribution of Mean Scores on the Transformational Leadership Style

Scale	Mean	S.D.
Idealized influence (attributed)	2.99	0.67
Idealized influence (behavior)	2.88	0.71
Inspirational motivation	2.74	0.76
Intellectual stimulation	2.69	0.80
Individualized considerations	2.85	0.69
Overall Transformational leadership style	2.83	0.59

As a composite variable, transformational leadership received a mean rating of 2.83 (on a five-point scale). The findings indicated that a representative sample of Iranian secondary school principals fairly often provided some elements of transformational leadership. Bass and Avolio (2003) suggested that ideal ratings for the transformational variables should be greater than three (>3.0). This benchmark shows that principals who have a mean score greater than three are very powerful in achieving the best outcomes. However, the principals surveyed as part of this research did not meet this benchmark.

Based on literature review, the level of transformational leadership in developed country is higher than developing country. In fact, in developed countries such as USA, educational master degrees are mandatory. School principals must complete the Principals' Qualification Program (PQP) before being appointed as a principal or vice-principal (Bush & Jackson, 2002). Moreover, there are programs for newly appointed principals in New South Wales and in New Zealand. In Ohio, new principals should attend a two-year curriculum to develop their knowledge, dispositions and leadership skills (Bush & Jackson, 2002). On the other hand, in developing countries specifically in Iran, training is not a requirement for appointment as a principal and there is still an assumption that good teachers can become effective managers without specific preparation (Bush & Oduro, 2006). This may be a reason that principals surveyed as part of this research did not meet an optimal level of transformational leader.

Among the different categories of transformational leadership, idealized influence (attribute) had the highest mean value (M=2.99, SD=0.67). This was followed by idealized influence (behavior) (M=2.88, SD=0.71). These statistics suggest that principals are able to display fairly often charismatic leadership behaviors in their schools. In fact, idealized influence occurs when leaders engender the trust and respect of their followers by doing the right thing rather than ensuring they do things right. When they focus on doing the right thing, they serve as role models (Kelloway & Barling, 2000). These leaders are regarded as effective and influential. They have personal power, which is not a typical feature of an ''ordinary'' leader (Kent et al., 2001).

In most of the developing countries because of their general socio-cultural characteristics, charismatic leadership is considered as the most appropriate and the most critical manner of leading for organizational leaders (Tuomo, 2006). Organizational change is the essence of development, and there is usually an urgent need for change in the internal work cultures of these countries at all levels (Tuomo, 2006). According to Conger, Kanungo and Menon (2000), effective changes require the initiative, guidance, and effort of charismatic leaders. Thus, Iranian principals should posses the charismatic qualities, in managing their teachers in order to ensure that they are able to share similar idea and vision towards achieving the organizational goals. In addition, policy makers should provide training in order to mould the charismatic qualities among the principals.

Respondents' third highest mean score came from individualized consideration (M=2.85, SD=0.69), implying that principals fairly often display individualized consideration leadership behaviors in their school. In fact, "a large portion of individualized consideration is developmental. Such principals can identify followers' needs for growth and provide the mentoring or coaching required to both meet those needs for growth and expand them to higher levels of potential" (Avolio & Bass, 1995, p.202). Hence, trainings should be provided for principals to learn how to support teachers' efforts, to encourage their autonomy and to empower them to take on more responsibility in line with their growing expertise and interest (Kelloway & Barling, 2000)

Also, the findings of this study displayed that principals fairly often motivated and encouraged their teachers to envision attractive future states, as indicated by inspirational motivation mean score (M=2.74, SD=0.76). In fact, this dimension of transformational leadership is very important because envisioning a desired future state and showing how to get there is fundamental to effective leadership. According to Ozaralli (2003), envisioning is creating an image of a desired future organizational state that can serve as a guide to interim strategies, decisions, and behaviors. Without the ability to define a desired future state, the executive would be "rudderless in a sea of conflicting demands, contradictory data, and environmental uncertainty" (Sashkin, 2000, p. 2). Envisioning integrates what is possible and what can be realized. It provides goals for others to pursue and drives and guides an organization's development (Bass & Riggio, 2006). Hence, principals should be trained to be able to inspire and communicate their visions in ways that are compelling, make people committed to it, and help make it happen.

In addition to the other characteristics of leadership, transformational leaders can stimulate extra effort from their subordinates through intellectual stimulation. This leadership factor encompasses behaviors that enhance followers' interest in and awareness of problems, and that develop their ability and propensity to think about problems in new ways (Bass, 1985). Hence, this style of leadership can increase followers' abilities to conceptualize, comprehend, and analyze problems (Bass & Avolio, 1990). Findings of this study indicated that

the mean score on intellectual stimulation was the lowest among the five dimensions of transformational leadership (M=2.69. SD=0.80). In all, the area where most improvement is needed is intellectual stimulation. Intellectual stimulation needs to be nurtured and cultivated as a way of life in the organization. Hence, the 'best and the brightest" principals should be hired, nourished, and encouraged. Besides, innovation and creativity should be fostered in the school and principals should be trained to be able to show their teachers new ways of looking at old problems, to teach them to see difficulties as problems to be solved, and to emphasize rational solutions.

Transactional leadership Style
 Participants were asked to respond to 12 Likert-type statements dealing with their transactional leadership behavior. Based on this questionnaire, three dimensions of transactional leadership were examined which were contingent reward, management-by-exception-active and management–by-exception-passive. However, the transactional score is the average score of the 12 items encompassing transactional leadership. Based on this questionnaire, transactional leadership style was measured by a mean score on a five-point Likert scale, where 0 (not at all) represents the minimum score of the scale and 4 (frequently, if not always) represents the maximum score.

Table 8. Distribution of Mean Scores on the Transactional Leadership Style

Scale	Mean	S.D.
Contingent reward	3.02	0.53
Management-by-exception-active	2.81	0.64
Management-by-exception-passive	1.10	0.60
Overall Transactional leadership style	2.31	0.34

According to Bass et al. (2003), transactional leadership is a necessary precondition for transformational leadership to be effective as it serves to develop the relationship between the leader and follower. It also provides direction and focus that, if lacking, would result in confusion and ambiguity from the use of transformational behaviors. In this study, descriptive analyses revealed that the respondents have a mean score of 2.31 (SD=0.34). It seems that principals sometimes display some elements of transactional leadership. In other words, this result indicates that principals sometimes tend to focus on task completion and teacher compliance, rely quite heavily on organizational rewards and punishments to influence teacher performance, and emphasize work standards, assignments, and task-oriented goals. The study result is not consistent with Gumusluoglu and Ilsev (2009), and Christopher's (2003) findings while the result of this section is in line with Jung et al.'s (2003) findings. This variation may be due to the difference in cultural, geographic, or religious dimensions. This is supported by Ardichvili and Kuchinke (2002) who conducted a comparative study of four countries of the former Soviet Union, Germany, and the US regarding leadership styles and cultural values among managers and subordinates. Result of this study indicated that two dimensions, contingent reward and inspirational motivation, produced the highest scores in all four countries of the former USSR. Also, two less efficient leadership styles, laissez-faire and management by exception, have received significantly higher scores in the four former USSR countries, than in the US and Germany. It is clear that socio-cultural dimensions influence leadership style of managers.

Among the three components of transactional leadership, the contingent reward subscale had the highest mean score (M=3.02). This result indicated that principals fairly often clarified role and task requirements. They discussed with teachers what was required and clarified how these outcomes would be achieved and the reward they would receive in exchange for their satisfactory effort and performance. In general, these principals provided tangible or intangible support and resources to followers in exchange for their efforts and performance, defined rules regarding work duties, maintained standards, and determined the consequences of goal attainment. Bass (1998) notes that leaders who use this method are "reasonably effective, although not as much as any of the transformational components in motivating others to achieve higher levels of development and performance"(p. 6). Also, Bass and Avolio (2003) stated that for contingent reward the rating should be greater than two. In this study, the mean score of the participants' responses on contingent reward was 3.02. It meets the criteria of Bass and Avolio.

On the other hand, Bass and Avolio (2003) indicated that the mean score of the participants' responses on management by exception (active) subscale should be less than 1.5 and the rate of management by exception (passive) should be less than one. In this study, management by exception (passive) had a rating of 1.10 and management by exception (active) had a mean rating of 2.81 which exceeded the benchmark set by Bass and Avolio. These rating were higher than what is considered ideal for a leader. In fact, optimally effective principals should use low level of management by exception (active and passive) behaviors. The management-by-exception

factor emphasizes the controlling aspects of management, where leaders intervene only when things go wrong (Bass et al., 2003). Correction, criticism, negative feedback, and negative contingent reinforcement are examples of interventions that principals can display in management-by-exception. Hence, both passive and active forms of management-by-exception use more negative rather than positive reinforcement patterns and correspond to low satisfaction with leaders by their followers (Northouse, 2001). Therefore, it is clear that appropriate courses should be provided for principals to learn the necessary leadership skills.

THE RELATIONSHIP BETWEEN THE LEVEL OF COMPUTER USE AND INDEPENDENT VARIABLES

The association between computer use and independent variables were explored by using the correlation analysis. Correlation analysis was used to describe the strength and direction of the linear relationship between two variables. To run correlation analysis, preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity had taken place. The correlation matrix shows a number of significant relationships between level of computer use by principals and the independent variables (Table 9).

Table 9. Summary of the Correlation Matrix of Independent Variables and Computer Use

Variable	Pearson Correlation	point-biserial/ biserial correlation	Sig. (2-tailed)
Computer Use	1		
Age	-0.43**		0.000
Administrative Experience	- 0.45**		0.000
Training Hours	0.29**		0.000
Gender		-0.079	0.15
Type of School		-0.080	0.16
Training Course		-0.059	0.29
Access	0.78**		0.000
Attributes	0.77**		0.000
Attitude	0.47**		0.000
Competence	0.74**		0.000
Cultural Perception	0.44**		0.000
Transformational Leadership	0.69**		0.000
Transactional leadership	0.11		0.06

Principals' Profiles and Level of Computer Use

Findings of this study indicated that by increasing age and administrative experience, level of computer use by principals may be decreased. This may be due to the fact that new and young principals have been exposed to computers during their training and therefore, have more experience using this tool. Moreover, study results showed that training hours have a significant relationship with level of computer use. It would seem that training can make a difference in the proficiency of principals in using hardware, software and in instructional, administrative proficiency. Furthermore, principals reported that they received training in four ways: in-service training, non-school computer classes, self-teaching methods, and short workshop. Although the vast majority of principals stated that they attended training programs (95%), findings showed that they spent a few times a week working on their computers. It would seem that principals' training programs have not been effective to increase the proficiency of principals in using computers for administrative and instructional purposes. Formal training seems to make a difference in the proficiency of principals in using hardware and software and in overall proficiency but not in instructional and administrative proficiency. This may be due to the emphasis that formal courses place on hardware components and program applications. In fact, technology training should improve management and administrative skills. In this way, principals become more organized and efficient. According to Peterson (2002), training in computer use should help principals become proficient users to meet the challenges they face in a changing technological society. Then, effective and extensive training must be provided for principals to use a new tool or strategy.

Computer Access and the Level of Computer Use

The relationship between computer access and the level of computer use was investigated using Pearson product-moment correlation coefficient. There was a strong, positive relationship between the two variables [r =0.78, n=320, p<0.05]. This result suggests that principals who had access to computers and the Internet were more likely to use them than those who did not have adequate access to equipment and network connections. Therefore, access to hardware and software is an influential factor related to computer use. This result supports

previous studies (Albirini, 2006a; Felton, 2006; Guha, 2000; Knezek & Christensen, 2002; Norris et al., 2003; Pelgrum, 2001; Schiller, 2003).

Computer Attributes and the Level of Computer Use

Principals' positive perceptions about the computer attributes had a very strong correlation with their level of computer use (r=0.77), indicating that as principals' perceptions of computer attributes improve, their level of computer use will be enhanced as well. This corroborates the proposition that the attributes of the technology itself play a major role in determining its receptivity (Rogers, 2003). The result of this section is consistent with prior theoretical arguments made by Rogers (2003) and previous studies in which Diffusion of Innovation examined (Albirini, 2006a; Al-Gahtani, 2003; Vishwanath & Goldhaber, 2003).

Attitude toward Computers and the Level of Computer Use

Study result showed that there was a moderate and positive correlation between computer attitude and computer use [r =0.47, n=320, p<0.05. Principals, who had positive feeling; liked; enjoyed ICT use in education and had realized the impact of technology on their life and society, used technology more in their administrative and instructional tasks. This symbiotic relationship between attitudes toward ICT and its use has been widely reported in the literature (Bai & Ertmer, 2008; Drent & Meelissen, 2007; Gilbert & Kelly, 2005; Han, 2002; Knezek & Christensen, 2002). Literature confirmed these findings pointing out that attitude is an important factor for using or avoiding computer-based technology (Albirini, 2006a; Ertmer, 2005; Drent & Meelissen, 2007; Zhao & Cziko, 2001; Teo, Lee & Chai, 2008).

Computer Competence and the Level of Computer Use

As can be seen from table 9, there was a strong and positive correlation between computer competence and computer use [r =0.74, n=320, p<0.05]. It is clear that principals with higher levels of skill and knowledge will exhibit higher levels of computer use. Without the knowledge of computer technology, principals might have a high level of uncertainty that influences their opinions and beliefs about the innovation. Therefore, principals with limited knowledge and background in computer-based information systems can not use computer efficiently and encourage their schools to ride the wave of technology. Literature and the results of this study revealed that computer competence was an important factor influencing computer use (Felton, 2006; Knezek & Christensen, 2002; Pelgrum, 2001; Rogers, 2003). Also, this result is in compliance with the findings of Albirini (2006a) and Schiller (2003).

Cultural Perceptions and the Level of Computer Use

The study result indicated that there was a moderate and positive correlation between cultural perceptions and computer use [r =0.44, n=320, p<0.05]. Principals who had positive perceptions of the value, relevance, and impact of computers in Iranian society and school, used computer more in their administrative and instructional tasks. In fact, such principals can model technology use for their staff and make their vision tangible. It is difficult for a principal that has not understood the value and impact of computer use in his school and society and wants to convince teachers to use computer in their teaching and learning process (Yee, 2000). This cultural perception relates the leaders' success to their individual ability to articulate and influence norms and values.

In addition, researchers have pointed to cultural perceptions as one of the factors influencing ICT adoption (Albirini, 2006b; Lee et al., 2007; Leidner & Kayworth, 2006; Loch et al., 2003). Findings from the current study support this conclusion. Moreover, the study's result is consistent with Rogers' premise regarding the role of social norms in the diffusion of innovations, and also with Thomas's "Cultural Suitability" hypothesis, which posits that the acceptance of a new technology depends to a large extent on its compatibility with the existing culture. Specially, principals in this study acknowledged the importance of ICT for their educational system and society. It shows the influence of their cultural norms on their perception of ICT.

Transformational Leadership and Level of Computer Use

As can be seen from Table 9, there was a moderate and positive correlation between transformational leadership and the level of computer use [r =0.69, n=320, p<0.05]. The study results indicated principals, who used computer in their administrative and instructional tasks, acted as strong role models for the effective use of technology in support of teaching and learning. Besides, principals who have ability to transmit a vision or a sense of mission for comprehensive integration of technology, to foster an environment and culture conducive to the realization of that vision and to create enthusiasm in followers, applied technology to enhance their professional practice and to increase their own productivity.

PROPORTION OF THE VARIANCE IN THE LEVEL OF COMPUTER USE EXPLAINED BY THE INDEPENDENT VARIABLES

To determine the proportion of the variance in computer use that could be explained by the independent variables, a multiple regression analysis was performed. Following Gay and Airasian's (2000) recommendations, simple correlations were first performed to identify independent variables that individually correlate with the dependent variable. These variables were utilized in the multiple regression equation to make a more accurate prediction of the dependent variable and to show the proportion of variance in the dependent variable explained by the independent variables. The independent variables that individually connected to the dependent variable were: age, administrative experience, computer access, computer attributes, attitudes toward computer, computer competence, cultural perceptions, and transformational leadership.

The summary of the multiple regression results are presented in Tables 10 and 11. As can be seen from the Table 10, R Square is about 0.76. It shows that four independent / predictor variables explain about 76% of the variance / variation in the level of computer use. This shows a very respectable result. Moreover, the value of F for the final model is 252.2 and the corresponding p-value was highly significant ($p = 0.0001$). So, it can be concluded that the regression model fit the data at 0.05 level of significance. In other words, this model is a good descriptor of the relation between the dependent and predictor variables. Then, the estimated multiple regression model is acceptable and a stable one to explain the level of computer use.

Table 10. Summary ANOVA Table

Source	Sum of Squares	df	Mean Square	F Value	R Square	Adjusted R Square	R	P
Regression	217132.4	4	54283.08	252.26	0.76	0.75	0.87	p<.0001
Error	67781.63	315	215.18					
Total	284914.0	319						

Table 11. Multiple Regression on dependent variable (Computer Use)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig
	B	Std.Error	Beta		
Constant	-11.84	5.43		-2.17	0.004
Access	3.11	0.40	0.33	7.68	0.000
Attributes	0.57	0.08	0.30	7.05	0.000
Competence	0.29	0.05	0.21	5.05	0.000
Transformational leadership	0.39	0.09	0.15	4.08	0.000

As is shown in Table 11, four predictor variables were found to be significant in explaining the level of computer use. The four predictor variables were computer access ($t = 7.68$, $p= 0.0001$), computer attributes ($t = 7.05$, $p=0.0001$), computer competence ($t = 5.05$, $p= 0.0001$), and transformational leadership ($t = 4.08$, $p= 0.0001$). All four constructs are equally important but have varying impact on computer use. Therefore, all four constructs should be viewed in an integrated manner in accordance to the conceptual model proposed in this study.

CONCLUSION

This study identified the extent to which Iranian secondary school principals used computers and explored the relationship between a number of variables related to ICT use. Findings from this study showed that principals spent a few times a week working on their computers. It seems that principals should be aware of the role of ICT in their work life and get appropriate skills to use and integrate technology into the schools. To increase principal use of computer technologies for instructional and administrative purposes, the following themes need to be addressed which are support, training, change in administrative methods and strategies, improvement of school infrastructure, management of workload, and attitudes toward computer use (Casmar, 2001).

Moreover, findings of this study indicated that to create a significant impact on the level of computer use, high level of computer access is needed. In fact, principals should have access to computer technologies in their offices, schools, or any location in which access to information and productivity tools is necessary. Also, funds need to be made available to purchase hardware and software. School districts are expecting principals to model the use of technology in their schools. For principals to do this, they must have access to updated hardware and software. School budgets must include funds for training and for hardware and software upgrades. The other

finding from this study indicated that principals perceptions about the computer attributes had a very strong correlation with the level of computer use. According to Rogers (2003), innovations offering more relative advantage, compatibility, simplicity, and observability will be adopted faster than other innovations. Rogers does caution, "getting a new idea adopted, even when is has obvious advantages, is difficult" (p.1), so the availability of all of these variables of innovations speed up the innovation-diffusion process. Therefore, it is crucial that secondary school principals were trained to improve their understanding about computer attributes since they are significantly related to individuals' adoption intentions.

In addition, principals had positive attitudes toward ICT in education. They had more positive affective attitudes than both cognitive as well as behavioral attitudes. Hence, to improve principals' background knowledge and attitudes towards ICT, policy makers should upgrade principals' knowledge in computer software, hardware, and Internet. Also, principals should be exposed to various ICT tools to improve their behavioral attitudes. To achieve this, principals should be encouraged to utilize computers, educational software, and the Internet in their administrative and instructional tasks. In this way, principals will realize the potential of the technology and see how computers can have a positive impact on their productivity as managers and instructional leaders.

In the age of technology and information, Iranian principals should become competent in using computers. They should use computers effectively to perform their daily responsibilities. In fact, their ability to use computers helps them become more effective managers in using and analyzing the information that is available to them. The effective use of the computer in management, communication, and decision-making can increase their accountability. Findings of this study indicated that Iranian secondary school principals are lacking in proficiency on database, spreadsheet, presentation/ multimedia software, the Internet, and information seeking as compared with other technology competencies. Hence, school districts and principals' centers should provide professional development for principals to become proficient in all the competency areas. Also, they should implement an evaluation system that ensures school principals are working with the technologies at a proficient level.

Attention to cultural beliefs and their impact on ICT adoption are very important in developing countries (Loch et. al., 2003) because socio-cultural factors may put ICT transfer at risk (Albirini, 2006b)."Duplicating strategies from other developed countries without any consideration about cultural adaptations of technologies might be less effective and successful" (Kousha & Abdodi, 2004, p.8). According to Fleron (1977), implementation of a new technology is not finished with installation of the technology and explanation of how to use it. In fact, the new technology should be accepted by the receiving society (Asemi, 2006). It must not contradict the values of society. Findings from this study indicated that principals had positive cultural perceptions of ICT in society and school. Such principals could use technology and create a suitable environment and culture to the integration of technology in schools. This cultural perception relates the principals' success to their individual ability to articulate and influence norms and values. Hence, understanding the cultural values is as important as understanding the technological benefits. Principals who are responsible for adopting and implementing technology in school must be aware of its societal and organizational cultural impacts.

Some researchers say that successful ICT implementation is not about equipment or software but influencing and empowering teachers; it is not about acquiring computer skills, but supporting teachers in the ongoing engagement with students in their learning (Yuen, Law, & Wong, 2003). Hence, we need transformational leaders who can encourage creativity, open-mindedness and facilitate conditions and events that create a positive environment for technology adoption (Frambach & Schillewaert, 2002; Schillewaert et al., 2005). According to Rogers (2003), such principals play an important role in the diffusion and adoption of innovations. The leadership style exhibited by the leader could help or hinder technology infusion. Findings of this study illustrated that transformational leadership style have a significant association with the level of computer use by principals. It is suggested that Iranian principals should be active learners in this fast changing arena. They should never stop learning and honing their skills but they must maintain a personal plan for self-improvement and continuous learning (Bennis, 1990). Hence, principals should develop their style of leadership and be familiar with current research and best practices. Furthermore, they should use new technologies and model the use of them to change and improve the environment in which educators function. If school leaders want to initiate and implement school change through the use of information and communications technology, they must be eager to model the transformational components of charisma (idealized influence), inspirational motivation, intellectual stimulation and individualized consideration in their schools. According to Bass and Riggio (2006), transformational leadership can be taught. Therefore, decision makers should redesign programs, such as leadership studies, in order to teach the components of transformational leadership to future administrators.

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EDUCATIONAL TECHNOLOGY FOR THE INCLUSIVE CLASSROOM

Andreja Istenic STARCIC,
University of Primorska, Faculty of Education Cankarjeva 5, SI-6000 Koper, Slovenia
University of Ljubljana, FGG, Jamova 2, 1000 Ljubljana, Slovenia
andreja.starcic@siol.net

ABSTRACT
This paper presents and evaluates the development of an educational technology curriculum aimed at pre-service, primary education and undergraduates; the focus is on the incorporation of ICT competences for inclusive education. The framework was the introduction of SEVERI e-learning environment in Slovenian schools. Students were able to monitor the development and implementation of SEVERI tools for special needs pupils in Slovenian schools, and plan teaching and learning in SEVERI within their course project work. Within an educational technology curriculum, a competence framework was developed for fostering the use of ICT in the teaching of, and learning by, special needs pupils. This was achieved against the backcloth of the baseline learning objectives of autonomy, inquiry, creativity and innovation. In pre-service teacher education in educational technology, the focus is on inquiry based learning, and on planning and incorporating the innovative use of ICT into teaching; the emphasis is also on enhancing the student teachers' competences for his/her own professional development. In focussing more specifically on the use of ICT for special needs pupils, the aim is to carry into effect the principles of equality, diversity and inclusive education. The research was designed to evaluate the candidate students' learning and to consider the alignment of learning objectives and activities with learning outcomes in the new curriculum. The research questions considered within the paper are: (1) How the new curriculum assists mutual development of ICT didactical and technical competences? (2) How the project work based on SEVERI foster the learning objectives of autonomy, inquiry, creativity, and innovation in ICT implementation in inclusive classroom? (3) How is the project idea based on needs assessment in pedagogical practice? (4) How were the procedures of lesson planning conducted and how were lesson plans used in lesson performance?

Key words: educational technology curriculum, pre-service teacher education, inclusive education, special educational needs, e-learning environment for special educational needs, competences

INTRODUCTION
Inclusion or integration is an important part of equal opportunity in education. Demands for inclusive education have increased and fostered major changes to schooling and education. Students with disabilities are educated alongside their peers within the local community therefore mainstream schools are required to adapt to accommodate a diverse group of students with a variety of needs (O'Gorman, 2005, p. 377). Approaches to the inclusion of children and young people into mainstream classrooms, and the identification and recognition of special educational needs, is an integral part of daily school work. The well being and actualisation of developmental and learning potential within a diverse student population is challenging the organisation of learning settings. In the European context, educational policies have tended to be proactive with regard to the challenges and demands. Standards and competencies for all teachers are defined in The Joint Interim Report by the Education Council and the European Commission on Progress towards Education and Training 2010 (ibid.). Teacher education programmes, specifically, have responded to the needs and challenges of inclusive education within the Bologna Study Programme Reform. Within the new teacher education curriculum, the Tuning Report (González & Wagenaar, 2003, p. 83) refers to key generic competences which provide the basis for inclusive education. These include: a) the appreciation of diversity and multiculturalism in the process of identifying learner disadvantages; b) team work and skills which enable the teacher to collaborate with professionals, parents and fellow teachers in dealing with special education needs; c) sensitivity about ethical issues and ethical commitment and d) inter-personal and communication skills.

Against the background of these competences, it is my argument that educational technology and information communication technology play an important role in creating an effective and adaptable learning environment, especially when teaching pupils with special educational needs and inclusive classrooms. However, the use of ICT in addressing special educational needs has, to date, been inadequate so far. Most hardware and software is designed for the mainstream population and does not pay sufficient attention to a wide range of capabilities and to people with disabilities (Wong et al., 2009, p. 109). Despite the current emphases on inclusion have stimulated much interest in using various ICT applications for integrating students with disabilities into the mainstream school environment, the review of existing literature indicates a lack of attention to the application of ICT for people with special educational needs (Williams et al., 2006). ICT for special educational needs assists the different types of disabilities with assistive technology (Turner-Smith & Devlin, 2005). The main gap is within development of learning environments and systems which facilitate inclusion of persons with different types of

disabilities. Teachers are not aware of e-learning environments and their potentials for individualised instruction, exploratory environments, collaborative learning and facilitating social skills, individualised study plans, classroom management for accommodating students with disabilities in the inclusive classroom (ibid.). Research findings show that the use of online communication by young people has become a most common activity, and that the internet and virtual environments have been highly integrated in the young people's lives, where young people with special needs are vulnerable and marginalised (Söderström, 2009; Livingstone & Helsper, 2007). Learning environments and systems which prepare young people with special needs for participation in information society foster implementation of *the developing ICT competences based on equal opportunities* which is highlighted in The Concrete Future Objectives of Educational Systems ("The Concrete ...", 2001).

Training teachers for the new roles and tasks in society, including the use of ICT in teaching and learning and in developing their own professional competences, is a priority within the EU and national policies (Buchberger et al., 2000, p. 30). *Competences in using ICT* (González & Wagenaar, 2003, p. 83) in a teacher's professional work and learning constitute one of the main drivers of change when creating powerful learning environments and applying new approaches to teaching. (Buchberger et al., 2000, p. 39). Certain studies have shown that integration of new technologies into classes has been slow in progress, and they warned of a discrepancy between the innovation objectives and the current level of ICT integration (Hermans et al., 2008, p. 1500). Two respective studies conducted among teachers in Australian and Dutch primary schools showed that integration of ICT, were performed using the traditional approaches, failed to bring about changes in approaches to teaching, which would have been required in order to set up powerful ICT-assisted learning environments (Hayes, 2007; Smeets, 2005).

Teachers' conceptions, beliefs as also their technology related attitudes are linked to self-efficiency (İşman, 2009) in technology acceptance process, and ICT experiences (Cavas et al., 2009) and are preconditions for decisions and actions regarding professional learning, teaching improvements and change. To measure the impact of teacher training, the focus is on the influence of training on teachers' attitudes, self-efficacy, enjoyment, usefulness, and behavioural intention towards the use of internet (Akpinar & Bayramoglu, 2008). In teacher training, the need for a shift from technical competences to competences in directing one's own professional development is needed (Istenic Starcic & Brodnik, 2005, p. 165) in order to equip teachers to respond to changes and incorporating innovation in teaching (Buchberger et al., 2000). Professional development in ICT has to address professional needs and cultures and not primarily focus on training for ICT skills (Triggs & John, 2004; Watson 2001 cited in Loveless et al., 2006, p. 5).

Approaches applied by teachers in teaching are based on their own experiences gained during their own pre-service education. Models and methods of ICT use in pre-service teacher education by teachers-educators across the curriculum impact on the use of ICT in teaching (Potter, 2006; Istenic Starcic, 2007; Drent & Meelisson, 2008, p. 188; Baslanti, 2006; Gülbahar, 2008). Teachers-educators in pre-service teacher education, with their understanding of technology potentials and impacts in primary education and their adjustment of their own teaching approaches and methods, provide a model for students – future teachers (Baslanti, 2006).

Educational technology curriculum
The reformed *Educational Technology* curriculum, within the reformed Bologna study programme of primary classroom teaching, was developed in the period 2008 – 2009 and accredited in 2009 as the compulsory course for all the first year students of the First Bologna Cycle (Istenic Starcic, 2009). The course consists of three ECTS credit points, and comprises lectures (totalling 15 hours) and tutorials in the IT laboratory (totalling 30 hours). Since 2005, its implementation has been embedded in the e-learning environment, thus facilitating the linking of lectures and laboratory exercises with the remote activities done by students (Kljun et al., 2006). The *Educational Technology* curriculum analysis identified the need for incorporating topics into ICT use within inclusive education. To this end, curriculum renewal took place within the *Equal e-Learning* project in the same academic year of 2008/09 when Bologna Reform took place. The curriculum included the SEVERI e-learning environment to prepare students to apply ICT for individualisation and differentiation for assisting diversity of students, their abilities, experiences and interests (Cotic & Valencic Zuljan, 2009). The discussion of topics took place within the development and incorporation of the SEVERI system into the Slovenian schools, which facilitated learning in the context of pedagogic practice and field experience (Baslanti, 2006).

The renewal of the curriculum aims at acquiring experiences, stimulating inquisitiveness and inquiry-based learning, autonomous selection, accommodation and testing, planning and incorporating the creative and innovative ICT use into teaching, and increasing the awareness of the importance and role of a teacher's activity in his or her own professional development. The course contributes transferable competences, as *learning to*

learn, *cooperation* in distributed-teams on the Internet, and includes the *organisation of work and time management* (González & Wagenaar, 2003). The main objective of the course is to assist the process of teachers' professional dimensions. Teachers' **autonomy** in applying the specific skills in different situations, adopting decisions, and contemplating their own practice constitute the important teachers' professionalism dimensions (Darling-Hamond, 1985). Research orientation and **inquiry** in conjunction with reflection enables the teachers' **creative** and **innovative** pedagogical work (Fullan, 1992). Stimulating teachers' creativity by using ICT is the subject of pre-service teacher education studies (Loveless et al., 2006; Potter, 2006; Istenic Starcic, 2007), providing students with competences to go beyond the current boundaries, of technology, knowledge, social norms or beliefs (Ettlie, 2006, p. 55). Creative and innovative ICT use in teaching and learning is preliminarily about changing approaches to teaching and learning (Drent & Meelissen, 2008, p. 188). Creative practices of teaching, using ICT, include three interlinked factors: creative processes of imagination and originality, the features of ICT for multimodal presentation and communication, and ICT capability as an expression of elements of higher order thinking-finding things out and developing ideas (Loveless et al., 2006, p. 5).

Prior to the Bologna reform, *Educational Technology* used to be part of the *Didactics and Educational Technology* course that was compulsory for all the students within the primary classroom teaching study programme. The programme was accredited in 1995. In terms of teaching and learning time, the *Educational Technology* according to the old programme is comparable with the course within the new programme (15 hours of lectures, and 30 hours of tutorials). There are three Pedagogic Faculties in Slovenia, which are all educating and training teachers in the preschool and primary classroom teaching. The Bologna reform was gradually instituted within all the three faculties, following the prearranged common guidelines (Zgaga, 2005), based on the Community document Common European Principles for Teacher Competences and Qualifications ("Common ...", 2005), and on the Tuning project with the cooperation of one of the Slovenian faculties (González & Wagenaar, 2003). The comparison of the renewed curriculum from 2009 with the curriculum from 1995 is presented in Table 1.

Table 1: Comparing the Educational Technology curriculum of 1995 and 2009

Didactics and Educational Technology - 1995	Educational Technology - 2009
Focus on study of literature with observation in practice, and theoretical seminar work on the computer use in education.	"Living practice" with focus on planning, development and testing, with project work, and studying cases of ICT use in education.
Study methods do not facilitate empirical experience of technologies within one's own learning.	Study methods facilitate gaining experiences to students so as to integrate them into their own pedagogical work.
Fragmentation of study contents.	Process- and product-oriented integral approach to dealing with study contents.
Summative evaluation and assessment.	Process evaluation; project work is a composite part of final course assessment.
Direction to technical competences in using technologies.	Technical competences in ICT use are obtained indirectly by students through developing the pedagogically didactic generic and subject-specific professional teaching competences.
Special educational needs are excluded.	Preparing student teachers to use ICT in the process of dealing with diversity in classroom accommodating a diverse group of students with variety of needs and integration of special educational needs students.

SEVERI e-learning environment for special educational needs
The *"Equal eLearning – Students with Learning Difficulties Using ICT and Learning on the Web"* project was aiming at further developing, localising and implementing the SEVERI e-learning environment. Originally, the SEVERI system was developed for students with special learning needs in vocational education. The *Equal eLearning* project facilitated its further development, localisation and implementation in the various learning and training environments of Finland, Slovenia, Hungary, Lithuania, Portugal and Romania. The main challenges include a more extensive implementation in special schools, its integration into regular primary school and training environments for the improved integration of students with special educational needs. In Slovenia, the introduction of SEVERI e-learning environment and methods was also focused on teacher pre-service educational curriculum and its testing on part-time students at the University of Primorska Faculty of Education. The SEVERI e-learning environment (Figure 1) caters for students with special educational needs which include

a range of physical, communicational, emotional and cognitive disabilities, causing learning difficulties in reading, writing and perceiving. SEVERI provides the working environment, where tools are designed according to students' abilities. Clearly structured activities are focused on attracting learners and enhancing the students' motivation and autonomy providing the tracing and monitoring of one's own progress. Graphic interface design is provided in large and clear fonts, colours, symbols, pictures and speech so as to assist a variety of disabilities and special educational needs. Audio-instructions are included as well. The student interface is presented in Figure 1. In 2008, the *Equal e-Learning* project was awarded within the Handinnov competition for innovations which positively affect the lives of young disabled people and help them adapt to education, working life and society. The competition is organised by ONISEP (French National Office for Information on Education and Professions), European Disability Forum (EDF) and Droit au savoir (Right To Learning). In 2009, the *Equal eLearning* project was awarded the ACCESS-IT 2009 Good Practice Label in the field of e-Accessibility and inclusive ICT.
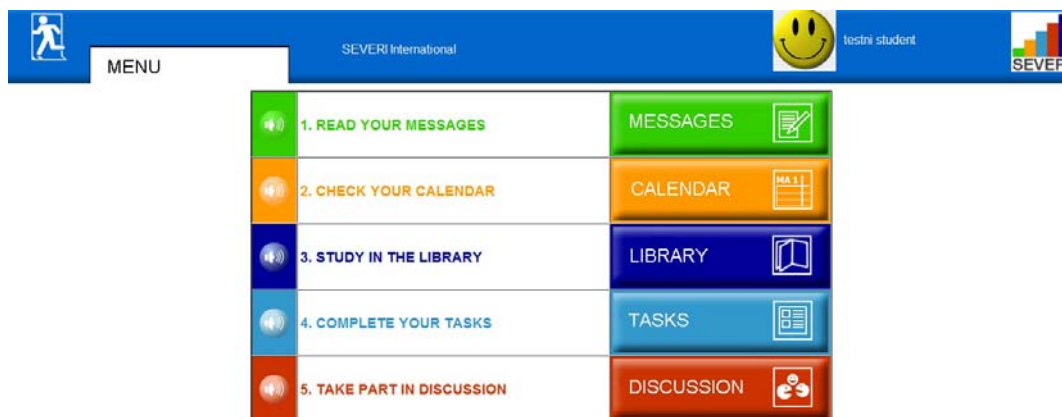
Figure 1: SEVERI e-learning environment – student interface

ICT for Inclusive classroom Project work structure
The project work is incorporated within the new Educational technology curriculum. The basic scope of the curriculum is to develop an autonomous teacher, who shall autonomously choose between options and tools, and adopt decisions on introducing creative and innovative solutions during lessons, taking into account the needs of individuals as well as groups. The structure of the project work is shown in Table 2. During tutorials, the students work on projects. At the beginning of the Project work, authentic cases from pedagogical practice are presented. Tutorial structure consists of the familiarisation with learning objectives, introductory motivation, discussing a topic or issue, working in groups, and completing the reflection journal at the end of every tutorial. The tutorial work is followed with practical work which is conducted by full time students during their teaching practice in schools. The part-time student teachers have a good opportunity to apply the project work during their normal professional work. For final assessment of the course, students write an essay on ICT use for special needs pupils and ICT in teacher's professional development and learning.

Table 2: Project work structure: Creative & Innovative ICT integration for inclusive classroom

1	Authentic cases	Integral treatment of processes was based on the authentic cases from practice. Teacher-educator included and treated topics, presenting cases from practice. Students linked the topics to their own experiences during presentation and discussion.
2	Idea development	The students developed an idea for ICT use for inclusive classroom, aiming at autonomy, inquiry, creativity, and innovation.
3	Idea communication	Students presented and discussed the idea with the other students in the group and with colleagues in their school environment.
4	Lesson planning	Students designed lesson plan including learning objectives, teaching and learning methods, cross-curriculum application, participatory production of learning materials with pupils.
5	Learning material design	Students designed the learning materials required for dealing with the topic and incorporated them into the SEVERI learning environment. They involved their pupils into the preparation of materials.

6	Lesson performance	Lesson performance took place during the regular lessons in classes taught by part-time students – teachers.
7	Project exchange	Lesson plans and learning materials were opened in SEVERI system for teacher exchange.

The research was designed to evaluate the students' learning and to consider the alignment of learning objectives and activities with learning outcomes in the new curriculum.

The research questions considered within the paper are:
(1) How the new curriculum assists mutual development of ICT didactical and technical competences?
(2) How the project work based on SEVERI foster the learning objectives of autonomy, inquiry, creativity, and innovation in ICT implementation in inclusive classroom?
(3) How is the project idea based on needs assessment in pedagogical practice?
(4) How were the procedures of lesson planning conducted and how were lesson plans used in lesson performance?

METHOD
Research methods and procedures
Evaluation study was undertaken to determine the value (merit and worth) of the Educational technology curriculum, so as to improve it and assess its impacts. Evaluation was process-oriented, consisting of formative evaluation aiming at improvement and summative evaluation for assessment of impacts. (Lincoln & Guba, 1986, p. 550). The purpose was to capture the process and collect information on teaching and learning activities and characteristics (teaching and learning approaches and learning objectives related to learning outcomes). Students were engaged in authentic tasks solving real problems. These were authentic representations of problems encountered in the field of study and in the real life of participants of study (Nevo, 2006, p. 447). The students were evaluated according to their active performance in using knowledge in a creative way to solve worthy problems (ibid.) during the learning process and final essay assessment.

A case study with qualitative research methodology (Stake, 1994) was used to investigate educational process in its natural environment (Denzin & Lincoln, 1994, p. 2), emphasising context (Greene, 1994, p. 538). The case study involved in-depth data collection from the multiple sources. The triangulation of data and resources from various points of departure, supporting all research questions was provided during the research process. For the validity, credibility and trustworthiness peer examinations and member checks were also applied. The qualitative data analysis was conducted in three stages: data description, analyses and summary, interrogation and identifying patterns.

The information was gathered and transcribed from:
- students' reflection journals (electronic, paper based),
- focus groups,
- students' project work products (lesson plans, learning material),
- students' essays for assessment.

Focus groups were used to address topics, which had not been considered by students prior to the evaluation study, and had turned up in project work. The aims were to identify new topics and deep understanding and interpretation of individual actions and attitudes within the given context. Focus groups are most effective where a large volume of information is to be gathered in a short period of time (Morgan, 1998, p. 45-54). Focus groups were implemented during lectures and tutorials.

With regard to the preset learning objectives of autonomy, inquiry, creativity and innovation, there is in the forefront in teaching and learning, according to Loveless (Loveless et al., 2006): the interplay of creative process and the use of features of ICT. Students explore their own process of creative work with ICT at the stage of planning and preparing materials for pupils, and at the stage of implementation. Reflection is crucial for the process of learning and development (students keep a reflection journal throughout the process) as is cooperation in a group, which facilitates interaction, exchange of experiences and positions (students cooperate with other students; students cooperate in the school working environment, students cooperate with the teacher-educator). The extent of compatibility between the preset learning objectives, learning activities and learning outcomes (Biggs, 1999) was monitored by analysing the students' reflection journals, students' project work, and students' essays for assessment.

The participants

The participants selected for testing were all part-time students in the second semester of primary classroom teaching course in the academic year of 2008/09 according to the old study programme. Part-time students involved in testing were teachers with a completed post secondary non-tertiary education degree, being educated for university education degree. The group of 43 persons consisted of 41 female and 2 male students. The students' age profile (Table 3) was as follows: 49-53 rage - 8 students, 46-48 range - 9 students, 43-45 range - 14 students, 40-42 range - 9 students, 36-39 range - 5 students. All the students had experiences in pedagogical practice. Analysis showed that they all had experiences in teaching of special needs pupils, either through involvement in regular classes or within departments intended for special needs pupils.

Table 3: Age profile

Age	36-39	40-42	43-45	46-48	49-53
Number	5	9	14	9	8

The data

During the course, students were writing electronic and paper based reflection journals based on open questions: "Are the learning objectives clear and to which extent you are able to fulfil them?" "How is the group work helpful in your learning process?" "How do you connect your normal professional work and the project work within the course?" "How would you describe the competences you developed in a project work?" "Are you facing any problems in doing project work, (if so please describe them)?" At the beginning of the course all students were asked to write one reflection journal focused on their ICT use for teaching and their own professional development. They were given open questions: "What experiences with ICT you have in your lesson planning and teaching?" "How do you use ICT in your professional learning?"

Students were asked to work in small focus groups (3-5 members) to discuss the ICT use for special educational needs. The focus groups' interaction was analysed. The project work products were lesson plans and learning material which were included in final assessment of the course.

For the assessment essays, students were asked to write about the ICT use for special educational needs and for the inclusive classroom and also about the role of ICT in teacher's professional development.

The data was processed according to the research questions. Coding sheets were used for analyzing the data for specific research questions. The coding frame is presented in Table 4. The codes for the research questions listed and the corresponding source from which data has been collected is mixed. The data was transferred to the coding sheets according to research questions, so that all comments on the particular question could be analysed together highlighting trends and issues. Frequencies are presented for students on the scale from 5-high to 1-none in Table 5.

Table 4: Coding frame

Source/ Research question with codes	Journal	Lesson plan	Learning material	Focus groups	Essay
How the new curricula assist mutual development of ICT didactical and technical competences?					
Technical skills	X			X	X
Shift in teaching	X			X	X
Shift in professional learning	X			X	X
How the project work based on SEVERI foster learning objectives?					
Autonomy	X			X	X
Inquiry	X			X	X
Creativity: Multimodal presentation and communication	X	X	X	X	X
Creativity: imagination, originality	X	X	X	X	X
Creativity: high order thinking-finding	X	X	X	X	X
Innovation	X	X	X	X	X
How is the project idea based on the needs assessment in pedagogical practice?					
Based on own teaching practice	X				
Shared experiences with other students	X				
Based on literature	X				
Teacher educator's advice	X				
How were the procedures of lesson planning conducted and how were lesson plans used in lesson performance?					

Changes in teaching and learning methods	X	X			X
Changes in learning contents	X	X			X
Cross-curricular connections	X	X			X
Co-creation of learning material with students	X	X			X

Table 5: Frequencies

Source/ Research question with frequencies	5-high	4	3	2	1-none
How the new curricula assist mutual development of ICT didactical and technical competences?					
Technical skills	6	0	0	0	37
Shift in teaching	34	3	0	0	6
Shift in professional learning	34	3	0	0	6
How the project work based on SEVERI foster learning objectives?					
Autonomy	0	0	39	4	0
Inquiry	0	0	30	13	0
Creativity: Multimodal presentation and communication	34	7	2	0	0
Creativity: imagination, originality	10	6	27	0	0
Creativity: high order thinking-finding	0	0	24	4	15
Innovation	17	3	0	0	23
How is the project idea based on the needs assessment in pedagogical practice?					
Based on own teaching practice	32	0	11	0	0
Shared experiences with other students	7	0	36	0	0
Based on literature	4	0	12	27	0
Teacher educator's advice	0	3	0	0	40
How were the procedures of lesson planning conducted and how were lesson plans used in lesson performance?					
Changes in teaching and learning methods	34	3	0	0	0
Changes in learning contents	20	5	6	0	6
Cross-curricular connections	40	3	0	0	0
Co-creation of learning material with students	0	11	2	30	0

FINDINGS AND DISCUSSION
The findings based on the data presented in the table 5 are discussed within research questions.

How is the project idea based on needs assessment in pedagogical practice?
Altogether 32 students made needs assessment strongly based on their **own teaching practice** with analysis of their classrooms. Almost 7 students had selected the topics almost exclusively based on **sharing experiences in a collaboration and discussion** with fellow students. Illustration from the student's journal is presented to support this factor: *"learning collaboratively and sharing when discovering and inventing provides me with a good insight in problems when dealing with special needs".*

36 students reported collaboration as important when discovering and selecting the idea. In the process of idea development some students (4) had predominantly used **information from the literature.** Student who made decisions strongly based on literature had written: *"examples from literature were very illustrative when showing approaches in teachers work for special needs education".* 39 reported the modest use of the literature. Only in extreme circumstances would the **teacher educator's advise** students (3) about an idea development process.

A qualitative study by Williams explored the working environment of teachers to identify what needs are to be addressed when developing an ICT learning environment for special educational needs. It considered the main issues in everyday work, the information needs of teachers, new experiences with ICT and knowledge of ICT impact upon the special educational needs learning environment, facilities and tools within environment (Williams, 2005, p. 540). During their daily work, teachers need most: familiarisation with the administrative procedures and policies, lesson plans and ideas, how to evidence work undertaken, and current level of areas in the curriculum that every individual student still needs to cover (ibid.). Project work was focusing on lesson plans and ideas, which form an integral part of teacher's daily work. Project topics were selected exclusively by students, which is a prerequisite for quality learning that is based on the motivation and interest of every individual student. Students prepared projects which included the deliberation on and proposals of creative ICT use in resolving different problems and dealing with different topics in inclusive classroom. How students

created their project idea was observed from journals. Student teachers mostly decided to work on specific topics needed in their classrooms.

How the project work based on SEVERI foster the learning objectives of autonomy, inquiry, creativity, and innovation in ICT implementation in inclusive classroom?
The realisation of the learning objective **autonomy** 39 students acquired level 3 and 4 students acquired level 2. For the **inquiry** all together 30 students acquired level 3 and 13 students acquired level 2. The **creativity** was highly achieved by 34 students regarding multimodal presentation and communication. 7 students achieved level 4 and 2 students achieved level 3. Creativity as imagination and originality was achieved by all students: 10 students at level 5, 6 students at level 4 and 27 students at level 3. Creativity as high order thinking-finding was achieved by 24 students at level 3. The **innovation** component was identified by 20 students.

Educational technology course aims at assisting the development of teachers' professional dimensions, which was captured within four learning objectives. The realisation of the learning objectives of autonomy, research, creativity and innovation were reflected in journals. The creativity and innovation was analysed from lesson plans and learning material. In focus groups students discussed the dimensions of professionalism. Focus groups were intent in particular, on exploring the unknown and on addressing the potential experiences which a teacher may expect in the future, using ICT for pupils with special learning needs. In their essays, the four learning objectives were analysed, regarding ICT use in inclusive classroom and teachers' professional development for ICT. In the Project work students were asked to look for and to expose the issues of discussion in their own pedagogical practice, and to include their pupils in the preparatory operations. At idea creation stage, they created the idea, using the different methods. Ideas were focused on the learning contents and on the learning method aimed at integrating children with special learning needs into the instructional environment of the regular classroom. At the subsequent stage, they evaluated their ideas in consultation with their student colleague and fellow teachers in school environment. At this stage, they further developed the idea, modifying it, where applicable. On having fully created the idea, they designed the lesson plan. Within the lesson plan, they planned the learning objectives, methods of teaching and learning, teaching sources, and methods of knowledge assessment. All the students incorporated into the process of preparing learning materials their own pupils who, within the scope of the different subjects, prepared products to be subsequently incorporated into the learning materials and into the SEVERI system. There was a multidirectional cooperation between the teacher and his/her pupils in a single class, as well as the cooperation between the different classes. Topics discussed, and for which the pupils prepared products, were in compliance with the topic of the Project task. Performance of lessons took place during their normal professional work. At certain schools, it coincided with other projects, which the teachers applied as the context within which they implemented their respective projects. The last stage, Project exchange, enabled the students to mutually exchange lesson plans and learning materials. The last stage had involved a consensus of all the persons involved, who agreed with the publication of products and with the mutual exchange and incorporation into teaching of all participating teachers (part-time students) within the SEVERI system.

The analysis shows that course work fostered students' development and understanding of the importance of **autonomy**. Student teachers are well aware that the field of ICT and inclusive education is the area where they feel weak and need the constant support of their professional colleagues and experts. They find the collaboration within the school environment as precondition for teaching an inclusive classroom. 39 students acquired level 3 and 4 students acquired level 2. They agreed that course work empowered them in acquiring a research orientation and **inquiry**. Although the inquiry strongly influences the professional lives of teachers, in Slovenian school arena hasn't been very popular (Cencic, 2006). Students expressed the concern that they have to work more in order to apply the research orientation and inquiry in their every day work. All together 30 students acquired level 3 and 13 students acquired level 2. Regarding **creativity** students showed good results as far as multimodal presentation and communication were conceived and also in terms of imagination and originality. Creativity with regard to high order thinking-finding was not well expressed. **Innovation** in teaching and learning was enhanced with Memorandum of lifelong learning (Cencic et al., 2008). The innovation component was identified in 20 students' lesson plans and learning materials and documented in journals. In journals and essays the innovation was augmented and supported with descriptions of teaching before Project work. The innovative approach within a Project work was dealing with inclusive classroom organisation, lesson ideas, and learning material. Students pointed out the conditions for innovative approaches in teaching at the system level, organisational level and as individual himself/herself. Among them they find most important individual's capacity for innovation, which depends strongly on competences teachers develop in their initial preparation and further professional training. In students' opinion innovation is strongly connected with creativity. Fewer students stated that innovation is connected with inquiry and autonomy. Within the project work the innovation capacity was identified by almost half participants (20 from 43 students).

How were the procedures of lesson planning conducted and how were lesson plans used in lesson performance?
Almost 30 students needed assistance of teacher educator and acquired level 2, 11 student level 4 and 2 students level 3. Cross-curricular lesson planning was well applied by all students. Changes in learning contents were applied by 37 students. Analysis of lesson plans and learning material showed that students which show capacity for changes in learning contents were able to identify the gaps in study contents and learning materials for pupils. Changes in teaching and learning methods were applied by 37 students. Students defined teaching and learning methods which foster the ICT use in classrooms and plan them in alignment with learning objectives and outcomes.

The link between lesson planning and lesson performance was crucial (Gülbahar, 2008). As early as in pre-service education, teachers need to be trained in planning and organising pedagogical activities which hold an important place in a teacher's daily routine. A major part of a teacher's decisions are adopted by him/her already in the procedures of lesson planning, before the actual teaching commences (Berliner, 1986). In lesson planning and performance, the teacher takes as basis the integral insight into a wider context, within which the teaching and learning of an individual with special educational needs takes place. The data was gathered from journals, lesson plans, and essays. With regard to the conduct of lesson plans, they were observed according to changes in teaching and learning methods, changes in learning contents, and cross-curricular connections. Special focus was on co-creation of learning material with students and how teachers planed participation of students in the process. During the process, the students kept their respective reflection journals, wherein they reflected on the set learning objectives and their realisation. Specific attention was aimed at linking the learning substance with the students' own pedagogical practice, and at seeking authentic ideas about incorporating ICT into instruction. In the light of the experiences gained, the students were able to effectively identify problems within the context of the school and class, by taking into account the systemic incentives and hindrances requiring ICT solutions. Among the five areas which were investigated, student teachers had most difficulties when applying co-creation of learning material with students.

How the new curriculum assists mutual development of ICT didactical and technical competences?
The data for this research question was gathered from journals, focus groups and essays. The coding sheet included the identification of activities in which students only developed on a **technical skills level**. 6 students were acquiring only technical competences with no didactical competences and shift in teaching, nor professional learning. When ICT was used for planning and conducting changes in teaching leading to transformation of teaching which was registered as **shift in teaching**. 34 students achieved level 5 and 3 students achieved level 4. If student teachers made a shift in their professional learning with ICT, a **shift in professional learning** was registered. 34 students achieved level 5 and 3 students achieved level 4.

Shift in teaching and shift in professional learning were linked; when acquiring shift in teaching also shift in professional learning was acquired. Technical skills level was strongly present at the beginning when students were having difficulties in adapting to the approach of project work. Gradually they were introduced to the comprehension of issues of creativity and innovation in using ICT. This approach stimulated integral treatment and solutions, aimed at overcoming technical hindrances. Some students encountered severe technical difficulties, which were resolved by harnessing a range of experts, as, for instance, computer science teachers at schools, pupils at schools or their own children in their home environment. Additional tutorials were made available so that teachers were able to get help in preparing the computer-supported materials. Study findings showed that this particular approach to teaching and using ICT in lessons – aimed at using ICT in inclusive education – was productive and facilitated a high level of transferring knowledge attained to the teacher's work. The shift in teaching was influencing lesson planning and teaching. From the students' journals some illustrations are extracted: *"introduction of ICT had changed my approach to lesson planning and conduction"*, *"ICT help me to fell empowered in daily routine"*, *"the start was very demanding for me since I haven't got a computer for a long time ... after acquiring basic skills my feelings are good and I can clearly see the advantages ICT could bring into my daily work"*.

The shift in professional development and learning was described by student teachers as *"positive channel for a change"*. Conditions for a change included: application of newly attained knowledge to the teacher's own teaching, taking as basis the teacher's own experiences, and stimulating motivation for inquiry and creative work (teachers themselves seek for study contents and develop creative solutions for their actual environment). This resulted in self-efficiency in technology acceptance process (İşman, 2009). In the essay prepared during the final knowledge assessment, the students demonstrated the thoroughness of approach to dealing with the issue of using ICT for special learning needs.

CONCLUSIONS

Digital literacy is considered as one of main enablers for the participation in the knowledge society (Istenic Starcic & Turk, 2010) and has to be provided based on the principal of equal opportunity. The educational technology has an important role in facilitating digital literacy of students and teachers. Within the renewal of the Educational technology curriculum, the ICT competences had been recognised as important in the process of the formation of teachers' professionalism which is based on autonomy, inquiry, creativity and innovation (Istenic Starcic, 2009). The project work had been applied to provide the learning environment of "Living practice" for students when developing didactical and technical component of their ICT competences. The implementation of the SEVERI e-learning environment for students with special educational needs took place at two levels: monitoring, observing and studying its introduction in Slovenian schools and planning and conducting lessons based on SEVERI.

The pre-service educational technology course has linked the theory and practice. The work in an IT laboratory was connected with teaching practice in schools. The group of part-time students who participated in the evaluation had a unique opportunity to transfer new knowledge to their day to day teaching practice of their normal professional work. Project idea, lesson and learning material design was based on the needs assessment of pedagogical practice. Evaluation was accomplished through the process of the project work and at final course assessment. The focus was on the lesson planning and lesson performance and on the learning material design and usefulness of the material in lesson performance. In the process of evaluation, students' learning was considered as was the alignment of learning objectives, activities and outcomes. Student teachers develop expertise in using ICT for their pedagogical work, both planning and teaching, were provided with the opportunity to contribute to increased equality, diversity and inclusive education. Inquiry-based learning within the work of the Project facilitated the use of ICT tools, with a follow on effect within the pedagogical context.

Key challenges of educational technology course are to prepare student teachers for:
- Autonomous planning and incorporation of ICT in lesson planning and performance;
- Inquiry and research approach when identifying ICT tools and systems and their application in teaching and learning;
- Creativity and innovation for teaching with ICT, designing learning material and learning environment, which foster creativity of all students assisting variety of individual approaches in creative communication and participation.

This study was conducted to speak to the question of educational technology in inclusive classroom and special needs education. The next step must be taken by teachers-educators providing students with curriculum opportunities to learn necessary competencies for the use of ICT and educational technologies. How they could recognise the conclusions of this evaluation study within their teaching and learning contexts and use them for their efforts within their own situations will impact the generalization of the study.

RECOMMENDATIONS AND IMPLICATIONS

For students to become teachers is essential to understand the potentials which educational technology offer in assisting teaching in inclusive classrooms and for accommodation of students with special educational needs. Students have to be facilitated for reflective action when taking up the role of a teacher:

- that digital divide of young disabled people can be reduced with improved access to computers and internet in the context of school work which could enhance digital literacy and e-participation of students in a society;
- that ICT assisted learning environments can be used for fostering student centred teaching and enhancing individualisation with tools for learning and evidencing students learning achievements and progress.

Educational technology curriculum has to incorporate the ICT competences, in conjunction with competences of cooperation, management, organization, and of other generic and subject-specific competences. ICT competences are developed as inter-subject result, as interface of generic and subject-specific knowledge (Istenic Starcic, 2007). Among key teachers' competences ICT competences and competences for inclusive education had been recognised as weak (Istenic Starcic, 2009). The educational curriculum course has to prepare future teachers for recognising ICT as enabler of own professional learning and development and as one of main drivers for change of pedagogical practice for student centred teaching in an inclusive classroom. E-learning environment in the inclusive classroom assists classroom management and facilitates the individual and collaborative engagement and activities in the process of development of abilities, experiences and interests of every individual student.

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EMERGENCE OF EPISTEMIC AGENCY IN COLLEGE LEVEL EDUCATIONAL TECHNOLOGY COURSE FOR PRE-SERVICE TEACHERS ENGAGED IN CSCL.[*]

Hamdi ERKUNT
Bogazici University, Turkey
erkunt@boun.edu.tr

ABSTRACT
Written interaction between pre-service teachers engaged in progressive inquiry using Knowledge Forum in two intense summer courses were analyzed to detect and rank those students in terms knowledge sharing, pressing on for further inquiry and the number of partners they communicated with. Social network analysis techniques were employed to cluster students in terms of their network centrality using a Freeman's betweenness value, where higher values indicated more communication flow occurred through that person. An aggregate score is calculated for each student and they were ranked into four levels of epistemic agency ranging from exceptional to low. Nearly half of the students in both courses ranked in the lowest level of epistemic agency interpreted as following mostly their own epistemic goals with minimal knowledge sharing with few partners and mediating little of knowledge sharing and collective inquiry. There were two to three students in each course with outstanding score in all of the five criteria and the others dispersed evenly from moderate to high. Both courses gave a low network centrality value indicating that the communication was not concentrated over a few individual but evenly scattered among the members. Epistemic agency is defined, and the analysis and rankings are elaborated with tables and charts.

Keywords: Epistemic agency, Knowledge building, Social network analysis (SNA), Progressive inquiry, Cognitive authority and responsibility.

INTRODUCTION
This study analyses the patterns of interaction among college students collaborating in an educational technology course. Students participated in a progressive inquiry in order to advance their explanations of shared problems with verbal and written contributions. Students generated their own conjectures on shared problems within a course that is structured and supported an extended collaborative discussion of student ideas. The purpose of the present study is to identify a specific type of agency assumed by students in the collaborative process of inquiry that ranks them in terms of cognitive authority and responsibility in pursuing collective epistemic goals. Scardamalia (2002) defines this epistemic agency as what emerges when students set forth their own ideas, negotiate a fit between their personal ideas and that of others, and take charge of their own knowledge advancement. The inquiry is brought forth through the interactions of learners with a collective effort towards a shared understanding of their ideas regarding the problems inquired about. Technologies can be designed to structure and support inquiry (Edelson, Gordin & Pea, 1999). In this study, students' collective inquiry relied on socially distributed cognitive resources that were generated by their social interactions in class and online using Knowledge Forum which is a second generation CSCL technology. Students' written interaction was analyzed in order to detect and rank them in term of their epistemic agency ranging from low to exceptional. Social network analysis techniques were employed to interpret interpersonal contact among the student, and k-means statistical analysis was performed to cluster students into four distinct levels of epistemic agency.

Epistemic goals
All students pursue epistemic goals when their efforts are directed for understanding something in school as they may try to meet course requirements or turn their understanding into practice. Traditionally teachers assume and manage the cognitive aspects of thinking and problem solving in the classrooms. In their effort to lead students to mastering a body of preconceived knowledge and skills the teachers usually set the main learning goals, monitor how students fair in making progress, and evaluate the outcomes. A competent teacher may be able to skillful gauge the complexity of their subject matter and streamline their instruction in order not to overwhelm students in reaching the learning goals. Such knowledgeable teachers are not only hard to find but also a deeper understanding usually will take more than just direct instruction (Palincsar, 1998; Bereiter & Scardamalia, 2008). Students who desire to follow their epistemic goals and wish to inquire more for a deeper understanding are likely to be underserved in traditional task-completion oriented classrooms that can spare minimal time and support for uncertain personal outcomes. On the other hand, some pedagogical structures such as self-regulated and co-operative learning and guided discovery (Brown & Campione, 1994) are notable systematic attempts to have more student role in learning. Collaborative learning offer more chances for students to work for a shared understanding as in the cases of project-based learning (Lee & Butler, 2003) and problem-based learning (Evensen & Hmelo, 2000), but neither the projects nor the problems are about idea improvement or knowledge advancement per se, and despite the considerable liberties given to students, their understanding can still be

surpassed by a collective effort through a sustained inquiry towards a shared understanding with new insights that can only come out collectively (Bereiter & Scardamalia, 2008). Bereiter and Scardamalia (Bereiter, 2002; Scardamalia & Bereiter, 1994) have devised a knowledge building pedagogy based on production and continual improvement of ideas of value to a community. Student ideas are offered individually and then improved collectively, where all members share the cognitive responsibility and feel the epistemic agency at varying levels.

Epistemic agency

A number of studies incorporated epistemic agency as an indicator of knowledge creation in collective processes with shared knowledge objects (Muukkonen & Lakkala, 2009), construct for setting, monitoring and evaluating collective learning goals (van Aalst & Chan, 2007), as a heuristic framework for progressive inquiry and a worthy goal for college education (Muukkonen et al, 2005), as an aggregate factor collective cognitive responsibility (Zhang, Scardamalia, Reeve & Messina, 2009), as a capacity for deliberate collaborative work (Damşa, Kirschner, Andriessen, Erkens & Sins, 2010), and as a defining characteristic of groups that decide as a group (Tollefsen, 2004).

Epistemic agency is not merely concerned with epistemological elements, such as just knowledge in itself, but also with the complex combination of qualities that permit a student to deal with knowledge, with learning in collaboration, and to be efficient when learning (Hakkarainen, 2004; Hakkarainen, 2009). The knowledge building model is employed in many schools as well as businesses and organizations with a focus on knowledge work. Epistemic agency is regarded as assuming cognitive responsibility in knowledge building which is more about shared epistemic goals and collective knowledge advancement as opposed to more personal epistemic goals (Scardamalia, 2002).

Metaphors for learning and knowledge creation

Acquisition and participation are two common metaphors for learning (Paavola Lipponen & Hakkarainen, 2004). Individuals are thought to construct their own pieces of knowledge in the acquisition process and the outcome is expected to demonstrate itself as a capability to apply this acquired knowledge in new situations.

Participation, on the other hand, is about taking part in social processes of knowledge construction in various cultural practices and shared learning activities. Knowledge does not reside in individual minds nor does it exist on its own. Knowledge is seen as an aspect of participation in specific cultural practices. Participation is situative with emphasis on durability of individual knowledge.

The distinction between acquisition and participation learning metaphors appears to be a matter of cognitive and situative perspectives of learning. Cognitive approaches emphasize computational models of mind, and the aim is to simulate the way the individual mind operates with knowledge. A cognitive perspective emphasizes *knowledge*, whereas situated approaches emphasize situatedness of human cognition, and participation in interactive, social processes as basic processes in learning. A situated approach emphasizes participation in social *practices* and *action*.

As a new metaphor of learning, knowledge creation dispenses with the dichotomy by emphasizing the process of acquisition rather than the outcomes, and participation in terms of the constant flux of knowing rather than having the knowledge (see table 1).

Table 1. Three models of innovative knowledge communities

	Nonaka & Takeuchi	Engeström	Bereiter
Type of processes focused on	Emphasis on the knowledge spiral, based on tacit versus explicit knowledge.	Emphasis on material object-oriented knowledge activities and practices.	Emphasis on knowledge building with conceptual artifacts.
Source of innovation	Transforming tacit knowledge into explicit knowledge.	Overcoming tensions, disturbances, and ambiguities through expansive learning.	Working deliberately to create and extend knowledge objects.
Scope of framework	Ontological levels (individual, group, organizational, and inter-organizational)	Activity systems and networks of activity systems.	Knowledge-building communities.

(Paavola et al., 2004 p.563)

Knowledge Forum

Knowledge Forum is a second generation CSCL environment that supports the learning of individual students by structuring the inquiry, providing tools for keeping a record of activities, and by pointing out essential phases of the process by using tools that direct the student's meta-cognitive awareness and enhance reflection (Pea, 1993). Knowledge Forum is distinguished from other learning management systems with its promotion of processes such as "defining problems and hypothesizing, researching and collecting information, analyzing and collaborating" (Knowledge Forum, 2007). Knowledge Forum, previously CSILE, has been in development over two decades with substantial research on how to use it to support collaborative work with knowledge (Scardamalia & Bereiter, 1994; Scardamalia, Bereiter, McLean, Swallow & Woodruff, 1989). Knowledge Forum database is completely generated by participants. Notes that are created online are stored as objectification of collective knowledge, which can be searched and reworked by others. Participants can also refer to other notes in the Forum that appear as links within the note, thus forming a visible web of incorporated ideas that mirrors the interwoven and dialogical nature of knowledge (see appendix A). Scaffolds, such as "I need to understand", "A better theory" point to the essential elements of inquiry and allow participants engage in an extended dialog with collectively accessible ideas rather than a mere dialog between minds (Bereiter & Scardamalia 1993).

Progressive inquiry

Muukkonen et al. (2005) devised a model of progressive inquiry as heuristic framework for epistemic advancement. Inquiry is a process of understanding driven by questions and includes certain epistemic elements. Progressive inquiry is based on shared expertise of the community which is enabled by supporting technologies, such as Knowledge Forum. Context is created for students to come up with their initial questions to get the inquiry started. Students set up initial research questions in an effort to satisfy their need to understand. Students are expected to use their own knowledge before consulting information sources and come up with some working theories. This process is likely to make students' intuitive conceptions visible and give them change to see the coherence of their thoughts in their effort to explain their ideas to others. The inquiry process continues with the critical evaluation the ideas for their weaknesses and strengths. Students often will refocus their inquiry by generating subordinate questions and learning more about these questions. The process is more likely to give way to new and improved working theories from this point on. Progressive inquiry can be conceived as an interrogative model of scientific inquiry that lends itself as an appropriate structure for distributed expertise among a community of learners and for the development of epistemic agency and related skills (Muukkonen et al., 2005).

Social Network Analysis

In a community of learners collaborating on advancing their collective knowledge their contributions have strong social components. Social network analysis offers several methods to investigate the flow of information within a group of people by abstracting a distance among them based on their contacts with each other. Each group member forms a node in the network with relational ties that get strengthened each time a member contacts another. The strength of these ties is conceptualized as a geodesic path between members. Some network indicators such as density, centrality and betweenness as well as individual qualities like in-degree and out-degree can be obtained (Wasserman & Faust, 1994).

Communities are formed through the accumulation of relations and influences among participants (Frank, 1998). Sharing and inquiring are two patterns of interaction used in this study. Social interactions of actors in the network were mostly commenting, collaborating, seeking for advice, mediating knowledge and providing social and emotional support. Access to knowledge and other resources is provided by structural context of relationship by means of links. Knowledge Forum is a networked learning environment that provides a shared space to the participants for producing, searching, classifying, commenting on, and linking knowledge together (Bereiter, 2002; Scardamalia & Bereiter, 1994).

Students who share and inquire further can be discerned in terms pursuing personal or collective epistemic goals and the degree of it may be interpreted as a degree of responsibly undertaken for collective knowledge advancement. The more students share their knowledge with more people and root for further inquiry with more people, the higher will be their epistemic agency. Social network analysis offers tools to analyze the density of such student interaction and show how central some of the members are in sharing knowledge and pushing for inquiry. Some members would be a channel, perhaps a broker, of information as more people do their knowledge sharing and inquiry through them (Hakkarainen & Palonen, 2003).

Knowledge Forum also offers some social network analysis tools for students to monitor various social aspects of their inquiry process. Reading contributions, referencing or improving on them via building on or adding annotations are readily analyzed as social contacts. Density of these contacts indicates whether the social contact is limited to among a few people or relatively dispersed among the community members.

METHODOLOGY
Students logged on the Knowledge Forum to read contributions written as notes and to create and/or revise their own notes and annotations. Student can either create a stand-alone new note or build on another note implying that this particular note is further work on the idea embedded in the note it builds on. Annotations, which are similar to sticky notes posted on objects, can be written by students in any number in any note. The first note of a view, which is a thematic organizer for notes, necessarily appears as a stand-alone note but students can also add a note in the same fashion to start a new line thought but such notes are not linked directly to another member. New notes that appear as stand-alone notes may either be meant for all to see or a creation of the author for various reasons. Such notes were not included in the analysis because they are not directly related to another member (see appendix A).

Students' written interaction as notes and annotations were analyzed to detect and rank those students in terms knowledge sharing, pressing on for further inquiry and the number of partners they communicated with. Student notes and annotations are relational because they can be interpreted as to be from one student to another. Social network analysis techniques and k-means clustering statistical tool were employed to rank students within each course in terms of their centrality using a betweenness value in the network, where higher values indicated more communication flow occurred through that person. An aggregate score is calculated for each student and they were ranked into four levels of epistemic agency ranging from exceptional to low.

Data collection
The data were collected over two summer courses taught one year apart with 23 and 21 students in each one where students exchanged 429 and 687 distinct written messages respectively online over a six week period, in addition to engaging in a similar verbal discourse three times a week for two consecutive 50 minute class meetings(see appendix B). Students worked on six problems of understanding about educational technology for the entire semester. Students in this study were of similar age and education with only gender as an evident demographic characteristic.

The course
Despite being thought a year apart, both courses were taught quite similarly. Students were introduced to knowledge building pedagogy and Knowledge Forum software at the beginning of the course. The instructor provided support on how to work with Knowledge Forum. A total of six problems of understanding, four about education and two about educational technology, were introduced in the first week of the course. Students were informed that they were expected to work on all six problems throughout the semester and their learning and understanding depended on their verbal and written contributions. Problem introductions were followed by students offering their ideas in their effort to understand and explain the problem in question.

Aligning assessment and learning with student goals in CSCL situations using electronic portfolios have been found to be a useful strategy (van Aalst & Chan, 2007; Erkunt, 2009). Students also prepared three portfolios using Knowledge Forum during course. They selected a number of best notes among all the notes organized thematically by the problems they worked on, explained how these notes affected their thoughts about the problem and they identified if and when a number of knowledge building principles were discernable in the notes selected based their collective process.

Knowledge Forum is designed to support and sustain idea improvement and makes the ideas and the process visible and workable with tools, such as scaffolds and referencing, to assist students in writing and reading contributions. (See the appendix A for a pictures of Knowledge Forum View, Note and Annotation, and appendix B for an exemplary discourse on "The good, the bad and the ugly" sides of technology problem).

Problems of understanding set the scene for the course because they were believed to be the sort of questions addressing the fundamentals of educational technology and inquiring about them would require students to get deeply into the subject matter and into relevant research in various domains (Bereiter, 2002). A computer in the class was used to access Knowledge Forum and project it on the screen. Students were asked to give their

impression of the course at the beginning, the middle and the end of the class. Here is how a student describes how the class was run[*]:

> We start discussing about either one of the topics in Knowledge Forum or any other topic that happens to be talked at the moment. None of us is afraid of being criticized because no matter what one says, true or false, he will be criticized by all others in the class anyway. The criticism is never aimed for belittling or justification. The only aim is to be able to get the best possible understanding of what is said.

Another student described the state of the mind in the course as follows:

> In the beginning of this term I thought we would be expanding our horizons by discussing the topic during the term in a way we have never discussed before. It turned exactly the same way but I suffered in the process a lot more than I anticipated. Simply because, feeling the necessity to say something about the topics both in the class and in the (Knowledge) forum all the time catches one off guard even in some unexpected occasions as the mind gets busy with the problems. Now I see that this was how we constructed our knowledge.

Another student depicted his experiences shortly after the end of the course about the knowledge building process as follows (the student alludes to entire knowledge building process by referring to Knowledge Forum):

> Thinking is more of an involuntary action for me now. I already was a careful person and I paid attention to details wherever I was, intending on getting a deep understanding. But Knowledge Forum made that deeper… Perhaps we were already knowledge builders in life but we didn't know about it. This course made us aware, that's all. But writing about this to Knowledge Forum is definitely a product of this class.

Coding
All the occasions of a member contacting another either via a build-on note or an annotation assumed to count towards the calculation of an outdegree score for that participant. All the written exchanges among the members were coded either as knowledge sharing (KS) or as attempts for distributed regulation inquiry (DRI) which means they have demanded further inquiry on a particular matter. Few notes that did not seem to be relevant to the context were excluded from the analysis. 30% of the notes and annotations were randomly chosen and independently rated by another person yielding a 70% Kappa value.

Most of the written student activity was about sharing what they presently knew and pressing on for further inquiry. Information provided as personal ideas or to support material usually in answering a question of declaring personal opinion on matters was coded as knowledge sharing (KS). Here is some knowledge sharing examples:

> As social needs change what's worth learning will also change. Therefore things worth learning may differ among cultures and societies.

> I also think that technology is unavoidable but I disagree with the claim that technology may have lost purpose and gotten out of our control because technology does not get out of control. It exists to make people's lives easier and raise the quality of life. If people use technology for their own evil goals, however, that only shows that people are out control not technology.

Distribution of regulative inquiry (DRI) is about clarifying meaning, spotting what is known and needs to be known as well stating that a satisfactory level has been reached in the inquiry. Here are some examples codes as DRI:

> A very nice point of view, indeed. You question if "humanity was able to reach its expected humanistic goals by cars, trains or planes." Do you really think we use technology to reach those goals? Or what do you really mean by expected humanistic goals?

> What about things that we learn out of necessity, would they be considered automatic learning? For

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[*] Student quatations have been translated from Turkish with minor corrections leaving the rest intact.

example, is learning to get in line when waiting for a bus in the bus stop an automatic learning according to your theory?

RESULTS

Students were a mixture of junior and senior pre-service teachers in both courses majoring in English language teaching, primary and secondary science teaching and guidance and counseling. They took this educational technology course as an essential requirement of their programs. Their average age was 22.2.

The first course (G1) had twenty three students with twelve male and eleven female students. Students contributed 424 written pieces with 339 coded as KS and 85 as DRI. The second course had twenty three students of which fifteen were males and six were female who contributed a total of 687 pieces out of which 561 coded as KS and 126 as DRI.

30% of contributions of each course were randomly selected and independently coded which yielded an inter-rater reliability rating of r =.68 (p<.001).

Social network analysis techniques were employed for obtaining density and centrality measures. Density refers to the number of observed links (network ties) in a network divided by the possible number of connections (Borgatti, Everett, & Freeman, 1999, p. 78; Scott 1991, p. 74). Connections in binary matrices indicated either by 0 for no connection and by 1 for a connection. Knowledge Forum automatically calculates densities including various factors such as note reading and adding build-on notes. The combined density for build-on notes and annotations gives the relational network density for the group in term of contacting and contributing through others. The densities for G1 and G2 were 52.1 % and 51.7 % respectively. Densities in terms of knowledge sharing and regulation of distributed inquiry were also calculated using UCINET (Borgatti, Everett, & Freeman, 1996) by abstracting each such link as 1 and no link as 0. These adjusted densities for G1 and G2 respectively were 38% and 41.7% (table 2).

Table 2. Density values for each class

Combined density for build on notes and annotations		Density for knowledge sharing and distributed regulation of inquiry	
G1	G2	G1	G2
52.1 %	51.7 %	38%	41.7%.

Freeman's degree of centrality is a measure for network cohesion based on sent and received notes and annotations among members. A general centrality value was calculated that combined incoming and outgoing messages along with directional centrality values for incoming and outgoing messages. In symmetrical matrices all connections were abstracted as 1 whereas in asymmetrical matrices connections were treated as directional from one member to another. The general Freeman's centrality measure for G1 and G2 were found to be 22% and 30% respectively. The directional outdegree and indegree values for G1 were 16.8%, and 20%, and they were 41% and 31% for G2 (table 3).

Table 3. Freeman's centrality values for each class

General centrality value		Directional			
		G1		G2	
G1	G2	Out-degree	In-degree	Out-degree	In-degree
22%	30%	16.8%	20%	41%	31%

K-means cluster analysis is a statistical method for partitioning *n* number of observations into *k* number of clusters so that each observation belongs to a cluster nearest to its mean. In this study number of outgoing knowledge sharing and inquiry demanding contributions were calculated for each student to obtain scores of KS Outdegree and DRI Outdegree. If we think of students as a member of a network where information flows among them, Freeman's Betweenness value is score showing how often a student is in the path from one student to another. A Freeman's Betweenness score for each student both for KS and DRI were calculated. Finally the number students or partners students were in contact with were incorporated as the fifth score, which was taken to indicate how social a student was. A 4-means cluster analysis was performed to assemble student into four homogeneous groups (Hakkarainen & Palonen, 2003). Table 4 shows the cluster centers in 4-means cluster analysis. Appendix C shows all the data used in social network analysis for both groups.

Table 4. Cluster Centers for Relational Measures of Epistemic Agency

4-means cluster analysis	Level of Epistemic Agency							
Variables	Level 1		Level 2		Level 3		Level 4	
	G1	**G2**	**G1**	**G2**	**G1**	**G2**	**G1**	**G2**
Outdegree of knowledge-sharing comments	11	30	15	16	29	41	14	69
Outdegree of distributed regulation of inquiry	3	7	7	2	7	15	1	14
Betweenness of knowledge-sharing comments	20	19	24	4	66	16	70	42
Betweenness of distributed regulation of inquiry	7	20	63	2	55	48	0	63
Number of dialogue partners	10	13	15	7	17	14	11	17
Number of students	12	12	4	4	4	4	3	2

DISCUSSION

The results indicate that nearly half of the students in both courses were ranked in the lowest level of epistemic agency interpreted as following mostly their own epistemic goals with minimal knowledge sharing with few partners and mediating little of knowledge sharing and collective inquiry. There were two to three students in each course with outstanding score in all of the five criteria and the rest dispersed evenly from moderate to high.

Both courses gave a low network centrality value (Freeman) of 22% and 30% respectively, which indicate that communication was not concentrated over a few individual but evenly scattered among the members.

Cluster analysis was most revealing for the exceptional and strong levels of epistemic agency. Ideally, students with high values in the five criteria used for cluster analysis would be expected to rise to higher levels of epistemic agency. The higher F values in the cluster analysis indicate that centrality of the students in terms of knowledge sharing (KS) and distribution of regulative inquiry (DRI) were more effective in clustering. Therefore, cluster analysis is only used for clustering the group and not ranking among the clusters. Ranking is done in terms of combinatory ranking of each variable, namely number of partners, centrality of the student in KS and DRI, as well student's their Outdegree of KS and DRI (see table 3 for constructs used in ranking).

Outdegree of KS indicates how many contacts a student made in an attempt to share his knowledge with others. Outdegree of DRI, on the other hand, indicates how many contacts are made in an effort for further inquiry by a student. Freeman's Betweenness value indicates how central a student is in term of KS and DRI in the network.

Some discerning attributes of levels of epistemic agency are given below and compared in table 5.

- **Level 1:** They mainly advance their own knowledge with low knowledge sharing, few dialog partners, low mediation of knowledge and interaction (betweenness).
- **Level 2:** They assume some responsibility for others. Relatively higher knowledge sharing, more dialog partners and higher betweenness.
- **Level 3:** They assume considerable responsibility for knowledge advancement. They have high betweenness value, indicating systematic effort for other to go deeper and clearer in their explanations. They have high knowledge sharing and high number of dialog partners.
- **Level 4:** They have higher or the highest scores on knowledge sharing, distributed regulation of inquiry, number of partners and cognitive centrality.

Table 5. Epistemic Agency Levels

	1	2	3	4
Knowledge Sharing	Low	Moderate	High	Excellent
Mediation of Knowledge and Interaction	Low	Moderate	High	Excellent
Number of Dialog Partners	Low	Moderate	High	Excellent
Knowledge Advancement Goal	Personal	Some interest in nearby members	High collective responsibility	Exceptional

Even though this study conceptualized epistemic agency from the perspective of knowledge creation, it is still considered to be an individual quality that appears to be more of a collective nature. In other words, epistemic

agency is a relational phenomenon that emerges between people rather than within (Hakkarainen & Palonen, 2003) when active networking efforts of the students are taken into consideration. Hakkarainen and Palonen (2003) suggest that a sophisticated knowledge sharing approach is where epistemic agency shows itself, nevertheless distributed regulation of inquiry should probably count as much for it may very well indicate a desire to for deeper understanding even though it has more of personal tint than knowledge sharing.

Bereiter and Scardamalia (2008) suggest that five dimensions explain most of the pedagogical variety. One of them is the amount of direction in instruction where teachers set most of the learning goals, manages the process and appraise the outcome vs. students themselves doing more of the cognitive labor that are essential to understanding anything. Levels of epistemic agency depicted here seem to indicate how much of the cognitive responsibility is assumed by learners. Another dimension is variation of instructional focus from individual to collective. In this study, the instructor presented students with some fundamental problems of educational technology and encouraged students to engage in knowledge building discourse with students' ideas setting the agenda over an extended dialog in class and in Knowledge Forum. Students were instructed about and directed towards idea improvement. A few of them excelled in sharing and inquiring collectively, more than half settled for their individual goals and contacted only a few others with little to share and inquire about in writing. Some students ventured to write more than others. Some even got very good at it and became a conduit of information among the rest. Both courses had lively and inquisitive classroom discussions and students frequently complained that they find it hard to write their ideas even though they kept up with reading most of notes.

Epistemic agency is conceived in this study from a knowledge creation perspective of learning but the stronger forms are still an individual socio-cognitive quality and it is not necessarily a shared capacity as suggested by Damşa et al. (2009) that comes out when groups collaborate on creating knowledge objects. Epistemic agency is seen here as an individual quality which is mostly a function of epistemic goals, and as goals become collective the agency may shift to serve more for these collective goals.

Limitations of the study
This study is an attempt to identify epistemic agency an emergent construct among a community of learners interacting through written exchange of contributions towards advancing their knowledge. They have pursued individual and collective epistemic goals with an apparent mix of both in their effort to understand something. Knowledge Forum served as a public idea workspace. Some student contributions were posted as stand-alone notes that appear by itself in the Forum. These notes are excluded in the social network analysis because their lack of any relational ties to another member. Such stand alone contributions are presumably not posted for anyone in particular but for the poster himself. There seems to be not a useful way of including such stand-alone contributions at the moment as a social factor even though the researcher believes that it is most probably meant for all to see.

Another limitation is with the 4-means cluster analysis employed to group the means into four levels, but the resulting ranking was only reasonably descriptive for the high or exceptional epistemic agency. Low level categories did not match the construct qualities of betweenness, outdegree and number of partners. This situation is remedied by ranking of clusters based on the constructs assuming that freeman's betweenness values for knowledge sharing and pressing on for further inquiry were prominent attributes of epistemic agency. Therefore medium and lower epistemic agency ranking was modified accordingly.

Students in this study were engaged in a socio-cognitive effort to understand the problems presented in a collaborative environment by design. They participated in collective knowledge creation activity that is quite uncommon for school situations. The instructor/researcher has considerable experience to work with traditional students and helped them adapt to collective knowledge creation by designing and fostering a classroom culture that encourages collective work and a wide variety of ideas. Those students who ranked high in epistemic agency cannot clearly be discerned as whether they were knowledge builders or such a classroom environment made them shine such a quality. Despite the fact that epistemic agency is taken to be an emergent construct this study, the conditions that gave rise to it were not taken into account at all. Hakkarainen (2009) suggest that the knowledge building framework is not sufficient to turn out a knowledge creating community unless social practice of that community is also changed and supported. For descriptive purposes it should be added that a willful instructor with increasing experience in becoming a knowledge building teacher had taught these courses and constantly worked at keeping the ideas in the center, fought off the resistance to take over responsibility for learning both individually and collectively, set up and maintained an atmosphere of idea improvement despite early and strong personal tint in student arguments towards the bearer of the idea – a cultural factor no doubt for trust is valued attribute that is hard to gain and put the test constantly in this culture. The instructor put his effort to establish a knowledge practice and worked towards gradually shifting the epistemic agency more to the

students who almost invariably found his courses very different and strangely appealing in the beginning, surprised that their impressions were even asked to be heard in the first place, and generally ended up appreciating how valuable and fun was to think not only about things but about thinking as well.

Structural holes are conceptualized as barriers for network members the crossing of which will privilege that member with a competitive advantage simply because that member has access to weak ties in the network (Burt, 1995). Hakkarainen and Palonen (2003) suggested age and education as probably structural holes in group engaged in progressive inquiry. Students in this study were of similar age and education with only gender as a prominent demographic characteristics but that was not regarded as a barrier. Presumably students in this study may have had foreseen some benefit to being a prominent channel of information flow their community but the study did not incorporate any specific structural hole as a factor.

The role of the Knowledge Forum in this study is considered as an epistemic technology that "transforms students' intangible ideas into digital entities that can be further articulated, shared, interlinked, and extended in long-term processes" (Hakkarainen, 2009), a technology that embodies epistemic entities or artifacts that are still have a capacity for further and novel lines of inquiry because they are materially embodied and knowledge intensive objects. Nevertheless these epistemic objects give a sense of incompleteness that sets them apart from a thing like appearances of things and tools of daily life. Epistemic objects seem to be in a process of continually defined and redefined with more properties added in time and they are stand ins for the lack of more basic objects (Knorr-Cetina, 2001). Knowledge Forum gives them a more object like quality ideas can be represented as text, pictures and videos.

CONCLUSIONS

Epistemic agency as an emergent construct can be measured if the student contributions are classified as sharing or inquiry and using 4-means cluster analysis seems to be sufficient for classifying the degrees of epistemic agency. The ranking of the levels, however, is most healthily done from the construct as knowledge sharing betweenness score seem the most meaningful as an indicator of a channel or broker that links strong and as well as weak ties. Distribution of regulative inquiry is suggested as the second tier for ranking the epistemic agency because pressing on for further inquiry is essential for collective efforts. Outdegree value of knowledge sharing and inquiry ought to contribute close to each other. Number of partners is also quite significant in the sense that the wider the network links the more likely a member is to be a broker of knowledge crossing the structural holes.

The question is, of course, whether the study investigated is a meaningful categorization for epistemic agency. If the epistemic agency is the cognitive authority and responsibility for knowledge advancement (Scardamalia, 2002) and if it is more likely to show itself through knowledge sharing mainly because that is when students contribute to the advancement of the collective knowledge of the class, then the written communications could provide a good unit of analysis as students seem to spend considerable effort to write and compose their thoughts. Their efforts are directed at providing some kind of explanation about the general problem or a part of it as the content analysis for one of the groups for their object of inquiry shows it to be 73% explanation, 15% inquiring about the problem and 12% providing information (this analysis of object of inquiry was only performed for group one). Collective efforts are relational and knowledge building is a collective endeavor where social network analysis seems like an appropriate tool for measuring relational ties. Ideally density of a social network is a good measure for the amount of contacts in a group especially in writing which could be dispersed longer time frames. Freeman's centrality is very useful for showing the concentration of contacts, which should be not be to high if the knowledge creation effort is dispersed among the members. Freeman's Betweenness value, on the other hand, shows how many times a member appears in the path between other two members and is quite relevant for epistemic agency as Hakkarainen and Palonen (2003) suggest because higher scores mean that member being a channel between other members as they share and inquire. Higher betweenness may bring an advantage to a member as he is more likely to learn about new knowledge that will contribute to innovations concerning the problem at hand. Structural holes may be more apparent factor in more heterogeneous group engaged in collaboration.

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APPENDIX A. Knowledge Forum, notes and annotations
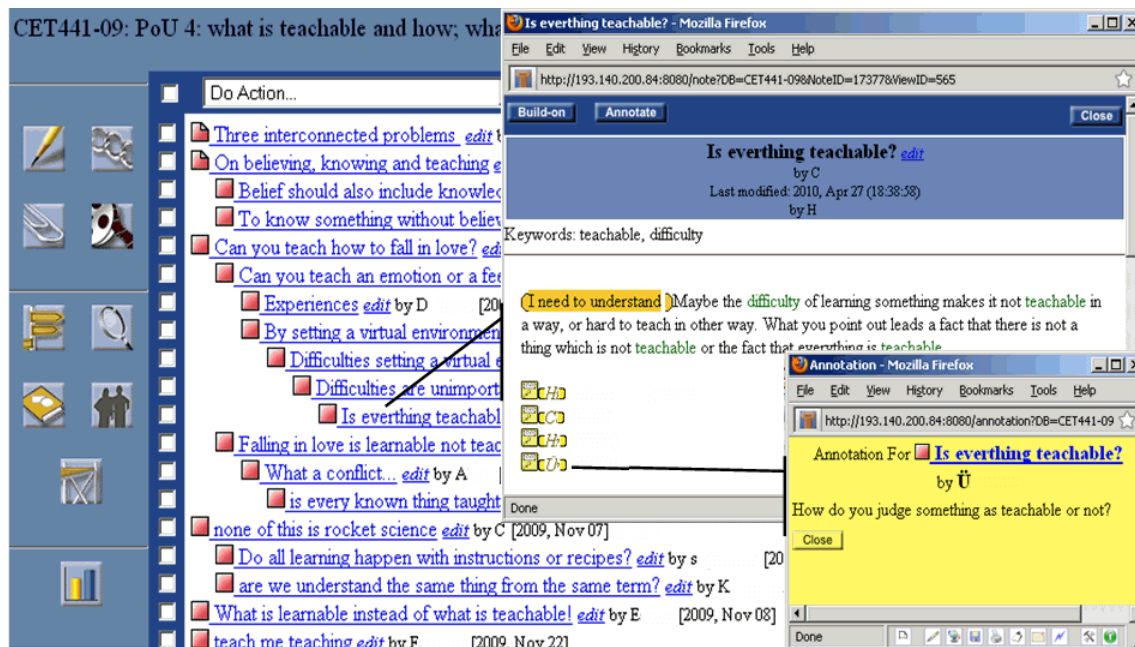
APPENDIX B. A section of inquiry reproduced from Knowledge Forum

This particular piece of discussion took place within last ten days of the intense summer course. Names are left as initials and indentations indicate they are build-on notes. Italicized text within bolded brackets are the scaffolds used by the students. Underlined texts between the parentheses are the clickable references for other notes in the database. The text blocks in italics are the annotations made in the immediate note above. These notes have been translated from Turkish with minor corrections leaving the rest intact.

Instructor	**Problem of understanding: The good, the bad and the ugly.**
	It appears that technology, whatever that is, creates just as many, if not more, problems than it intends to solve.
	Besides the aforementioned paradox, technology is also attributed an agency; an entity that can create a difference by itself. This could be a misunderstanding language may be forcing on us, but maybe there is some truth to it.
	Moreover, technology is thought of as value-free; good with the good and bad with the bad. Is that really so?

Last 10 days of a 35 day period
....

F. K.	**Even if what I said is true, mine is not the only truth. [2009, Jul 24]**
	[*My Theory*] It seems we are stuck with certain ideas in this discussion: "technology is good itself but we misuse it", technology is out of control not us, "technology has side effects", technology serves capitalism, "the problem is out of our hands and technology does not make you lazy" etc… All of them have some valid points. That is, they all can be considered right from a certain point of view. Our problem, however, is over generalizing. We seem to think only of telephone, TV, computers, weapons and such when thinking of technology. If we could only think about drugs that heal, homes we live, drinking water in Japan, clothes we wear and foods we consume as technology as well, then perhaps we can judge technology better. Therefore, all of the above points of view can claim that they are right, unless it is really obvious, but no one can say that only theirs is the truth.

F. C.

I can't decide [2009, Jul 25]

[*Putting our knowledge together*] Even if I agree with him (Even if what I said is true, mine is not the only truth) that a few examples aren't sufficient to show whether technology is good or bad, just claiming either way does not necessarily make technology good or bad. The opposite could also be true. Thus it seems difficult make a definitive judgment.

T. P.

Definitive?? [2009, Jul 26]

I don't think our discussion here is about making definitive judgments. Obviously a topic with clear-cut answers would not naturally come up in this course. I see nothing wrong with everyone making up their own minds. 90% of our lives exclude any sort of definitive judgment. Let it be same here.

M. K.

The good is here but can't find the ugly anywhere. [2009, Jul 28]

[*This theory cannot explain*] Is this the point of this discussion? None of the notes here claims to be the only truth, and our friend who started this discussion says it isn't so here (Definitive??). We are just trying to question the ideas so that we can better see the good, bad and ugly sides of technology. This effort expands our minds and prepares us for persuading others about or refuting the new ideas. We can continue our discussion outside the class 7/24 and that is the good side of technology. The bad side, on the other hand, is that writing this note leaves me with a stiff neck and bloody eyes late at night. I can't decide about the ugly side yet. Should we wait for someone to offer their only truth?

G. P.

Could this be the ugly side? [2009, Jul 29]

[*A better theory*] Perhaps we can consider our case of not accessing to Knowledge Forum yesterday due to a technical problem as its ugly side. Technology failed all of us. Our technological Knowledge Forum was interrupted because of technology.

F. K.

This may be more of disadvantage than the ugly side. [2009, Jul 30]

[*Different opinion*] It may result in bad consequences but we may not be able to generalize from it. The real problem appears to be our unconditional dependency on Knowledge Forum. We should prepare ourselves for such occurrences if we all accept this system with its good and bad sides. This is similar to services of a government agency coming to a halt due to technical problems. Since we are not going to give up Knowledge Forum just for this, we must therefore be prepared and have alternative solutions.

F. C.

I don't think so [2009, Jul 31]

[*Putting our knowledge together*] As a friend points out here (Could this be the ugly side?) I don't think such a technical foul up can be regarded as ugly because all the good and useful things may have imperfections. And it was a temporary problem and was fixed quickly.

T. S.

No offence but there is an ugly side. [2009, Aug 01]

[*I need to understand*] Luckily we were back on quickly in our case (This may be more of disadvantage than the ugly side) but what if the problem was prolonged, say, a government system was down a long time thereby disrupting many necessary and vital

functions only because they were dependent on computers, would we still not call it the ugly side? What if, for example, we need a print out for a course project written only in computers just before it is due only to find out that our work is all damaged beyond recognition when it last saved. We would have nothing. Can we still not claim this as the ugly side of technology?

G. P. | **This would be the ugliest. [2009, Aug 02]**

[*Putting our knowledge together*] As our friend says in the note (No offence but there is an ugly side) the ugly side reveals itself much better when we expand the situation outside our course, because it scary even just to think about how our lives would have been paralyzed if all the information in the cyberspace evaporated due to technical problems.

F. K. | **Points of view. [2009, Jul 30]**

[*Putting our knowledge together*] In fact, as I have said before, we won't be able to make definitive judgments about technology such as it being good for certain things therefore indispensable or it being harmful one way of another thus should be dropped immediately. Nevertheless, as you also wrote in this note (The good is here but can't find the ugly anywhere), here we learn about alternative ideas and develop various points of view. I think that the beautiful and the ugly sides of technology will remain relative to the person except for, perhaps, some obvious cases. As I also mention in my course impressions, not only we have learned quite a few new things in this process but also we developed lots of different skills. I think this turned out to be very good.

S. K. | **If we were to summarize it all… [2009, Aug 03**

[*My Theory*] I don't understand humans. First they invent bullet-proof vest and then comes the bullet that penetrates that vest. I think we have to consider technology from this perspective as well: it is a field that progresses by disproving itself. Newest innovation discards the previous one. We are engulfed in pollution and chaos. Of course, we humans are the ones doing it. I think we are now well beyond seeking the useful but rather pursue the fantastic. I think the problem that is source of our problems.

M. P. Dear S. K.. Don't you think that now we see this situation as normal? They even show the pollution as innovation. It is true that it a field progressing by disproving itself and for now any other solution is not in sight, but just for now. I am hopeful for the future :)

O. A. I think it is quite normal for humans to discard the older technologies and replace it with new ones. I don't think we should call it neither pollution nor chaos. This is how technology got started: it aims for continuous progress, for the highest peaks

M. P. It true that we are in continuous progress in the field of technology but it is also quite clear that we will stumble upon the hole we dug in this very progress. No need to empty the world in the name of progress (I refrain from using harsher terms here since we are in a virtual environment). We have to be more careful with our steps

APPENDIX C. Data used in social network analysis for both groups

		Size of network				Knowledge-sharing network				Distributed regulation of inquiry				Levels of epistemic agency	
ID		Dialog partners		Indegree		Out-degree		Between-ness		Out-degree		Between-ness			
G1	G2	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2
01m	01m	18	4	17	11	21	5	48	12	7	1	33	0	2	1
02f	02m	19	4	41	4	31	7	76	0	13	3	61	0	4	1
03m	03f	20	4	27	7	42	6	55	2	2	3	60	7	4	1
04m	04f	15	9	15	7	5	16	19	5	15	3	22	6	1	1
05f	05f	11	7	18	7	9	10	16	0	4	2	1	0	1	1
06m	06m	12	12	9	27	24	30	18	11	0	3	0	9	2	2
07f	07m	18	7	18	7	14	18	11	4	13	0	58	0	3	1
08f	08f	16	2	17	4	17	3	25	0	2	1	11	3	2	1
09m	09f	11	15	12	51	20	64	29	49	5	17	20	76	2	4
10m	10f	17	0	28	2	29	24	37	0	8	3	55	0	4	1
11f	11m	12	11	16	30	19	24	64	15	2	3	0	2	2	1
12m	12m	10	18	8	66	12	74	62	34	1	10	0	50	1	4
13m	13m	12	16	4	32	12	40	23	14	4	9	30	27	3	2
14m	14m	10	0	5	10	10	11	86	0	1	1	1	0	1	1
15f	15m	8	13	7	6	15	31	31	4	2	3	0	0	1	1
16f	16m	12	14	8	40	3	45	15	19	3	11	0	41	1	3
17f	17m	7	17	2	16	14	23	0	5	2	6	0	3	1	1
18m	18m	12	10	8	15	23	24	85	3	5	2	65	0	2	3
19f	19m	17	16	22	44	7	31	24	12	1	27	62	59	3	3
20f	20m	8	12	6	47	7	48	43	17	1	6	0	45	1	3
21m	21m	7	15	3	39	9	35	24	18	4	12	79	23	1	2
22m	-	6	-	4	-	4	-	20	-	0	-	0	-	1	-
23m	-	5	-	1	-	5	-	1	-	1	-	0	-	1	-

EXPLORING THE BEHAVIOURAL PATTERNS IN PROJECT-BASED LEARNING WITH ONLINE DISCUSSION: QUANTITATIVE CONTENT ANALYSIS AND PROGRESSIVE SEQUENTIAL ANALYSIS

Dr. Huei-Tse Hou
Assistant professor,
Graduate Institute of Engineering,
National Taiwan University of Science and Technology,
Taipei, Taiwan
hthou@mail.ntust.edu.tw

ABSTRACT
Project-based learning using online learning environments is becoming increasingly popular. To in-depth explore the behavioural patterns and limitations faced by students in project-based learning where online forums are used. This study conducted an empirical case study of an online project-based learning activity in a management course, in which 70 college students participated. The study integrates two analytical approaches: quantitative content analysis and progressive sequential analysis. The analytical approaches allow researchers to explore and visualize the content and patterns of participants' online project learning discussion behaviours. The results indicate that learners' limitations include poor time-management and insufficient initial data collection. The students also demonstrated a lack of proper data evaluation processes and sufficient comprehensive analysis. The limitations are in-depth discussed and suggestions for teachers and educational software developers are also proposed.

Keywords: online discussion, project-based learning, behavioural pattern, progressive sequential analysis

INTRODUCTION
Project-based learning is a learner-centred instructional approach and can help students develop skills such as data collection, coordination, peer discussion, and information analysis (Blumenfeld et al., 1991; Thomas et al., 1999; Thomas, 2000), and this teaching approach is becoming increasingly applied. Project-based learning has been combined with different instructional strategies in recent years and applied to various subject domains (e.g., Şahin, 2008; Neo & Neo, 2010; van Rooij, 2009; Hou et al., 2007a). Its characteristics have also been discussed in numerous studies (e.g., Koo et al., 2009; Ipek, 2010; Park & Ertmer, 2008; Kramer et al., 2007; Hou et al., 2007a; Lam et al., 2009; Thomas, 2000; Edelson et al., 1999; Krajcik, et al, 1998).

The employment of web environments in project-based learning has also become an important aspect of educational technology. Past studies have revealed students often lack in-depth analysis process (Hou et al., 2007a; Hou et al., 2007b; Thomas, 2000; Krajcik, et al., 1998; Edelson, Gordon, & Pea, 1999) and treat online information as direct answers to questions on project topics (Wallace & Kupperman, 1997; Chang & McDaniel, 1995) in project-based learning, and this may result in inappropriate inferences and discussions (Krajcik, et al., 1998). Limitations in peer collaboration and time management have also been noted (Thomas, 2000; Hou et al., 2007b).

On the other hand, since asynchronous discussion allows learners to interact with each other on a topic and construct knowledge, argumentation may also be achieved (e.g, Oh & Jonassen, 2007; Cho & Jonassen, 2006). Due to the increasing popularity of online forums, project-based learning that is based on online discussion activity (e.g., Hou et al., 2007a) has become a topic that deserves to be analyzed at a deeper level.

Therefore, the analysis of actual behaviours in project-based learning that incorporates online discussion is the key objective in this study. Analyzing the behavioural patterns may further explore the potential causes and natures of the aforementioned limitations. These findings may also serve as important references for teachers with regard to strategies used for intervention and guidance in project-based learning that incorporates online forums.

There have been studies in the area of online discussion-based teaching (e.g., Hewitt, 2005; Patricia & Dabbagh, 2005; Hou et al., 2007a, 2008). However, studies on project-learning discussion behaviours (e.g., the clarification of topics, coordination of projects, and collection/evaluation of data) are rare recently. Therefore, it is a crucial research topic to empirically analyze the behavioural patterns of a project-based learning activity incorporating an online discussion activity. In this study, an new analytical approach which integrates two analytical methods: quantitative content analysis (Rourke & Anderson, 2004) and sequential analysis (Bakeman

& Quera, 1995) is proposed and applied to explore the behavioural patterns of a online project-based learning activity. A coding scheme for learning behaviours has been devised based on past studies of project-based learning (Blumenfeld et al., 1991; Thomas, Mergendoller & Michaelson, 1999; Thomas, 2000). Each discussion-message will be chronologically ordered and will undergo a quantitative content analysis and a series of progressive sequential analysis in an integrative manner. The proposed new analytical methods will allow researchers to use progressive, chronologically-ordered sequential analysis to infer visualized patterns in the progress of students' project-learning related behaviours. By the above pattern analysis, researchers can in-depth explore and discuss limitations of learners' behavioural patterns. The specific purposes of this research are as follows:

1. Conduct a project-based learning activity incorporating an online discussion activity. Integrate quantitative content analysis and progressive sequential analysis to analyze the behavioural patterns of learners' project-learning behaviours.
2. Discuss limitation of the patterns and provide suggestions for teachers with regard to strategies used for guidance in online project-based learning.

METHOD
Participants and Procedures
The participants in this case study were 70 college students studying management, all of whom had completed information-related courses and were capable of using online forums. This study arranged a project-based learning activity incorporating online discussion in a management course that was undertaken by these students. The students were asked to analyze a business-management case assigned by the teacher, and to complete a project report collaboratively. Their assignment was to analyze the obstacles faced by an organization's managers and to provide suggestions. The entire project-based discussion activity was conducted in the forum that this study provided, and which only had basic functions, such as posting and replying to articles and showing the list of articles, in order to avoid interference from outsiders or the complications of a complex interface. The 14-day activity required the 70 students to collaborate, jointly collect data and make comments on its analysis, compile their findings, and present the final report in the forum by posting articles and responses. During the entire process of discussion, the teacher was not allowed to intervene or provide guidance in order to avoid the teacher's subjective guidance.

Design
In this study, quantitative content analysis and progressive sequential analyses were adopted. According to the coding scheme for project-based learning discussion behaviours (see the section of *Coding scheme and Data Analysis*), each article and response posted by a student was coded based on chronological order so that researchers might explore the patterns of students' daily project-based learning. Lag sequential analysis (Bakeman & Quera, 1995) allowed researchers to examine whether the sequence of a certain coded behaviour followed by another occurs with statistical significance (e.g., whether the students demonstrated the behavioural pattern of conducting an "initial data-evaluation" after completing "data-collection" in a project-based learning activity). This method, which has been adopted by studies of online learning and online communities (e.g., Hou et al., 2007a, 2008, 2009), allowed researchers to infer a visualized diagram of behavioural patterns. In this study, a progressive sequential analysis was proposed and adopted, in which the data that was coded daily underwent a lag sequential analysis for behavioural patterns. For example, the codes accumulated in the first day, in the first two days, in the first three days, and so on, right up till the last day, were analysed for behavioural patterns as a way for exploring how the students' behaviours shifted on a daily basis. This approach allows us to understand the time points at which significant sequences emerge, continue, or disappear. This study proposed this fairly new analytical approach with the desire to analyse characteristics and limitations in students' project-based learning, and to increase its research validity. In contrast with past approaches of only conducting one-time sequential analyses of all the coded data (e.g., Hou et al., 2007a, 2008, Jeong, 2003), our approach could allow us to better understand students' processes in daily project learning.

Coding scheme and Data Analysis
After reviewing past studies on project-based learning (e.g., Blumenfeld et al., 1991; Thomas, Mergendoller & Michaelson, 1999; Thomas, 2000, etc.), the study compiled procedures and models for project-based learning. This research also considered the characteristics of online discussion and proposed the coding scheme (seen in Table 1), which is dedicated to behaviours in online project-based learning discussions.

Table 1 Coding scheme for project-based learning online discussion behaviours

Code	Dimension
PL1	Initial analysis of the project topic
PL2	Presence of data collection relevant to the project.
PL3	Initial evaluation of the collected data.
PL4	Writing on and analysis of the project content.
PL5	Comprehensive analysis, compilation of existing analysis and data.
PL6	Proposing comments regarding task coordination.
PL7	Discussions irrelevant to the project.

For content analysis, each article or response posted in the forum was coded by a professional psychology researcher. Since each posted article could receive multiple responses, this study treated each article as a unit: the content of a posted article was treated as the first message, while the responses it received were treated as its continuing messages based on their chronological order. Using the coding scheme, the coder coded each message based on the dominant content of the message and on which item in the coding scheme best applied to the content of the message. The codes were chronologically ordered so that researchers could analyze daily frequencies. After the discussion from 14 days of activity was coded, 180 coded messages were yielded. To ensure the inter-coder reliability, the entire discussion was coded by another coder with a similar background. The Kappa value was 0.73 (p < .001), reaching the .001 level of significance. The collected data was then provided for further analysis.

RESULTS AND DISCUSSION
The distribution of the coded behaviours gathered from the 180 coded messages generated during the 14-day activity is shown in Figure 1. Instances of PL3 and PL6 were not found and are thus not included in the figure. Figure 1 indicates that PL4 (writing and analysis) is most frequent (67.78%), followed by PL1 (initial analysis: 18.33%). The frequencies of the other codes are much lower than that of PL4. The fact that PL7 (irrelevant discussions) only took up 2.22% of the total suggests that the students demonstrated a certain level of focus during the project-based learning activity.
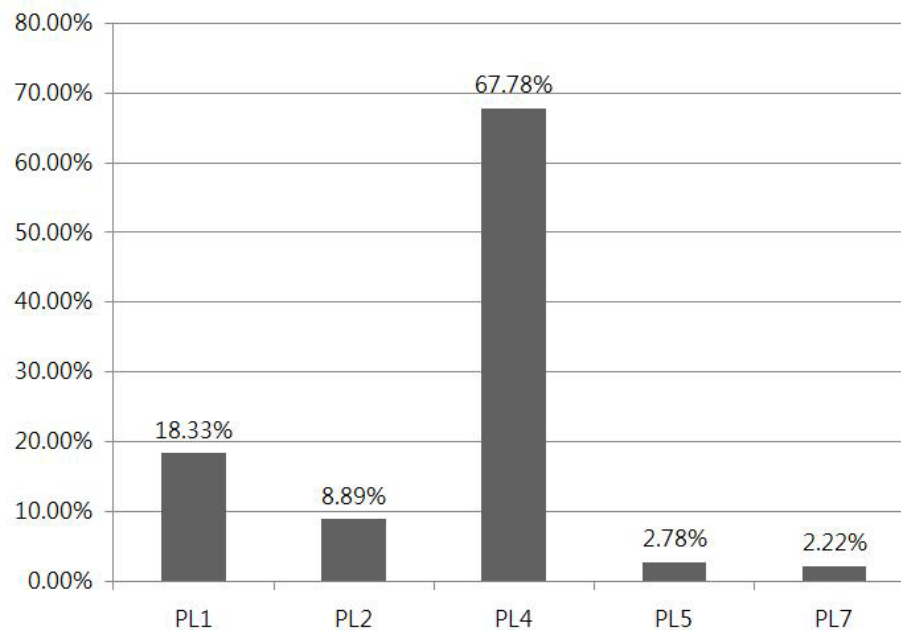
Figure 1 Distribution of the quantitative content analysis of codes in online project-based learning

Past research has highlighted learners' limitations of analysis process in online project-based learning (Hou et al., 2007a; Thomas, 2000; Krajcik, et al., 1998; Edelson, Gordon, & Pea, 1999). The coding of the behaviours in our study may allow in-depth understanding how these limitations are formed. For example, a fact worth noticing is that the frequency of PL2 is rather low (8.89%), and the participants may have proceeded directly to initial analysis and writing (PL4) without going through data-evaluation (PL3 was not found). In addition, they

did not discuss task coordination (PL6 was not found). Compilation and comprehensive analyses were also limited (PL5 only took up 2.78%). PL3 and PL5, which indicate the ability to evaluate and summarize different comments and information, are important components of argumentation (Erduran et al, 2004) which the participants often lacked.

In order to further examine the issue of time management in project-based learning as mentioned in previous studies (e.g., Thomas, 2000; Hou et al., 2007b), the number of daily discussions in our study is summarized in Figure 2. As shown by Figure 2, the total number of postings from Day 1-8 (taking up 57.14% of the entire task-time) was as low as 27.8%. On Day 9, however, the number increased significantly (17.8%), but dropped again by Day 10. According to the review of the discussion content on Day 8-10, this temporary rise may have been a chain reaction by numerous participants who actively posted articles on Day 9, but the effect was not sustained.
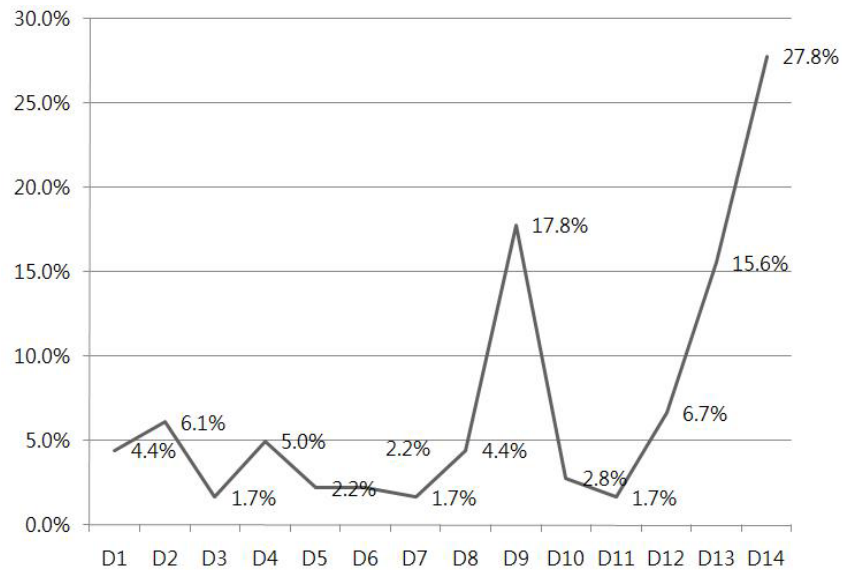
Figure 2 Distribution of the frequency of daily discussions

After Day 11, however, the extent of discussion nearly doubled every day, indicating a sudden increase as the project came to an end. A possible reason for this is that students often procrastinate about their studies until the last minute. To better reveal potential causes and more details, this study conducted a quantitative content analysis based on the time-line. The daily frequency of each code is summarized in Figure 3. The results showed that discussion in the first 8 days was not only less frequent but also had fewer instances of PL1 (initial analysis) or PL2 (data-collection). The behaviours in the first 8 days were mostly direct analyses and writing on the project (PL4). By going directly to PL4, the students may have indicated a lack of initial understanding and data-collection, as a result of which the depth of the discussion later on may have been rather shallow, or may have involved inappropriate inferences (e.g., Krajcik, et al., 1998). This study also discovered that PL4 had three ups and downs from Day 1 to Day 8, yet its frequency tends to drop. This indicate that active participation in analyses during this stage tends to drop and the participants were not motivated enough. On Day 9, PL1 and PL2 increased along with PL4; from Day 12 to Day 14, PL1 increased, while data-collection (PL2) did not. Researchers also noted that PL5 (comprehensive analysis) was still rather infrequent during the entire process, even in the later stages. This reflects the consequences of the participants' lack of initial data collection; as a result, they were not able to quickly gather, analyze or compile the needed information and comments from each other in the later stages.
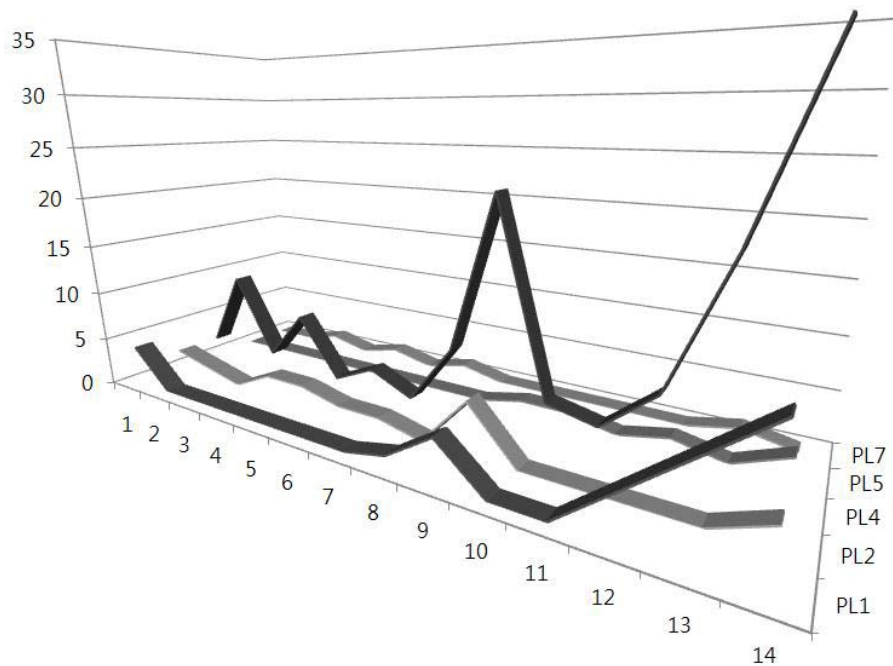
Figure 3 Frequency of daily codes in online project-based learning

To better understand the relationships between each code, a series of lag sequential analysis (Bakeman & Quera, 1995) were conducted, which allows us to examine the overall interactions between codes within a certain time-line and to visualize behavioural sequences. The Adjusted Residuals Table of sequential analysis could be created by calculating the transition-frequencies of the behaviours during a certain time period (Bakeman & Quera, 1995; Hou et al., 2007a, 2008; Jeong, 2003).

Table 2 is an example (Day 1-9). Each z-score in the table indicates whether a given sequential continuity was significant. The rows in the table represent the starting behaviours, and the columns represent behaviours that followed the starting behaviours. A z-score of +1.96 or higher indicates a significant sequence (p<0.05). Table 2 indicates that up until Day 9, the two sequences that reached the level of significance were PL1->PL1 and PL4->PL2.

Table 2 Adjusted Residuals Table of sequential analysis (lag=1, Day 1-9)

Z	PL1	PL2	PL4	PL5	PL7
PL1	6.51*	-0.9	-1.51	-0.34	-0.59
PL2	-0.68	-0.9	0.24	-0.34	1.49
PL4	-7.08	3.05*	1.01.	1.15	-0.72
PL5	0	0	0	0	0
PL7	-0.5	-0.67	0.61	-0.25	-0.44

p< 0.05

Though past studies have addressed the sequences of behavioural patterns in online learning (e.g., Hou et al., 2007a, 2008; Jeong, 2003), all of them have been a one-time analyses in which all the codes were gathered and analysed together. This approach, however, does not allow us to explore the possible progressive transformations of behavioural pattern sequences in each time stage. To address this issue, this study conducted a progressive sequential analysis; that is, the codes accumulated from Day 1 through any other day were placed under sequential analysis based on their dates (as shown in Table 3).
The result indicates that the 14-day process can be divided into 3 stages. Based on the significant sequences, the behavioural transition diagrams were inferred (as shown in Figure 4); in these, each arrow indicates the direction of a shift in a significant sequence. Based on this, researchers can further explore how the discussion behaviours are correlated with each other.

Table 3 Progressive sequential analysis of discussion behaviours in online project-based learning

Day	Significant Behavioural Sequences
1	N/A
1-2	N/A
1-3	N/A
1-4	N/A
1-5	N/A
1-6	N/A
1-7	N/A
1-8	N/A
1-9	PL1->PL1, PL4->PL2
1-10	PL1->PL1, PL4->PL2
1-11	PL1->PL1, PL4->PL2
1-12	PL1->PL1, PL4->PL2, PL4->PL4
1-13	PL1->PL1, PL4->PL2, PL4->PL4
1-14	PL1->PL1, PL4->PL2, PL4->PL4
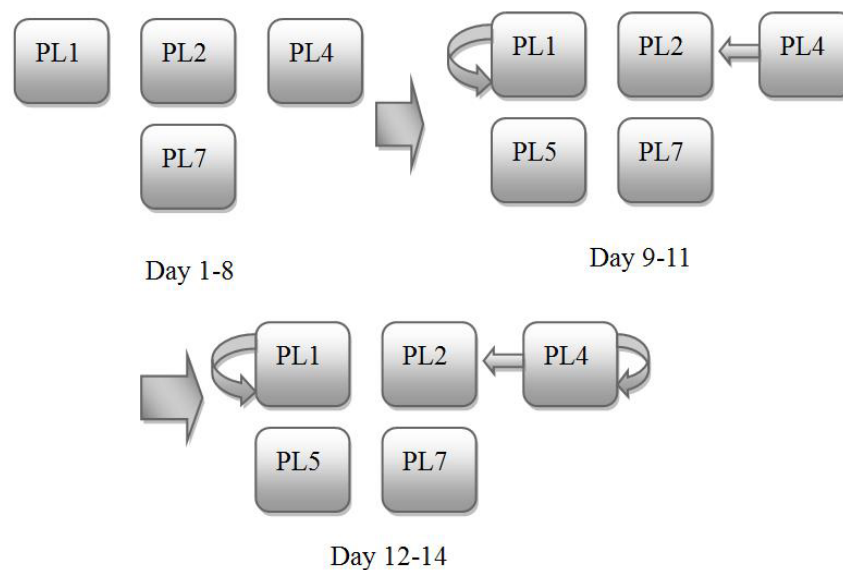
Figure 4 Progressive sequential-analysis transition diagrams in each stage

This study discovered that in Stage 1 (Day 1-8) not only is the extent of discussion low, as revealed by the quantitative content analysis, but there is also no significant sequential correlation between these behaviours. In Stage 2 (Day 9-11), the participants started showing continuity in initial analysis (PL1->PL1) and analysis with data collection (PL4->PL2). In the last stage, Stage 3 (Day 12-14), the participants further demonstrated continuity in analysis and report-writing (PL4->PL4). These sequences indicate the behaviours in Stage 1 are more sporadic and separated from one another, and they take up about 60% of the entire discussion time. Although initial analysis is sustained in Stage 2 (PL1->PL1), the appearance of the sequence PL4->PL2 indicates that most of the participants started to collect data after an official analysis and did not follow the expected course, such as initial analysis -> data collection -> data evaluation -> report-writing (e.g., neither PL1->PL2, PL2->PL3, PL3->PL4, nor PL2->PL4 have reached a level of significance). This finding reveals the detail information regarding the limitations in learners' information analysis (e.g., Wallace & Kupperman, 1997; Chang & McDaniel, 1995); that is, they looked for information they needed for writing a report without first going through a systematic information analysis process, and they may have directly applied online information to official analysis and reports without proper evaluation. In Stage 3, although analysis and report-writing show continuity, they still had not reached the significance of the sequence "PL4->PL5" (comprehensive analysis) before the entire learning activity was over. The quantitative content analysis indicates that the insufficient information gathered may have limited the depth of discussion. Information on the categorization of these stages, sequences, and frequency, could serve as references for teacher intervention.

The above analyses demonstrates the limitations of students in online project-based learning in terms of time

management and information analysis, and may allow us to in-depth realize some possible causes, inter-behaviour interactions, and those areas that require more guidance from teachers.

SUGGESTIONS

In this case study, the empirical observation and analyses indicate that participants' limitations include poor time management (procrastinating until the last moment) and insufficient initial data collection. The students also demonstrated a lack of proper data evaluation processes (e.g., lack of PL1->PL2, PL2->PL3, PL3->PL4, PL2->PL4, or PL4->PL5, etc) and sufficient comprehensive analysis (PL5). One phenomenon observed in regard to time management was decreased motivation to continue a given discussion, which may lead to the effect of "dead discussion-threads" as proposed by Hewitt (2005). With little time left in Stage 3, the depth of analysis may have also been hindered. Another important issue is that the participants did not conduct initial data-evaluation and talk about task-coordination (PL3 and PL6 are absent), and therefore the discussion may lack a structure or appropriate order.

The above findings could help teachers and researchers gain a better understanding of the relevant limitations in online project-based learning, and may serve as valuable references for timely interventions. This study then provides suggestions for teachers and educational system developers are as follows:

1.   A teacher may motivate students and increase the extent of discussion by providing incentives in the initial stages of the course. To avoid the abovementioned limitation in the sequence PL4->PL2, the teacher may post an article to remind learners not to neglect data collection (PL2) or initial data evaluation (PL3). This may also lead to better information analysis and compilation (such as triggering the sequences PL1->PL2, PL2->PL3, PL3->PL4, PL2->PL4, or PL4->PL5). The teacher could also consider using scaffolding (e.g., van Rooij, 2009) by asking students to complete certain analytical procedures in a given order and review their coordination and task delegation. As for the chain-reaction caused by numerous participants actively posting articles, and its sustainability, the teacher is advised to notice the community's "peripheral members" (Zhang & Storck, 2001) and to post articles that encourage them to participate in the discussion right from the initial stages, and to interact with other members. Since the "community climate" may also affect knowledge sharing (Bock et al., 2005), the teacher could post articles to break the ice or settle conflicts in coordination. It is hoped that the above recommendations can serve as valuable points of reference for teacher intervention.

2.   To a developer of educational systems, the limitations in students' co-operative project-based learning serve as important references for the development of an automated detection system. The topic of embedding sequential analysis detection calculation into an e-learning system deserves to be explored (Hou et al., 2010), since the result could be an automation for the instant analysis of the frequencies and sequences of students' behaviours. This system may also serve as a reference for teachers' dynamic guidance and intervention.

CONCLUSION

This study aims to in-depth analyze the behavioural patterns of learners' project-learning behaviours. This study applied two analytical approaches: quantitative content analysis and progressive sequential analysis to explore the behavioural patterns of learners' online discussions. The results indicate some learners' limitations in their project-based learning activity. The limitations include poor time management and insufficient initial data collection. The students also demonstrated a lack of proper data evaluation processes (e.g., lack of PL1->PL2, PL2->PL3, PL3->PL4, PL2->PL4, or PL4->PL5) and sufficient comprehensive analysis (lack of PL5), the suggestions for teachers and educational software developers are also proposed in the above suggestion section.

Regarding the limitations of the study, due to the limitations of the samples, this study focused more on the project-based learning in higher education settings. This may limit generalization of findings to other grade years or subjects. More empirical studies on different academic systems and subject domains may be explored in the future in order to determine the similarities, differences of the behavioral patterns. Moreover, the above proposed specific framework and techniques of automatic detection environment for online project-based learning discussion are yet to be developed and explored by future studies.

Finally, integrating more interactive learning strategies (e.g., problem-solving, peer assessment, role playing or peer tutoring) with project-based learning instructional activities may provides scaffolding functions to enhance learners' knowledge construction, and researchers may apply more coding schemes (e.g., social knowledge construction, problem-solving process or cognitive phases) at the same time to explored the discussion content and patterns in project-based learning for higher validity in future studies.

It is wished that the analytical methods (i.e., quantitative content analysis with progressive sequential analysis), findings, and suggestions in this study can serve as references for teachers, researchers, and system developers working on online project-based learning.

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LOW PROFICIENCY LEARNERS IN SYNCHRONOUS COMPUTER-ASSISTED AND FACE-TO-FACE INTERACTIONS

TAM Shu Sim, KAN Ngat Har & NG Lee Luan
Department of English
Faculty of Languages and Linguistics
University of Malaya
50603 Kuala Lumpur, Malaysia
tamss@um.edu.my; kannh@um.edu.my; ngleeluan@um.edu.my

ABSTRACT
This experimental study offers empirical evidence of the effect of the computer-mediated environment on the linguistic output of low proficiency learners. The subjects were 32 female undergraduates with high and low proficiency in ESL. A within-subject repeated measures concurrent nested QUAN-qual (Creswell, 2003) mixed methods approach was used. Interactions between the subjects in mixed ability dyads in face-to-face (F2F) and synchronous computer-assisted (SCA) environments provide the data. The unit of analysis was negotiation of meaning (Varonis & Gass, 1985) which is the key construct that is claimed to promote second language acquisition (SLA). The evidence indicates that opportunities for SLA for low proficiency learners are enhanced with the occurrences of negotiation of meaning in both SCA and F2F environments. In particular, the SCA allowed for varied syntactic and semantic modifications which provided ample opportunities for low proficiency learners to negotiate for comprehensible input and to notice form.

Keywords: Computer-assisted language learning; computer-mediated communication; second language acquisition; language proficiency

INTRODUCTION
Many studies of computer-assisted language learning (CALL) have extolled the benefits of computers (Ducate & Lomicka, 2008; Kelm, 1992; Kennedy & Levy, 2009; Kern, 1995; Kessler & Bikowski, 2010; Lee, 2004; Simpson, 2005; Tudini, 2007; Warshauer, 1997). In the technology-based language classroom, Beatty (2003) identified eight applications of CALL i.e. word processing, games, literature, corpus linguistics, computer-mediated communication (CMC), WWW resources, adapting other materials for CALL and personal digital assistants.

CMC, from the communicative language teaching perspective, fulfils the principles that benefit language learning i.e. the communication principle, the task principle and the meaningfulness principle (Richards & Rodgers, 1986). CMC also realizes Underwood's (1984) criteria for communicative CALL summarised as follows:

- acquisition rather than learning practice
- implicit grammar teaching rather than explicit
- real and meaningful communication
- no judging and evaluation of everything
- authentic and natural target language usage
- flexible

In the language learning contexts, CMC provides a means for more opportunities for communicative practice with technology. In particular, for low proficiency learners and those who are shy and reserved, the computer-mediated environment seems to provide opportunities for increased linguistic output (Beauvois, 1992; 1998; Bradley & Lomicka, 2000; Tidwell & Walther, 2006).

CMC has been defined as "communication that takes place between human beings via the instrumentality of computers" (Herring, 1996, p.1), described as "conversation in slow motion" (Beauvois, 1992, 1998) and recognized as communication with high levels of interactivity (Chun, 1994; Kern, 1995; Pellettieri, 2000; Salaberry, 2000; Smith, 2003). Hence, investigating the communication or interactions in this context is inevitable (Chapelle, 1999; Holliday, 1999; Salaberry, 2000). Additionally, a comparison between computer-mediated communication (CMC) and face-to-face (F2F) communication seems to be a critical and valuable extension of research on CMC at this juncture to evaluate the use of CMC in SLL and to provide for a more pragmatic understanding of CALL (Chapelle, 2003; Levy, 1999; Ortega, 1997). Research in second language acquisition (SLA) has been marked by the call by Chapelle (2003) for CALL researchers to channel their work

along the lines of that of Interactionist SLA researchers (Long, 1985; Pica, Holliday, Lewis, & Morgenthaler, 1989; Varonis & Gass, 1985). The work of Blake (2000), Fernandez-Garcia and Martinez-Arbelais (2002), Lee (2002), Smith (2003), Tudini (2003), and Wang (2006), amongst others, reflect this call. In other words, advances in theories of SLA should inform current language learning and teaching practices. Of particular interest in SLA is the role of interactions in promoting language development.

Much of the existing studies in CMC lack empirical evidence. Therefore, this study set out to obtain empirical evidence of the effect of the computer-mediated environment on the linguistic output of low proficiency learners and subsequently, evaluate the potential of this computer-mediated environment to support these learners for SLA development. To this end, the SLA frameworks of negotiation of meaning (Pelletieri, 2000; Pica et. al, 1989; Varonis & Gass, 1985) were employed to compare the interactions produced by the high and low proficiency learners in computer-mediated and face-to-face environments.

THEORETICAL FRAMEWORK
Negotiation of meaning in F2F interactions
Interaction promotes L2 development because there is an inherent need on the part of the interactants to understand the speech in order to participate in the on-going discourse and maintain flow (Gass & Varonis, 1984). Therefore when learners participate in interaction, this discourse flow not only provides them with the opportunity to formulate short-term hypotheses about the meaning of their interlocutor's utterances, but also with appropriate data to formulate long-term hypotheses about the structural and pragmatic rules of the language (Gass & Varonis, 1984).

Embedded with frequent occurrences within F2F interactions is the construct of negotiation of meaning or negotiation routine (NR). The Interactionist hypothesis within the instructed SLA literature identifies the NR construct to be the feature that is ideal for learners to acquire the second language (Long, 1980; 1985; Pica, 1994; Varonis & Gass, 1985 among others). During a negotiation of meaning which normally occurs due to conversational trouble (Long, 1980), it is found that there are greater modifications in the quality of the interaction. This is due to the attempts at making the utterances comprehensible to the interlocutor. This negotiation of meaning is claimed to provide more opportunities for learners to push for interactional adjustments because the turns go back and forth until the incomprehensibility of the message meaning is resolved. In this manner, negotiation of meaning supports comprehensible input and output, and aids SLA.

Other researchers (Hegelheimer & Chapelle, 2000; Pica, 1994 among others) have corroborated Long's (1980) findings and concluded that the most useful interactions are those with occurrences of negotiation of meaning that help learners to comprehend the semantics and syntax of the input (Krashen, 1980) and the comprehensibility of their own linguistic output (Swain, 1985) as well as those that offer ample opportunities for a focus on form (Schmidt, 1990). An example of a negotiation routine follows:

NS: Do you wanna hamburger?   [*Trigger*]
NNS: Uh?   [*Indicator or signal*]
NS: What do you wanna eat?   [*Response*]
NNS: Oh! Yeah, hamburger   [*Reaction to response*]

Long, 1981, p. 269

As the above example reveals, negotiation can serve as a means of working through perceived or actual gaps in communication or comprehension of message meaning. Furthermore, more turns dedicated to the negotiation routine means that "more work [is involved] in the resolution before the routine finally pops and the conversation continues" (Varonis & Gass, 1985, p. 83) and hence, provides more opportunities for negotiation of comprehensible output and input and noticing of form.

Varonis and Gass (1985) developed a framework for analysing a non-understanding routine or negotiation of meaning wherein a negotiation routine consists minimally of a *trigger* that caused the non-understanding in the utterance, an *indicator* or signal of non-understanding, a *response* to the indicator and finally an optional *reaction to the response* (please refer to the above example). This framework is widely used to analyse instances of negotiation including studies of negotiation in the computer-mediated communication environment (Blake, 2000; Pelletieri, 2000; Smith, 2003; Toyoda & Harrison 2002); hence, by using the same model and terminology, a comparison across studies in CMC contexts can be made.

In addition, Pica et al.'s (1989), Pica's (1994) and later Pelletieri's (2000) qualitative analysis particularly of the different types of indicators and responses present in negotiation routines reveals numerous ways learners' attention is drawn to the incomprehensible portion of the utterance when there is an indication of non-understanding. The different types of indications of non-understanding (clarification requests, confirmation requests, comprehension checks) and the subsequent modifications which include lexical, structural and morphosyntactic modifications, serve to identify the ways negotiation routines maximise the conditions for comprehensible input, output and attention to form, and are therefore potentially conducive for SLA.

In a nutshell, according to SLA theory and research in the Interactionist tradition, interaction in general and negotiation of meaning in particular gives learners opportunities to comprehend message meaning, attend to and notice second language forms, produce comprehensible and modified output that compels the development of morphology and syntax, and at the same time enables them to have authentic communication (Hegelheimer & Chapelle, 2000). Whether learners capitalize on the opportunities provided by the attention on form to acquire the language especially in the long term has not been determined conclusively in the studies on negotiation thus far.

Negotiation of meaning in computer-mediated communication
In the technology-impacted pedagogical context, a fertile environment that best promotes interactions and negotiations from the Interactionist perspective in SLA is the networked task-based language teaching with CMC. CMC also enforces Swain's (1985) comprehensible output hypothesis because networked exchanges are text-based and therefore, learners must produce the structures and hence, push comprehensible output (Blake, 2000). Furthermore, the emergence of a new variety of language has resulted in a call for the development of the research field of CMC (Paramskas, 1999 cited in Harrington & Levy, 2001).

The literature on CMC reveals some early attempts at comparing CMC and F2F (Chun, 1994; Kern, 1995; Warschauer, 1996). These studies which compare computer-assisted class and teacher-fronted class discussions (Kern, 1995; Warschauer, 1996) observe increased participation and output by learners in the computer environment. However, it can be hypothesized that group size and equality of participation are "negatively related in traditional oral interactions and positively related in computer-assisted interactions" (Gallupe, Bastianutti, & Cooper, 1991 cited in Ortega, 1997, p. 86). In other words the bigger the class size, the greater the benefits of electronic over non-electronic interactions. These studies arguably are lacking in comparable conditions.

The studies on negotiation of meaning in the CMC context have used Varonis and Gass' (1985) schema in identifying and labelling the component parts of an instance of negotiation of meaning. The features of the negotiation routines investigated include the number of occurrences of negotiations across different task types including the number of turns (Blake, 2000; Iwasaki & Oliver, 2003; Pellettieri, 2000; Smith, 2003; Tudini, 2003), types of triggers (Toyoda & Harrison, 2002), feedback (Pellettieri, 2000; Tudini, 2003), self-corrections (Smith, 2003; Tudini, 2003), and an expanded model of negotiation in the CMC context (Smith, 2003). Particular to language proficiency, some studies (Beauvois, 1992, 1998; Kern, 1995) have reported increased linguistic output in the CMC context for minority, shy and reticent learners. These findings rest largely on anecdotal rather than on empirical evidence.

All these studies examine features of negotiation routines in the CMC environment but do not provide a contrast with negotiation routines in the F2F environment. Thus, the findings can only describe the features of negotiations peculiar to the CMC context but cannot claim with empirical support the extent CMC advances SLA compared to the F2F environment. As such, the comparative study of negotiation of meaning between the CMC and F2F environments particularly in the context of the role of language proficiency undertaken in this study would constitute a significant and timely contribution. Three frameworks: Varonis and Gass' (1985) schema of an instance of negotiation of meaning, Pica et al.'s (1989) categories of indicators and responses and modifications from Pelletieri's (2000) in the CMC context, are combined as a modified framework to provide for quantitative and qualitative perspectives on negotiation routines in the F2F and CMC contexts.

Research objectives
This study aims to provide a data-driven, empirically-informed evaluation of the effect of the synchronous computer-assisted (SCA) environment on the linguistic output of low proficiency learners. It seeks to do this by evaluating online chat or SCA interactions through the comparison of low proficiency learners' interactions against that of high proficiency learners in two environments, namely F2F and SCA, using the key construct that is claimed to promote SLA i.e. negotiation of meaning or a negotiation routine (NR). The role played by the

mixed ability dyad formation of high and low proficiency learners on the linguistic output of low proficiency learners with a specific focus on the use of indicators and responses is the focus of investigation.

Within the larger frame of SLA and CALL, the study also aims to add to the body of knowledge on CALL and SLA's construct of negotiation of meaning in particular the extent of the role of language proficiency in interactions in the F2F and CMC environments. The empirical findings from this study will enable informed pedagogical decisions and choices pertaining particularly to low as well as high proficiency learners to be made.

METHODOLOGY
This within-subject, repeated-measure quasi-experimental study which utilizes a concurrent nested QUAN-qual (Creswell, 2003) mixed methods approach was set up to determine the extent of the role played by language proficiency in the learners' linguistic output in the two different environments: F2F and SCA. The analytical frameworks for the routines of negotiations of meanings are derived from Varonis and Gass (1985) and Pica et al., (1989).

Participants
The participants were 32 Year One undergraduates from different departments who had minimal familiarity with one another. At the time of the experiments, the majority of them were between 20 and 23 years of age. All 32 participants were females to control the gender variable.

Purposive sampling method was used to select the participants. Participants were selected based on a pre-study selection questionnaire. Proficiency in the English language was one of the criteria as the study was based on mixed dyads of high and low proficiency. In addition, computer and keyboard abilities and familiarity with MSN Messenger or Yahoo! Messenger was also a necessity. After the participants were selected, attempts at randomization were made where the participants were placed in pairs.

Variables
The independent variables selected for the study were the interactions in the two different environments in which the participants had to perform four different communicative tasks. The SCA environment used either the MSN or the Yahoo! Messenger online chat software. The dependent variables selected for comparison between the SCA and F2F environments were the qualitative features of routines of negotiation of meaning i.e. the indicators and responses found within the framework of negotiation routines. The study was interested to determine if these dependent variables were affected by the language proficiency (high and low) of the participant and how low proficiency learners fared in particular.

Based on the literature reviewed which indicated that mixed-ability dyads promoted negotiations of meaning (Blake, 2000; Boulima, 1999; Pellettieri, 2000; Varonis & Gass, 1985), a low proficiency participant was paired with a high proficiency participant. To determine the proficiency level of the participants, the Malaysian University English Test (MUET) was used. All tertiary students in Malaysia are required to take the MUET. MUET uses a system of 6 bands to classify overall language proficiency based on four skills: reading, listening, writing and speaking. A student's total scores on these four skills are added together to arrive at an overall band with Band 1 being the lowest proficiency grading and Band 6 the most proficient.

For this study, it was determined that the mixed-ability dyads would be two to three bands from each other i.e. if a participant was at Band 2 she would be paired with another from Band 4 or 5. There were none with Band 1 in the population; hence, the pairs were made up of those who scored Bands 4, 5 or 6 and those who scored Bands 2 or 3. Planning time of ten minutes was given to each dyad before each experiment was run as time given for preparation would help to reduce anxiety (Fulcher, 1996).

Task variables which have been shown to have an influence on linguistic output (Robinson 2001 including task conditions, task complexity (Robinson, 2001) and task type (Pica et al., 1993) were given careful consideration. Decision-making task type was chosen for this study for various reasons. Decision-making tasks or target tasks (Nunan, 2001) have received very little attention in the task-based CMC context and, as such, they are novel and interesting. Decision-making tasks are convergent (Duff, 1986) with a two-way exchange of information but with more than one outcome (Pica et. al, 1993); therefore they have the potential to generate interactions for analysis (Long, 1980). While there is no guarantee of this because of the open-ended nature of the task objectives, as has been pointed out by Pica et al. (1989), the conversational nature of decision-making tasks do provide potentially equal opportunities for both participants to negotiate meaning toward mutual comprehension of each other's production.

To remove the potential of task complexity as a variable in order to enhance the reliability of the findings, four decision-making tasks based on topics which were neutral in nature and common to the general life experience of a university student were prepared for the study. The topics were making decisions about where to go for a holiday, where to take a pen-pal for a weekend, deciding on a stress-reducing programme for university students and on the content of a television programme for teenagers. These four topics corresponded with Tasks A, B, C and D respectively.

Tasks A and B were adapted from Condon and Cěch (1996); these two tasks required participants to plan an itinerary for a weekend, one for a getaway anywhere in the world and the other for a friend to visit southern Louisiana. For this study, a local destination was used. Tasks C and D were modified from two oral test situations used in the MUET of December 2000. The modifications were necessary because the original tasks were meant for a discussion for four participants. All four prepared tasks were pre-tested with two ESL lecturers to rectify any fundamental problems with the tasks or the instructions.

Table 1: Task variables that were controlled

Variable	How the variable was controlled
Format	Mixed-ability dyad (high and low proficiency learners)
Planning time	Ten minutes of planning time before each task.
Task type	Four decision-making tasks
Sequence of tasks	Alternate between task and environment for each experiment.

The dyads had to perform two tasks in the CMC environment and another two in the F2F environment. To reduce the potential variable of task sequence from the study and increase the reliability of the findings (Pica et. al, 1993) The sequence of tasks (Pica et. al, 1989) given to the dyads was controlled i.e. each dyad began with a different task in a different environment. For example, the first dyad began with Task A in the SCA and Task B in the F2F environment while the second dyad performed the reverse: Task B in the SCA environment and Task A in the F2F and so on. In other words, the dependant variables in this study (quantitative and qualitative measures of routines of negotiation) were measured 16 times i.e. with 16 pairs of participants in four different tasks, two in the CMC environment and another two in the F2F environment. Table 1 presents the task variables that were controlled and the means by which they were controlled.

Data analysis procedure
Using the schema developed by Varonis and Gass (1985, see 2.1 above), negotiation routines in the data were first identified. Next, six different types of indicators adapted from Pica (1989; 1994) and Pelletieri (2000) were applied to the data. These indicators are:

1. Explicit statement or request for clarification
2. Request for confirmation through repetition
3. Request for confirmation through modification of trigger or the previous utterance (another indicator or response when it is an extended negotiation)
4. Request for confirmation through completion or elaboration of trigger or the previous utterance (another indicator or response when it is an extended negotiation)
5. Inappropriate response (Note: In Pelletieri's and my data, an inappropriate response also serves to indicate lack of understanding)
6. Request for confirmation through comprehension check e.g. Do you understand?

The next stage of data analysis involved Pica et al.'s (1989) study which presented findings from F2F interactions and reported that the type of responses is influenced considerably by the type of indicators used. Pica et al. had established that the indicator type 'explicit statement or request for clarification' would be most beneficial for SLA because it elicited responses with syntactic modification through embedding and elaboration in clause(s). These features in the data for this study were then extracted for further analysis and comparison. The percentage and means of the categories of indicators by the high proficiency learners were calculated first; then the same was applied to low proficiency learners.

Statistical testing procedures were conducted on the numbers for comparison and contrast in the two different environments. Similarities and differences were identified. This procedure was repeated for the response categories by the high and low proficiency learners in the two different environments.

A sample of 25 percent data was coded by an independent rater. Second coder inter-rater reliability was between 89 percent and 97 percent on the following points: identifying the different moves of the NRs, categorising the types of indicators and responses.

RESULTS AND DISCUSSION
The data and discussion for indicators will be presented first followed by that for responses. Within each section, the data for high proficiency learners (HPL) will first be discussed and then compared with the data for low proficiency learners (LPL).

Indicators
The distribution of indicators by the HPLs in the two environments is presented in Table 2. In the F2F environment, the HPLs indicate problems with comprehensibility of message most commonly with type 2 indicators i.e. request for confirmation with repetition, with 68 occurrences (37%). Following closely behind is type 3 (request for confirmation through modification of the trigger) with 58 occurrences (32%). The third most common is type 1 which is explicit statement or request for clarification. All three types of indicators have the potential to provide optimum conditions for SLA opportunities.

In the SCA environment, the most common type of indicator utilised by HPLs is type 3 i.e. almost half of the total number of indicators (31 occurrences or 47%); while the second most common indicator is type 1 i.e. 24 number of occurrences or 36 percent. Type 3 indicators by HPLs with requests for confirmation through modifications of the trigger would provide modified models of LPLs' problematic triggers, thus providing more opportunity for comprehensibility of input, output and notice of form. In other words, whenever there was an indicator of non-understanding in the SCA environment, more than 80 percent of the time, the indicator type would be a type 3 or type 1; both provided conditions that maximised the potential for SLA. Surprisingly, type 2 occurred minimally in the SCA environment while in the F2F it was the second most common type of indicator tabulated. Type 2 indicator is a request for confirmation through repetition; so it does seem that type 2 is quite irrelevant in the SCA environment compared to the F2F environment.

Table 2: Distribution of indicators (%) among the high proficiency learners (HPLs) in the F2F and SCA environments

Type of indicators	No. of occurrences in the F2F environment (%)		No. of occurrences in the SCA environment (%)		Combined total no. of occurrences (%)	
1. Explicit statement or request for clarification	32	(18)	24	(36)	56	(22)
2. Request for confirmation through repetition	68	(37)	4	(6)	72	(29)
3. Request for confirmation through modification of trigger or the previous utterance (another indicator or response when it is an extended negotiation)	58	(32)	31	(47)	89	(36)
4. Request for confirmation through completion or elaboration of trigger or the previous utterance (another indicator or response when it is an extended negotiation)	19	(10)	1	(2)	20	(8)
5. Inappropriate response	2	(1)	6	(9)	8	(3)
6. Request for confirmation through comprehension check e.g. Do you understand?	4	(2)	0	(0)	4	(2)
TOTAL	183	(100)	66	(100)	249	(100)

In addition, Pica et al. (1989) found that type 1 indicator correlates significantly with syntactic modifications as the type of response regardless of task type. This study thus far had tested and advanced the correlation of type 1 indicator with syntactic modifications as responses and found a significant correlation regardless of environment. In other words, the higher occurrence of explicit statement or request for clarification by HPLs in either

environment would provide opportunity to promote SLA through syntactic modifications from the LPLs. Therefore, in this study, the higher occurrences of indicator types 3 (47%) and 1 (36%) by the HPLs by percentage in the SCA compared to the F2F environments (type 3, 32% and type 1, 18%) seemed to assist LPLs more in the SCA environment by providing them with the models of their problematic triggers and by prompting responses with syntactic modifications. The distribution of indicators by the low proficiency learners (LPLs) is examined next and the results are presented in Table 3.

Table 3: Distribution of indicators (%) among the low proficiency learners in the F2F and SCA environments

Type of indicators	No. of occurrences in the F2F (%)		No. of occurrences in the SCA (%)		Combined total no. of occurrences (%)
1. Explicit statement or request for clarification	28	(16)	16	(32)	44 (19)
2. Request for confirmation through repetition	93	(52)	5	(10)	98 (42)
3. Request for confirmation through modification of trigger or the previous utterance (another indicator or response when it is an extended negotiation)	39	(22)	20	(40)	59 (25)
4. Request for confirmation through completion or elaboration of trigger or the previous utterance (another indicator or response when it is an extended negotiation)	12	(6)	1	(2)	13 (6)
5. Inappropriate response	7	(3)	8	(16)	15 (7)
6. Request for confirmation through comprehension check e.g. Do you understand?	1	(1)	0	(0)	1 (1)
TOTAL	180	(100)	50	(100)	230 (100)

In the F2F environment among the LPLs and similar to the HPLs, the most common way to indicate a problem of non-understanding is by requesting for confirmation through repetition i.e. type 2 (52%). This tallied with the results in Pica's (1994) study. The second most common way is through requesting for confirmation through modifications of the trigger (type 3, 22%). The third most common way is type 1 i.e. explicit statement of request or clarification request with 16 percent (28 occurrences) of the total number of occurrences of indicators among the LPLs in the F2F environment.

Interestingly, in the SCA environment among the LPLs, the highest occurrence of indicator type is type 3 (request for confirmation through modifications of HPLs' trigger); this is followed by type 1 with 16 occurrences (32%) and then type 5 (16% or 8 occurrences) with inappropriate response as an indicator of non-understanding. Type 5 seemed to be quite typical of the SCA environment because of the delay in transmission causing an inappropriate response. Type 2 which was very common in the F2F environment with 52 percent, only garnered 10 percent (or 5 occurrences) in the SCA.

In terms of indicators tabulated in the LPLs' repertoire, the SCA environment seemed to provide opportunity for comprehensible output from the LPLs and comprehensible input from the HPLs more than the F2F environment. This is through the preference for type 3 (request for confirmation through modifications) and type 1 (clarification request which would elicit a syntactic response from the HPLs). This seemed to indicate that the computer environment was more conducive as a provider of conditions for SLA.

Paired *t*-test was conducted in light of the normal distribution of the data on the number of occurrences of indicator types 1 and 3 for the HPLs and LPLs in the F2F and SCA environments to determine the significant differences and the results are presented in the Table 4. The results show that among the high proficiency learners, there are no significant differences in the occurrences of indicator type 1 and type 3 between F2F and SCA environments. Similarly, among low proficiency learners, there are no significant differences in the occurrences of indicator type 1 and type 3 between F2F and SCA environments.

Table 4: Paired *t*-test comparisons of the number of occurrences of Types 1 and 3 indicators in the F2F and SCA environments

Indicators	F2F			SCA			t*	$p < .008$
	n	M	*SD*	n	M	*SD*		
High Proficiency Learners								
Type 1	15	.93	1.10	15	1.07	1.28	.34	NS
Type 3	16	2.44	3.71	16	1.25	1.60	1.25	NS
Low Proficiency Learners								
Type 1	15	1.87	1.81	15	1.00	1.13	1.94	NS
Type 3	16	3.63	2.96	16	1.94	2.44	1.94	NS

*With Bonferroni adjustments for multiple comparisons, $p < .05 = .008$
Type 1 - explicit statement or request for clarification
Type 3 - request for confirmation through modification of trigger

In other words, on the role of language proficiency, although there were percentage differences in the two environments, there were no significant differences between types 1 and 3 in the F2F and SCA environments and between the HPLs and LPLs. To determine if there was a pattern in the preference of indicators by the HPLs and LPLs in the two environments, the three most common indicators among the HPLs and LPLs in the two environments were extracted and examined further in the following tables: Table 5 for F2F environment and Table 6 for SCA environment.

It is interesting to note that in both the environments, the 3 most common types of indicators preferred were the same for both the HPLs and LPLs although in terms of the number of occurrences and percentage of occurrences, there were relative differences. Both types of proficiency levels (HPLs and LPLs) preferred to indicate problems with comprehensibility of message most commonly with type 2 followed by type 3 and then type 1 in the F2F environment while in the SCA environment it was type 3 most preferred followed by type 1 and then type 5.

Table 5: The three most common indicator types among the LPLs and HPLs in the F2F environment

Most common indicator types by HPLs	Most common indicator types by LPLs
2 Request for confirmation through repetition (37%)	2 Request for confirmation through repetition (52%)
3. Request for confirmation through modification of trigger or the previous utterance (another indicator or response when it is an extended negotiation) (32%)	3. Request for confirmation through modification of trigger or the previous utterance (another indicator or response when it is an extended negotiation) (22%)
1. Explicit statement or request for clarification (18%)	1. Explicit statement or request for clarification (16%)

Table 6: The three most common indicator types among the LPLs and HPLs in the SCA environment

Most common indicator types by HPLs	Most common indicator types by LPLs
3. Request for confirmation through modification of trigger or the previous utterance (another indicator or response when it is an extended negotiation) (47%)	3. Request for confirmation through modification of trigger or the previous utterance (another indicator or response when it is an extended negotiation) (40%)
1. Explicit statement or request for clarification (36%)	1. Explicit statement or request for clarification (32%)
5. Inappropriate response (9%)	5. Inappropriate response (16%)

The similarity in trend points to the fact that the behaviours in indicating problems seemed to be similar despite the difference in the language proficiency in the two environments. In addition, based on the types of indicators preferred, the two most preferred indicator types (i.e. types 3 and 1) in the SCA environment seemed more conducive for providing opportunities for SLA compared to the two most preferred indicator types in the F2F environment (i.e. types 2 and 3). This similarity in patterns also seemed to indicate that the environment and language proficiency had no role in the types of indicators 1 and 3 and this was tested further.

A correlation analysis was conducted to investigate the relationship between language proficiency and indicator types 1 and 3. It was found that there were no significant correlations between language proficiency and type 1 (r = -.30, p > .05), language proficiency and type 3(r = -.29, p > .05) in the F2F environment. Similarly in the SCA environment there were no significant correlations between language proficiency and type 1 (r = -.02, p > .05), language proficiency and type 3(r = -.13, p > .05). These results show that the indicator types 1 and 3 were not significantly correlated with language proficiency or the environment. In other words, the choice of indicator type 1 or 3 was not determined by language proficiency or by the environment.

Overall on the role of language proficiency on indicators, the above findings seemed to indicate that the indicator types 3 and 1 which would provide more opportunities for enhancement of SLA seemed to have high occurrences by the HPLs and LPLs in the SCA and the F2F environments. These trends augur well for SLA in both the environments. In other words, the requests for confirmation with modifications by the HPLs and the explicit statements or requests for clarifications by the HPLs would provide linguistic models of the LPLs problematic triggers and induce modified responses from LPLs through syntactic modifications and vice versa regardless of the environment. The findings for the role of language proficiency in the qualitative feature of responses of the negotiation routines are presented next.

Responses
Certain types of responses have been put forth to be more conducive for linguistic development (Pica et al., 1989). This study examined the role of proficiency in this qualitative feature found in the negotiation routines.

The results for the HPLs are presented first followed by those for the LPLs. Distribution of types of responses by the HPLs in the two environments is presented in Table 7.

Among the HPLs, in the F2F environment, the most common type of response is type 4 (46%) with sub-category 4D (34%). In the SCA environment, the highest occurrence of response type is also type 4 (65%) with sub-category 4D (48%) occurring with a higher percentage than in the F2F environment. The second highest is type 4B with 17 percent of occurrences. Since types 4D and 4B are claimed to be the response types that provide the most opportunity as linguistic models for LPLs' problematic triggers, therefore, the SCA environment seemed to be more conducive to provide for opportunities for SLA. The fewer occurrences of negotiation routines in the SCA environment were taken into consideration when making this claim.

Table 7: Distribution of types of responses (%) among the high proficiency learners in the F2F and SCA environments

Type of responses	No. of occurrences in F2F (%)		No. of occurrences in SCA (%)		Combined total no. of occurrences (%)
1. Switch to a new topic	2	(1)	0	(0)	2 (1)
2. Suppliance of information relevant to topic, but not directly responsive to indicator (previous utterance)	9	(5)	5	(11)	14 (6)
3. Repetition of indicator	9	(5)	2	(4)	11 (5)
4. Self modification of trigger (Production of modified i.e. comprehensible output)					
A. Phonological modification	2	(1)	0	(0)	
B. Semantic modification, through synonym, paraphrase, or example	20	(11)	8	(17)	
C. Morphological modification through addition, substitution, or deletion of inflectional morpheme (s) and / or functor (s)	0	(0)	0	(0)	81 (46)
				30 (65)	111 (50)
D. Syntactic modification through embedding and elaboration in clause (s)	59	(34)	22	(48)	

5.	Repetition of trigger	18	(10)	4	(9)	22 (10)
6.	Confirmation or acknowledgment of indicator only	56	(32)	5	(11)	61 (27)
7.	Indication of difficulty or inability to respond	2	(1)	0	(0)	2 (1)
	TOTAL	177	(100)	46	(100)	223 (100)

The results for the types of responses by the low proficiency learners (LPLs) are examined next. Table 8 shows that among the LPLs, in the F2F environment, the highest response type is type 6 (71 occurrences or 40%) which was expected given their limited linguistic ability. The second highest is type 4 response (32% or 56 occurrences) with sub-category 4D (26 occurrences or 15%) and 4B (25 occurrences or 14%).

Table 8: Distribution of types of responses (%) among the low proficiency learners in the F2F and SCA environments

	Type of indicator	No. of occurrences in F2F (%)		No. of occurrences in SCA (%)		Combined total no. of occurrences (%)
1.	Switch to a new topic	1	(1)	2	(3)	3 (1)
2.	Suppliance of information relevant to topic, but not directly responsive to indicator (previous utterance)	15	(8)	12	(20)	27 (11)
3.	Repetition of indicator	22	(12)	3	(5)	25 (11)
4.	Self modification of trigger (Production of modified i.e. comprehensible output)					
	A. Phonological modification	5	(3)	1	(2)	
	B. Semantic modification, through synonym, paraphrase, or example	25	(14)	3	(5)	
	C. Morphological modification through addition, substitution, or deletion of inflectional morpheme (s) and / or functor (s)	0	(0)	2	(3)	71 (30)
			56 (32)		15 (25)	
	D. Syntactic modification through embedding and elaboration in clause (s)	26	(15)	9	(15)	
5.	Repetition of trigger	9	(5)	3	(5)	12 (5)
6.	Confirmation or acknowledgment of indicator only	71	(40)	25	(42)	96 (40)
7.	Indication of difficulty or inability to respond	4	(2)	0	(0)	4 (2)
	TOTAL	178	(100)	60	(100)	238 (100)

In the SCA environment, again because of the limited linguistic ability of the LPLs, the highest response type is also type 6 (42%); the second highest is type 4 (25%) with 4D (15%) followed by type 2 with 12 occurrences (or 20%). 4B only garnered 3 occurrences (or 5%); this meant that there were limited semantic modifications. In other words, response type 6 was very common among the LPLs in both the environments probably due to the limited repertoire of the LPLs. Self modifications of trigger i.e. type 4 was collectively high in both the environments while type 2 was unusually high in the SCA environment among the LPLs; the latter is probably due to the delayed transmission problem in the computer environment.

Compared to the F2F environment, the LPLs seemed more often to supply information which was not directly responsive to the signal of the interactional problem in the SCA environment; this reveals their linguistic inability to follow the interaction and to provide more appropriate responses directly relevant to the utterance before that. This is in contrast with the F2F environment. As for the lower occurrences of type 4B in the SCA environment compared to the F2F environment, semantic modification is limited probably because of the LPLs' limited linguistic repertoire.

Worth mentioning was the response type 4C in the SCA environment which garnered 2 occurrences by an LPL. This type of modification was not tabulated in the HPL or in the LPL data in the F2F environment. In this SCA environment among the LPLs however, both cases belong to an LPL because of the need to self-correct or modify her utterance at the morphological level as the example below shows:

L: **what i mean....**
H: i think we should make it compulsory but let the student decide on which sports they want to enter
L: **what i meant** is they can enter any sports or act they like

For a comparison with HPLs' preference of response type, the three most common response types among the HPLs and LPLs in the F2F and SCA environments were extracted and are presented in Table 9 for the F2F and Table 10 for the SCA environment.

Table 9: The three most common response types among the LPLs and HPLs in the F2F environment

Most common response types by HPLs	Most common response types by LPLs
4D Syntactic modification through embedding and elaboration in clause (s)	6 Confirmation or acknowledgment of indicator only
6 Confirmation or acknowledgment of indicator only	4D Syntactic modification through embedding and elaboration in clause (s)
4B Semantic modification, through synonym, paraphrase, or example	4B Semantic modification, through synonym, paraphrase, or example

Table 10: The three most common response types among the LPLs and HPLs in the SCA environment

Most common response types by HPLs	Most common response types by LPLs
4D Syntactic modification through embedding and elaboration in clause (s)	6 Confirmation or acknowledgment of indicator only
4B Semantic modification, through synonym, paraphrase, or example	2 Suppliance of information relevant to topic, but not directly responsive to indicator (previous utterance)
2 Suppliance of information relevant to topic, but not directly responsive to indicator (previous utterance)	4D Syntactic modification through embedding and elaboration in clause (s)
6 Confirmation or acknowledgment of indicator only	

In contrast to the similar trend observed in the types of indicators tabulated for both the HPLs and LPLS in both the F2F and SCA environments, the response types saw differences more so in the SCA than in the F2F environments. In the F2F environment, the three most common response types are similar but the ranking of frequency of occurrences is slightly different with HPLs having 4D (syntactic modification through embedding and elaboration in clause) as the highest response type followed by type 6 (confirmation or acknowledgment) while LPLs have response type 6 followed by type 4D. 4B (semantic modification, through synonym, paraphrase, or example) is relatively common for both HPLs and LPLs in the F2F environment. The linguistically more capable HPLs were able to generate responses of type 4D which has the greatest potential for SLA because of its syntactic modifications. These varied responses would provide a model and give opportunities to the LPLs to notice form and negotiate comprehensible output. Type 6 occurred most commonly in the LPL's data pointing to their limited linguistic repertoire which limited their ability to modify their utterances. Type 6 responses were also preferred among the HPLs in the F2F environment probably because the simple confirmation or acknowledgment was the easiest form of response and in the F2F environment was appropriate.

In the SCA environment on the other hand, the LPLs' linguistically limited repertoire is evident with the preference for simple acknowledgment in the form of type 6 responses. Furthermore, type 2 responses in the SCA environment were not surprising given the fact that the delay in transmission sometimes caused the suppliance of information relevant to the topic but not directly responding to the indicator. The 4D responses which would be the type of response with the most potential for SLA because of the syntactic modifications does not seem to be given the opportunity to occur as often in the SCA environment for the LPLs compared to the F2F environment. The HPLs' responses on the other hand, having more variety and modifications (type 4D and 4B), were similar to Pica's (1994) findings in the F2F data. These response types would provide evidence of

linguistic adjustments by interactants in negotiating meaning towards comprehensible input and output and in this case, in the SCA environment, provided a more varied linguistic model to LPLs' indication of non-understanding and thus provided more opportunities for notice of form.

In addition, response type 4D which was particularly favoured for the modifications of comprehensible output was tested for correlation with language proficiency. The results show that there is a significant correlation between language proficiency and 4D responses in the F2F environment ($r = .41$, $p < .05$) but not the SCA environment ($r = .30$, $p > .05$). This meant that the 4D responses generated by HPLs were not bound by the environment; HPLs produced 4D responses more in the F2F than in the SCA environment. For the LPLs, the 4D responses were found to be lower in the F2F but not in the SCA environment. The LPLs were given the opportunity to produce type 4D linguistically more varied responses to HPLs' indicators of non-understanding. This significant correlation provides evidence to support SCA as an environment for SLA through responses with syntactic modifications made by low proficiency learners.

SUMMARY AND CONCLUSIONS

On the whole, the role of language proficiency in relation to the occurrences of indicators seemed to show that the greater tendency to indicate problems with type 3 (requests for confirmation through modifications of the trigger) and type 1 indicators (explicit statement or requests for clarification) by both HPLs and LPLs would provide more opportunities for LPL enhancement of SLA in the computer and the F2F environments. The response types produced in the two environments seemed to indicate that LPLs benefitted from the ample opportunity to negotiate for comprehensible input and to notice form due to the HPL's varied syntactic and semantic modifications (types 4D and 4B). The LPLs' response type to produce semantic responses i.e. their comprehensible output, however, seemed to be hindered in the SCA environment but this was not the case for the syntactic modifications which was correlated with LPLs in the SCA environment.

It can be concluded that learners' communicative language ability can be promoted with technology, in this case through the SCA environment. This experimental study utilising the SLA feature of negotiation of meaning or negotiation routines (NRs) provides empirical evidence that this environment offers an additional context for communicative language practice particularly for low proficiency learners.

IMPLICATIONS FOR PEDAGOGY AND RESEARCH

With the empirical findings from this study, language teachers can promote the use of technology (CMC) in language teaching with the awareness that opportunities for SLA are enhanced with the occurrences of negotiation of meaning. The SCA mode of communication cannot replace F2F interactions but it can be an additional environment to provide opportunities for language practice with a view to developing communicative language ability with technology. Specifically, online chats could be an option for communication among learners and between learners and teacher.

In addition, anecdotal studies (Beauvois, 1992; 1998; Kern, 1995) and perception studies (Lee, 2004) on CALL which have promoted the CMC environment for low proficiency or minority or shy learners have gained corroboration from the empirical findings of this study. The SCA environment can support SLA as an additional context for those with low language proficiency to interact with others in the class. For low proficiency learners, it would be particularly beneficial to incorporate lessons using online chats as a bridge for F2F interaction.

Furthermore, the choice of discussion or decision-making tasks in this study generally provided the impetus for interactions and negotiation to occur (Long, 1980). The conversational nature of discussion/decision-making tasks provided potentially equal opportunities for both participants to negotiate meaning toward mutual comprehension of each other's linguistic production. However, unlike jigsaw tasks, there is no guarantee for negotiation to occur because of the open-ended nature of the task objective leading to more authentic production. Thus, goal-oriented tasks of the decision-making type should be deployed for the CMC environment for L2 learning and acquisition.

This study provided evidence that the frameworks employing the SLA negotiation of meaning at the macro (Varonis & Gass, 1985) and micro (Pica et al., 1989) levels were applicable for the further development of research and theory in CALL. The additional analytical framework by Pica et al. (1989) enabled an investigation of the qualitative measures of the routines of negotiation at a micro level. This framework could be employed in similar studies to enable comparisons to be made.

Future comparative research in this area may have as a feature the gender variable. The relatively small number of participants in Pica's et al.'s (1989) F2F study observed some interesting differences in the NRs between the

male and female participants. This merits further investigation. Furthermore, Smith's (2003) expansion model of negotiation in a CMC environment is a relatively new development. His rather detailed model of negotiation of meaning which applies to the CMC context only extends the basic negotiation routines of four stages proposed by Varonis and Gass (1985). Future researchers interested in extending the knowledge on the nature of negotiation of meaning in a CMC context will find Smith's model worth examining.

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PERCEPTION OF YOUNG ADULTS ON ONLINE GAMES: IMPLICATIONS FOR HIGHER EDUCATION

Liwen CHEN
Department of Technology Management
Chung-Hua University, Taiwan
lwchen@chu.edu.tw

Tung-Liang CHEN
Department of Technology Management
Chung-Hua University, Taiwan
tlchen@chu.edu.tw

Hsu-Kuan Jonathan LIU [*]
Department of Hospitality Management
I-Shou University, Taiwan
[*]Corresponding author: jonathan@isu.edu.tw

ABSTRACT
The purpose of this study is to identify and categorize the perceptions of young adults before we allocate the resources to design, develop, and implement digital game-based learning in higher education institutions in Taiwan. Q-methodology was conducted for this study because it is a quantitative analysis of subjective data. Thirty young adults from a university were surveyed and asked to rank-order 30 statements about online games. Factor analysis was used to identify the number of factors and the correlation study attempts to identify the individuals who are highly correlated with one another in each specific factor. The data were processed and analyzed following the usual steps of Q-methodology by using the PQMethod software. Three operant factor types (i.e. New media resisters, Pajamasocializers, and Game value resisters) were identified. The findings of this study can help higher education institutions to be aware of the negative and positive attitudes toward online gaming.

Key words: Nominal Group Technique; Massively Multiplayer Online Role Playing Game MMORPG.

INTRODUCTION
Massively Multiplayer Online Role Playing Game (MMORPG) is becoming a form of both entertainment and socialization for the youth. Online games have become part of the educational, social and cultural activities for the Net Generation. Despite the fact that online games are still held in low regard by a majority of public critics, a growing amount of research indicates that games have promising potential as learning tools (Gee, 2003; Squire, 2003; Shaffer, Squire, & Gee, 2005). The needs and demands of Net Generation students are changing rapidly. Today, students not only expect traditional e-learning with accessibility and availability, but also demand multiple forms of interaction and individualization in distance education programs (Chang & Lee, 2010). What the future of e-learning holds is yet to be known, but much attention has be directed toward integrating features of online gaming systems into the e-learning environment in order to meet the new demand of learners.

Numerous studies have shown that digital game-based learning is the next generation's educational media (Foreman, 2003; Oblinger, 2004; Squire, 2005). In traditional e-learning, educators tend to focus on how much *information* is transferred to the learners via streamed-video lectures, lecture notes posted online, discussion on chat boards, and e-mail communication with instructors. For digital game-based learning, the main focus is multiple forms of interaction with instructors, learners, and the learning content itself. Fundamentally, the primary challenges for instructional designers become how *knowledge* is acquired and possibly distributed, shared, and created within the online community. The curriculum design is no longer "one size fits all," but rather that the learning content is customized for each individual in digital game-based learning programs. Thus, there is increasing emphasis on community, simulation, customized curriculums, constructivistic learning, and social-cultural learning experiences in this new paradigm of e-learning. This new paradigm of e-learning has challenged our fundamental perception of education and games and our role in it. Subsequently, it has the potential to reshape the future of higher education in order to adapt to new demands from learners.

However, despite enormous investments in online learning technologies, most of the available data showed that one of the major obstacles to e-learning is culture resistance. As we look at the worth of online games in higher education**,** the question that needs to be asked is this: If we level the playing field in e-learning and use online

games as the next generation of educational media, will the students utilize this method? This is especially so because these virtual worlds involve significant development costs and continuous development processes. Consequently, the purpose of this study is to identify and categorize the perceptions of young adults before we allocate the resources to design, develop, and implement digital game-based learning in higher education institutions in Taiwan. Therefore, the research questions that guide the study are as follows:

1. What are the subjective opinions of university students in Taiwan on online games?
2. What are the factors that represent university students who share similar patterns of thoughts? How many factors are there?

METHODOLOGY
Measuring Subjectivity
Q-methodology was chosen for this study because it is a quantitative analysis of subjective data. In this study, the instrument was developed based from the in-depth interviews. In addition, factor analysis is used to identify the number of factors and the correlation study attempts to identify the individuals who are highly correlated with one another in each specific factor (Brown, 1992; Brown; 1993; Brown, 1994-1995; Brown, 1996; Brown, 1997)

Participants
The Q-sorts include 30 young adults ranging in age from 19 to 25 years old. Twenty (66.7%) of the respondents were males; the other ten (33.3%) were females. Fifteen (50%) of the respondents were gamers; the other 15 (50%) were non-gamers. The respondents spent time online ranging from one to ten hours daily. In this study, the daily average of hours spent online for the student group is 3.70 (SD = 2.22).

Procedures
The participants were recruited from a private university in Taiwan. First, concourse (viz., a set of comprehensive statements) was collected to reveal the possible paradigms via the first interview with university students. The research instrument, Q-sample in this study, was developed based on the results of the first interview (i.e. Nominal Group Technique was used for this interview) and through literature review. In this study, the Q-sort design is with 9 piles (-4 through +4, with frequencies 2-3-3-4-6-4-3-3-2). The Q-sort design regulates the exact number of statements that a respondent can put into each pile in the continuum. Each participant sorted 30 statements in the Q-sample according to those with which they most agree (+4) to those with which they most disagree (-4). In other words, participants constructed their viewpoints in Q-sorts on the sorting answer sheet (see Figure 1).
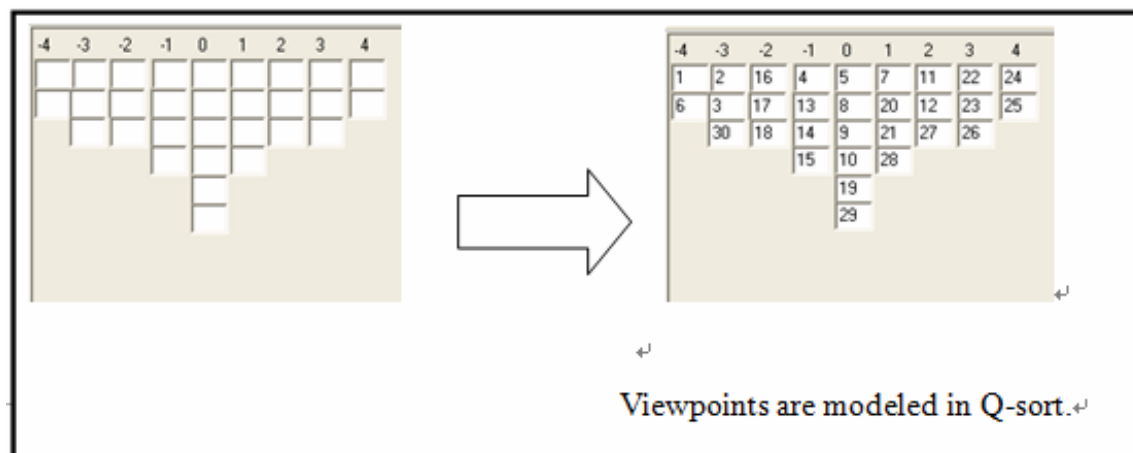
Figure1. Q-sorting

Before sorting, the Q-sample is indeterminate. When a participant sorts the opinion statements, the Q-sample is altered from an indeterminate condition to a determinant one. Each completed Q-sort is a record of an individual's state of the mind. Eventually, 30 students were interviewed and 30 Q-sorts were collected. The 30 Q-sorts were processed and analyzed following the usual steps of Q-methodology by using the PQMethod software. Correlation, centroid factor analysis, and judgmental rotation (hand rotation) were employed to derive significant factors. Overall, three operant factor types were identified.

RESULTS

The analysis of students' Q-sorts which yielded three distinct factor groups: (1) Factor A: New Media Resisters, (2) Factor B: Pajamasocializers, and (3) Factor C: Game Value Resisters. Twenty-three (76.7%) of the 30 students' Q-sorts were divided into the three operant factors. Of the remaining seven Q-sorts, one was not considered to be statistically significant (loadings less than 0.36 on these three factors) and another six were confounded; that is, loading significantly on more than one factor.

It should be noted that more than half of the 23 students whose Q-sorts were analyzed were identified as the New Media Resisters. Of all the factors, A is the most against online gaming philosophically. In contrast, Factor B contains eight Q-sorts (34.7%) and is the most committed advocate of online gaming. The remaining three Q-sorts in Factor C are identified as the Game Value Resisters. Overall, the operant factor structure for the student group is listed and explained as follows (see Table 1):

Table 1. Factor Structure for Student Group (*)

ID.	Gender	Age	Hours spent online daily	Player	Rotated Factors		
					Factor A	Factor B	Factor C
027	M	2	2	Y	69		
025	M	2	2	Y	66		
017	M	2	1	Y	66		
030	F	2	2	N	61		
015	F	2	3	N	60		
018	F	1	3	N	59		
022	M	2	3	N	59		
023	M	2	1	N	58		
010	M	2	2	N	54		
001	M	2	2	Y	53		
019	F	2	1	N	49		
026	M	2	1	N	47		
006	F	2	2	Y	39		
012	F	2	2	Y		79	
014	M	2	2	Y		68	
011	M	2	1	Y		61	
004	M	2	2	Y		60	
024	M	2	2	N		55	
002	M	2	3	Y		50	
003	M	2	3	N		48	
013	M	2	1	Y		45	
016	M	2	1	N			60
029	F	2	1	N			51

(*) only significant loadings shown ($p<.01$), decimals omitted; 7 undefined Q-sorts are not included.
M: Male; F: Female; Y: Yes; N: No; Age 1: under 20 years old; Age 2: 21-25 years old; Hours spent online daily 1: 1-2 hours; Hours spent online daily 2: 3-4 hours; Hours spent online daily 3: above 5 hours.

Factor A: New Media Resisters
Group A, the largest factor group extracted, is comprised of 13 respondents representing 56.5% of the P-sample. Of the Q-sorts in Factor Group A, there are: eight male and five female; five players and eight non-players. Twelve participants range from 21 to 25 years old and one is under 20 years old. In addition, there are four participants who spend one to two hours online daily, six participants who spend three to four hours online daily, and three participants who spend more than five hours online daily. Overall, the following statements are the most highly ranked statements (+4) for factor A (see Table 2):

- Playing online games is a waste of time.

- Gaming reduces the time available for studying, which can negatively impact academic performance.

Members of Group A agreed, but slightly less so (+3) with the following:

- Players might stay up for playing online games. Playing day and night will cause health problems, as well as nearsightedness and other vision problems.
- Playing online games is a waste of money.
- Individuals are vulnerable to Internet addiction while gaming. If players are addicted to the virtual world, this would lead to social withdrawal in real-world.

In contrast, members of Group A disagreed strongly (-4) with the following:

- There are jobs and ranking ladders within players' role-play, which will help players to develop their managing and organizing skills.
- Playing online games can improve reaction time, enhance real-time judgment skills, stimulate brain activities, enhance logical thinking, and improve eye-hand coordination.

And disagreed, but to a lesser degree (-3) with the following statements:

- Playing online games can develop typing skills; playing an English version of an online game can improve English proficiency and can also allow joining gaming competition abroad
- Playing online provides an environment that allows individuals to become familiar with computers and develop computer literacy. It helps players to develop interest in computers.
- Virtual society. I think online games become virtual social communities, which allows players to learn and solve real-world problems in a simulated environment. Players' game characters battle and interact with their opponents' game characters in online games and the players' character interacts with what appear to be other humans in real life.

Compared with the other factor groups, Factor A contains more Q-sorts of females (N=5) and Q-sorts of non-gamers (N=8). Interestingly, five (71.4%) out of seven female participants are in Group A. Of all three factors, members of Group A are the most averse to online gaming, believing that online gaming is related to educational decay, social-isolation, health problems, Internet addiction, and family problems. Factor A participants do not recognize the positive aspects of online gaming, such as social interaction in gaming and players' physical and psychological development. Though members of Group A hold the common stereotypes about online gaming, they do value online gaming as it stimulates the development of the software industry. In addition, they are aware of the popularity of online gaming on higher educational campuses. It is noteworthy that members of Group A are philosophically opposed to online gaming. However, they have a high perceived value of the technical features of online gaming (i.e., graphic design of characters and scenes, sound effects of motion pictures, and role-plays).

Also, it is worth mentioning that there are five gamers (45.4% of the gamer population) who are also the resisters of online gaming in Factor A. The researcher had further interview with these respondents to ensure the research results are consistent with the data collected after interpreting the factors. This finding may be due to the fact that these university students know they do not like online gaming but are asked by their peers and university classmates to explore the virtual gaming world together. In other words, they play games because they want to improve friendships with their existing peers. They play games because it is a common topic among students' peer groups. Their opinion profiles reveal that they show strong negative feelings about online gaming, but they see that online games have brought friends together for shared play and interaction.

Factor B: Pajamasocializers
Group B, representing 34.7% of the P-sample, is comprised of eight respondents. Of the Q-sorts in Factor Group B, there are: seven male and one female; six players and two non-players. Interestingly, six (75%) out of eight participants in Group B are gamers. Members of group B are all 21 to 25 years old. In addition, there are two participants who spend one to two hours online daily, four participants who spend three to four hours online daily, and two participants who spend more than five hours online daily. Overall, the following statements are the most highly ranked statements (+4) for factor B (see Table 2):

- The visualizations, 3D graphic design, and sound effects of motion pictures in online gaming are nice; the design of characters is cute; the design of the scenes is vivid and sophisticated.
- Many university students play online games. Online gaming is a common topic among students' peer

groups.

Members of Group B agreed, but slightly less so (+3) with the following:

- Playing online games is a waste of time.

- Gaming is highly interactive. Individuals can play their own roles, organize a team for adventures, and accomplish tasks in order to gain experiences and advance in levels.

- Playing online games can improve reaction time, enhance real-time judgment skills, stimulate brain activities, enhance logical thinking, and improve eye-hand coordination.

In contrast, members of Group B disagreed strongly (-4) with the following:

- Some online games contain too much sex or violence. Thus, they are not suitable for everyone to play.

- I think online game play will lead individuals to isolate themselves from other family members. It will raise concerns on family relations.

And less so (-3) with the following:

- Playing online games can make money (selling an account number and virtual objects).

- Playing online games will stunt brain activities and people will become very stupid.

- I feel online games only target those specific groups of people in Internet cafes and only target youth. The market is not fully penetrated yet.

Compared to the other factor groups, Group B has higher percentages of gamers (N=6) and males (N=7). Of all three factors, members of Group B are the most optimistic about the social, technical, psychographic, and behavior benefits of online gaming, including the multimedia design, interactivity and social learning, higher order thinking and eye-hand coordination, instant feedback, self-affirmation, multiple identities, and anonymous companionship. Factor B participants do not recognize the common stereotypes and negative aspects of online gaming such as parent-child communication problems, social isolation, violence and violent acts within the games, internet addiction, educational decay, and stunted brain development.

Group B participants are aware of the popularity of online gaming on higher educational campuses. In addition, they don't consider gamers to be limited to young people and believe that the current gaming market already includes various demographic subgroups. In other words, there are different age-groups of gamers existing in the virtual world.

Factor C: Game Value Resisters
Group C is comprised of two respondents. Of the Q-sorts in Factor Group C, there are: one male and one female; two non-gamers. Both members in Group C are 21 to 25 years old. Both participants spend one to two hours online daily. They identified strongly (+4) with the following statements (see Table 2):

- Playing online games is a waste of time.

- Playing online games is a waste of money.

Members of Group C agreed, but less so (+3) with the following:

- Until now, there has been no online game rating or age regulatory system for players. The government is too slow and too far behind to develop online gaming-related policies.

- Online games, with a lot of hidden online crime, have increased problems in society.

On the other hand, members of Group C disagreed strongly (-4) with statements:

- The higher the level, the higher the achievement. For pursuing victory, individuals will keep playing continuously.

- Online games occupy Internet broadband usage and waste public resources. Online games have not much value – we should not give them too high a regard or over-promote online games.

- I think online games ensure privacy and anonymity. They provide a form of escape and help players forget about the real world troubles and pressures, as well as being an activity for killing time.

And less so (-3) with the following:

- Some online games contain too much sex or violence. Thus, they are not suitable for everyone to play.
- I think online game play will lead individuals to isolate themselves from other family members. It will raise concerns on family relations.
- I will be in a good mood if my avatar is dressed appealingly - those virtual objects make me feel gorgeous!

Group C participants deem online gaming a waste of time and money. However, they still recognize a few benefits and positive effects of online gaming, such as enhanced typing skills and language proficiency. Apparently, they still see some value in gaming. In addition, they do not appear to be concerned over the contents of online gaming (i.e., violent behavior) nor the parent-child communication problems. In fact, this group is quite concerned about gamers' social isolation issues, the crime in the virtual world, and the slow development of government policy related to online gaming.

Consensus Statements

Taking the analysis as a whole, this study reveals various perceptions about online games and three factor types are identified in this study: (1) New Media Resisters, (2) Pajamasocializers, and (3) Game Value Resisters. Overall, the students' statement scores by factors/opinion types, generated by the PQmethod statistical software, are shown in Table 2. However, consensus statements between Factors A, B, and C are twofold. The most agreed upon statement among all three factors was "Playing online games is a waste of time." They reveal that those students in Group A, B, and C do not recognize the practical value of playing online games.

In addition, the most disagreed upon statement among all three factors was "I think online games only target those specific groups of people in Internet cafes and only target youth. The market is not fully penetrated yet." Those respondents believe the online gaming industry has already targeted market segments besides the subgroup of youth and the submarket of gamers in Internet cafes.

Table 2. Student Group's Statement Scores by Factors/Opinion Types

Statements	Factors(*)		
	A	B	C
1. The visualizations, 3D graphic design, and sound effects of motion pictures in online gaming are nice; the design of characters is cute; the design of the scenes is vivid and sophisticated.	2	4	0
2. Playing online games is a waste of time.	4	3	4
3. Many university students play online games. Online gaming is a common topic among students' peer groups.	2	4	0
4. Playing online games can make money (selling an account number and virtual objects).	-2	-3	1
5. Playing online games can develop typing skills; playing an English version of an online game can improve English proficiency and can also allow joining gaming competition abroad.	-3	-1	2
6. Gaming reduces the time available for studying, which can negatively impact academic performance.	4	-2	2
7. Online gaming is one way of making new friends. People who come from different places or players who have the same interests can chat, disclose their feelings, and care for each other online. Also, fellow players sometimes meet each other and have fun together in the real world.	-1	2	1
8. Players might stay up for playing online games. Playing day and night will cause health problems, as well as nearsightedness and other vision problems.	3	0	1
9. Some players often voluntarily help fellow players in online games, such as guiding the way, lending tools and equipment, teaching how to reach the next level. Some players voluntarily share their experiences battling monster and level-up know-how for other players as reference guides on gaming-related web sites.	-1	1	-1
10. Until now, there has been no online game rating or age regulatory system for players. The government is too slow and too far behind to develop online gaming-related policies.	0	1	3
11. Playing online provides an environment that allows individuals to become familiar with computers and develop computer literacy. It helps players to develop interest in computers.	-3	1	0
12. There are jobs and ranking ladders within players' role-play, which will help players to develop their managing and organizing skills.	-4	0	0
13. Playing online games will stunt brain activities and people will become very stupid.	0	-3	1

Item	A	B	C
14. Gaming is highly interactive. Individuals can play their own roles, organize a team for adventures, and accomplish tasks in order to gain experiences and advance in levels.	0	3	-1
15. Some online games contain too much sex or violence. Thus, they are not suitable for everyone to play.	0	-4	-3
16. I think online game play will lead individuals to isolate themselves from other family members. It will raise concerns on family relations.	1	-4	-3
17. The higher the level, the higher the achievement. For pursuing victory, individuals will keep playing continuously.	-1	1	-4
18. I think online games only target those specific groups of people in Internet cafes and only target youth. The market is not fully penetrated yet.	-2	3	-1
19. Online games can stimulate the development of the software industry.	1	1	-1
20. Virtual society. I think online games become virtual social communities, which allows players to learn and solve real-world problems in a simulated environment. Players' game characters battle and interact with their opponent's game characters in online games and the player's character interacts with what appear to be other humans in real life.	-3	2	-2
21. Playing online games can improve reaction time, enhance real-time judgment skills, stimulate brain activities, enhance logical thinking, and improve eye-hand coordination.	-4	3	-1
22. I will be in a good mood if my avatar is dressed appealingly - those virtual objects make me feel gorgeous!	-2	0	-3
23. Online games occupy Internet broadband usage and waste public resources. Online games have not much value – we should not give them too high a regard or over-promote online games.	0	-2	-4
24. Playing online games is a waste of money.	3	-1	4
25. Online games, with a lot of hidden online crime, have increased problems in society.	2	0	3
26. Individuals are vulnerable to Internet addiction while gaming. If players are addicted to the virtual world, this would lead to social withdrawal in real-world.	3	-1	0
27. I think online games ensure privacy and anonymity. They provide a form of escape and help players forget about the real world troubles and pressures, as well as being an activity for killing time.	-1	0	-4
28. I think online games will lead users to a degree of social withdrawal and have anti-social behaviors toward society. It has a negative impact on players' human relations in general.	1	-2	2
29. Security issues are a very high concern, because accounts, passwords, and virtual objects are easily stolen.	0	0	2
30. Online games provides different role-plays and players can assume a "reinvention of self" and experience different identities which are distinct from their real life. Players can self-manipulate and control what they cannot achieve in offline settings. I think online games satisfy personal imagination and fantasy.	1	2	-2

* Item rankings: -4 = most unimportant in this sample; 0 = ambivalent; +4 = most important in this sample

DISCUSSION AND CONCLUSION

The Group A participants (56.5% of the students) are philosophically opposed to online gaming. Group A participants reacted affirmatively to most of the negative statements about online gaming. Furthermore, those Group B respondents, representing 34.7% of the student group, are the supporters of online gaming who had high philosophical value ratings and high technical value ratings in this study. In addition, members of Factor C have more neutral attitudes toward online gaming. They think that video games have some negative effects, but also have some benefits. Interestingly, this research does find evidence of some negative perceptions of gaming, but closer examination with those gamers (i.e. gamers in both the New Media Resisters' group and the Pajamasocializers' group) reveals that online gaming is a valuable social learning tool.

This study began with the premise that today's university students recognize the positive effects of online games, however, the following conclusions from my study reveal a very different picture: (1) most of the students are philosophically against online gaming; (2) online games are a social activity and an interactive medium; (3) the concerns of female students need careful consideration. Accordingly, the findings indicate that respondents' attitudes about online gaming are not affected by age or by hours spent online daily, but by gender and prior game-playing experiences.

1. Most of the students are philosophically against online gaming.
   The results of this research have illustrated that the majority of university students (approximately 56.5% of the participants) are philosophically against online gaming. Based on the findings, we can no longer assume

that all of the university students demand a game-based learning environment. In other words, online gaming will attract some learners while repelling others, as previous literature explained (Squire, 2004), especially, individuals who perceive both a low philosophical value and a low technical value toward gaming.

2. Online games are a social activity and an interactive medium.
The gamers in Pajamasocializers are the most optimistic about the social benefits of online gaming. In addition, those gamers in the New Media Resisters' group explained that online gaming is a social gathering place for youth. It helps players to improve friendships with their existing peers. Therefore, as evidenced by those gamers in both the New Media Resisters and the Pajamasocializers, online gaming is a social learning tool and it provides multiple forms of interaction.

3. The concerns of female students need careful consideration.
Overall, the findings of this study provide new information that female students may not choose to engage in digital game-based learning methods. Most of female students do not recognize the positive aspects in online gaming. And they also hold the common stereotypes about gaming. This study suggests the gender differences in the gaming worlds. In other words, the concerns of female students need careful consideration. In fact, this research suggests that females may be socially against video games or are likely to have psychological barriers when gaming in public. Therefore, an attention should be paid to gaming narratives, graphic design, game characters, and story structure. Especially because the gaming industry, game worlds, and education policy makers are usually male-dominated, such information can be useful to game developers and higher education administrators as they recruit more females to make strategic decisions about games design and digital game-based learning projects in the curriculum.

FINAL THOUGHTS: INNOVATION FOR LEARNING
In this internet economy era, school administrators face a number of challenges, one of which is how universities ought to relate to media. In this study, the researcher has gathered data to diagnose internal realities in universities. This research indicates that the majority of students showed negative feelings about online gaming. Should schools turn their backs to emerging media? This research does not propose that this is the end of the story for digital game-based learning. Clearly, if schools are going to face demands for change, they should also be sensitive to the external realities, especially in this networked, global world.

Generally speaking, it is unlikely that the trend and the development of digital game-based education will abate in the foreseeable future as the literature review suggested previously. Few young learners today live in a home without a computer and few of today's elementary school students in countries such as Taiwan and South Korea have known a world without video games. Research universities are continuously facing competition from profit-oriented institutions. More and more companies, such as Microsoft, are looking at the value of online games for educational use. Higher education institutions must be prepared for what lies ahead. Based on this understanding, one of the biggest challenges facing higher education today is how to achieve student satisfaction and retention in a cost effective manner against tough competition. Certainly, online games cannot be a complete substitute for textbooks on campus at this stage, but they could be an alternative for learners with different learning styles. As a matter of fact, information technology is not always a cure for all the challenges we are facing on university campuses; however, it signals a new era for higher education in this twenty-first century.

IMPLICATIONS FOR HIGHER EDUCATION
After the e-learning boom went bust, university online education was left facing a host of unrealized threats and opportunities, from digital game-based learning to mobile learning. Where will the e-learning program go from here, and who will drive it forward? Consequently, it is vital for higher education institutions to be aware of the negative and positive attitudes toward online gaming indicated in the research findings. Based on the results of the study, recommendations for further research for universities which intend to encourage the implementation of digital game-based learning are listed as follows:
1. Minimizing uncertainty and risk

- Universities should consider how to encourage the acceptance of digital game-based learning among female students. More female game designers should participate in digital game-based learning projects. More female students should be invited to join the games during the beta-testing stages in order to get their feedback.

2. Ensuring the Quality of Digital Game-Based Programs
- Attention should be paid to gaming narratives, story structure, characters, and graphic design.

Therefore, it will be well accepted by a diverse and multicultural population of students and faculty in higher education institutions in order to stress racial, gender, and culture diversity in the virtual world.

○ Online gaming oftentimes does not match the assessment criteria in most of national testing. Universities should consider how students, teachers, and school boards would criticize or accept the notion of playing games in formal educational settings since such process-oriented and socio-cultural approaches (i.e., Deweyian pragmatism) have a troubled history of implementation in the standard national curriculum.

○ Higher education institutions should have a proper balance between the formal and the informal modes of education, a proper balance should be created between theory and practice in the virtual world, and a proper balance should be designed between learning content and context in digital game-based learning programs. Curriculum designers and game designers should work closely in order to assure the quality of the programs.

○ In order to provide scaffolding experiences to learners, universities should employ some experienced individuals or subject matter experts (i.e., practitioners or retirees in that subject area) to act as game masters (GM) in the virtual world; so that personal support and adequate responses can be provided simultaneously in the virtual world.

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THE PERCEPTIONS OF STUDENTS, TEACHERS, AND EDUCATIONAL OFFICERS IN GHANA ON THE ROLE OF COMPUTER AND THE TEACHER IN PROMOTING THE FIRST FIVE PRINCIPLES OF INSTRUCTION

Frederick Kwaku SARFO (PhD)
Department of Interdisciplinary Studies, College of Technology Education – Kumasi
University of Education, Winneba, Ghana
Sarfofredk2001@yahoo.com

Kwame ANSONG-GYIMAH
Department of Information Technology Education, College of Technology Education – Kumasi
University of Education, Winneba, Ghana
kwameansong@gmail.com

 ABSTRACT
This study explored the perceptions of 395 participants (students, teachers, and education officers) in Ghana on the role of the computer and the teacher in promoting the first five principles of instruction for quality teaching and learning. To achieve the intention of the study, five point Likert-type scales based on the first five principles of instruction, with Cronbach alpha of .87, were used for the data collection. Frequency distributions and chi-square tests were employed to analyse the data. The results of the study indicate that there is perception dissimilarities among the participants on the role of a computer and a teacher in implementing the first five principles of instruction. In addition, according to the findings, there is a mismatch of participants' recommendations on training students to acquire computer skills, and training teachers to acquire skills in designing their teaching. The theoretical and practical implications of the results are discussed.

Keywords: first five principles of instruction, perception, students, teachers, computer

INTRODUCTION
During the last few years, information and communication technology (ICT - in the context of this study is computer specific) has been adopted in many areas such as business, entertainment, government and education. The global adoption of computers has been the landmark on the educational scene for the last few years (Albirini, 2006). Harvey (1983) envisages that the effectiveness of the use of computers in education may be an important factor in determining which countries will succeed in the future.

 Computers are used in education for varied reasons (Leshin, Pollock, & Reigeluth, 1992; Heinich, Molenda, Russell, & Smaldino, 1996). In most of the schools, computers are used to aid management and administrative activities - activities that directly relate to management and administrative support, and activities that steer the management of the whole organisation as one entity. In addition, computers are used in schools as an object of instruction - learning to acquire computer knowledge and skills to meet the challenges of the information age. Moreover, in most schools, specifically in higher institutions, the curricula have been upgraded to include computer components (e.g., computer application in accounting, computer application in design and technology, computer application in medicine, computer application in curriculum development). Furthermore, and more importantly, computers are used for learning and instructional purposes. In this article, the interest in computers concentrates on their use in schools for learning and instructional purposes.

In developing countries, particularly in Ghana, the metaphor of the information age has generated a whole set of speculations about the need for educational reforms that will accommodate the new tool, "computer", as indicated by Pelgrim (2001). Government and educational planners in Ghana have responded to the challenge by creating national programmes to integrate new technologies (e.g., computers, internet, and intranet) at all educational levels. Computer technology is attracting a large proportion of the country's limited budget for education. However, with regard to the use of computers in teaching/instruction to increase learning gains, as noted by Earl (2002), Sarfo & Elen (2007) and many other instructional technology researchers, the costs are huge, but the impact may not be realised as expected. Solomon (2002) indicates that the revolutionary change in education - learning in particular – expected with the computer has not been realised. One of the reasons assigned to this, according to Solomon (2002), is that computer users in educational settings, thinking that computer alone will bring a revolutionary change in learning, mostly focus on access to computer rather than on effective instructional principles designed by teachers. This study sets out to investigate the perceptions of students, teachers, and education officers on the role of computer and effective instructional principles designed

by the teacher for successful learning. The intention is to make academic contribution to the integration of computer into teaching and learning to promote the achievement of quality education.

RELATED LITERATURE

Since the 1980s, the proliferation of micro-computers with their ever-increasing power, processing capacity and lower prices, has generated a renewed interest in integrating computers in education And there has also been a significant increase in the number of computers in schools (Reiser, 2001). Educational policy makers and educational practitioners believe that integrating computers in instruction is an excellent means of achieving the modern aims of education. In that regard there is a widespread conception that computer technology can play a key role in enhancing teaching and learning (Kozma & Macghee, 2003).

Kozma (1994), who is recognised as one of the best known prolific debaters for media (computer) effectiveness in instruction and learning reviewed two studies/projects: 1) thinker tools (White, 1984, 1993) and 2) Jasper Woodbury series (Cognitive and Technology Group at Vanderbilt, 1992). He concluded that processing capacity rather than symbol systems or attributes of media (computer) facilitate learning. According to Kozma (1994), the capacity of a medium determines its strengths and functions in cognitive processes. The capacity of computers is the underlying structure that explains and contributes to understanding how computers influence learning (Seel & Winn, 1997). A review conducted by Schater (1999) shows that on the average, students who used computer instruction scored in the 64th percentile on tests on achievement, compared to students in the controlled conditions without computers who scored in the 50th percentile. Moreover, research results of ImpaCT2 (a project commissioned by the U.K Department for Education and Skills and managed by BECTOR (2002) indicates that computer use has a positive impact on test results. In Michigan's Freedom to Learn (FTL) program, laptops are provided to a number of state's middle schools along with extensive teacher professional development around technology integration. Evaluations on the progam by Lowther, Strahl, Inan, & Bates (2007) show that students participating in the FTL had significantly higher levels of engagement in their work and in using computer as a learning tool when compared with the national average.

In addition, the results of randomised control trials conducted by Murphy (2007) to test for the effect of the use of computer to learn foreign language comprehension found significant positive effects. In line with these findings and many others, many computer determinists entertain the expectation that the introduction of computers itself will bring about quality teaching and learning (Elen, Lowyck & Van den Berg, 1999). According to them, all one needs to do is to equip schools with computers and access to the internet and a positive change will follow. The conception that computer can play a key role in enhancing teaching and learning has also been expressed in Ghana (President's Committee on Review of Education in Ghana, 2002). In Africa, and specifically, in Ghana, the sentiment for the introduction of computer technology in all schools and other governmental and non-governmental organisations has been best summarised by Professor F. H. Allotey of the Kwame Nkrumah University of Science and Technology when speaking in Tanzania to top decision-makers in Africa:

> "We paid the price for not taking part in the industrial revolution of the late eighteenth century because we didn't have the opportunity to see what was taking place in Europe. Now we see that information technology has become an indispensable tool. We can no longer sit down and watch passively" (Sagahyroom., 1995, p 164).

Following this idea, many educationalists, students, teachers, policy-makers (including the government), and other agencies are optimistic that computer technology is the bedrock of quality socio-economic activities and quality education, particularly quality teaching and learning in Ghana (President's Committee on Review of Education in Ghana, 2002; ICT for Accelerated Development [ICT4AD], 2003; World Bank, 2007). Over the past years, government, Microsoft Corporation, and other agencies (e.g., Voltacom) have made attempt to develop ICT (computer) in Ghana. One of the moves is the Kofi Annan ICT Centre of excellence. This centre is a joint Ghana India project established with the main responsibility to produce the human capacity needed for the various educational institutions and the emerging ICT industry in Ghana. In 2004, Parliament passed into law Ghana's ICT4AD   policy. The policy indicates the vision of Ghana in relation to ICT in the knowledge and technological age. It addresses fourteen priority stages. One of the stages is promoting ICT in education – the deployment and exploitation of ICTs in education. This policy is at various stages of implementation. In addition, through the help of various agencies, including Global e-School and Communities Initiative (GeSCI), an ICT in Education policy document was prepared and released in 2007 (Mangesi, 2007). Some of the objectives of the policy:

- ensuring that students have ICT literacy skills before coming out of each level of education;
- providing guidelines for integrating ICT tools at all levels of education;
- facilitating training of teachers and students;
- promoting ICT as a learning tool in the school curriculum;

In line with these developments, many of the universities and polytechnics in Ghana have developed their own ICT policies. For instance, learning management system has been developed to support teaching and learning activities in the University of Ghana (Mohammedhai, 2009). Internet facilities are available in almost all the public universities (e.g., University of Ghana, Kwame Nkrumah University of Science and Technology, University of Education, Winneba) and private universities (e.g., Ashesi University, Valley View University) to facilitate research/development, teaching, and learning activities. These developments are not without problems relating to poor maintenance system; woefully inadequate resources (computer – hardware and software); very slow internet connectivity; high cost of internet usage; power interruption; and many others.

Attempts have been made to provide computer laboratories in most of the Senior High Schools (SHS). However most of the basic schools have no laboratories (President's Committeee on Review of Education, 2002). Even the computer laboratories in most of the Senior High Schools are virtually empty. Those which have been equipped, have computers that are very old and cannot function properly or are completely dysfunctional. Some schools have managed, on their own, to acquire computers through their Parents Teachers Associations (PTA) and Old Boys and Old Girls Associations. In most of the schools (tertiary, SHS, and basic), both the students and the parents agree to pay certain amounts as part of their school fees towards the purchase of computers to facilitate teaching and learning.

Apart from a few experimental Senior High Schools and very few SHSs in the urban areas, there are no internet facilities in Senior High Schools in Ghana. Lack of funding is the most common reason for the inability to acquire adequate computer facilities in Basic and Senior High Schools. It can be concluded that in Ghana there is a remarkable attempt at the government level, ministerial level, school level, parent level, and student level to provide ICT (computer) resources to facilitate teaching and learning towards the achievement of quality education.

However, it is quite clear that the use of computer or any medium at all to improve learning is subject to considerable debate (Clark, 1994, 2001; Kozma, 1994, Sarfo & Elen, 2007). From the literature, the issue of pedagogical effectiveness of computer technology in teaching and learning has not been convincing.

Clark (1994, 2001), who is one of the best-known prolific debaters against media (computer) gains in learning, indicates that the achievement gains resulting from computer based instruction studies are overestimated and that they are actually due to the uncontrolled, but robust instructional method in computer based instruction. In other words, findings in the studies that support computer gains in learning confound medium (computer) with content or method. The learning gains achieved were due to the method, the content, or novelty, and not to the computer used. It is not the processing capabilities of media (computer) that facilitate learning. Instead, it is the creative development of instructional strategies or methods that actively engage learners (Sarfo & Elen, 2007).

To support this assertion, Smaldino, Lowther, & Russell (2008) emphasise that the 'magic' in computer technology, if it existed, all lies in the instructional design of the software, and not in the hardware. Moreover, after having thoroughly and comprehensively reviewed 375 empirical studies conducted in the past 70 years, Russell (1999) provides abundant evidence that technology (e.g., computer) does not directly improve learning.

In addition, Salomon (2002) indicates that despite the infusion of information technologies with the internet and multimedia, e-mail and simulations, and endless other possibilities and affordances, classrooms today with the exception of few daring pioneering cases, are not very different from those of yester-years in terms of learning impact. Earle (2002) claims that despite the general sense that the computer revolution of the last decade has had a major impact in schools, the nature of this impact seems to be limited to access and information retrieval rather than improved teaching method to yield learning gains. The results of the study conducted by Sarfo & Elen (2007) to test the effects of powerful learning environments with and without computer indicated no significant difference in terms of learning gain. In a study of the effectiveness of reading and mathematics with and without computer on standardised test scores, Dynaski et al. (2007) found no significant improvement in scores between treatment and control classrooms in either subject.

In summary, the above research results and reports suggest that the use of the computer will not itself result in better learning. More importantly, there is established evidence based on what has been discussed that effective design of support (good design of learning tasks and interventions), rather than the computer is the fundamental building block and therefore the most effective means of achieving quality education.

In regard to the design of effective support for learning, Merrill (2002, 2006) has identified the first five principles of instruction: 1) task centeredness, 2) demonstration, 3) activation, 4) application, and 5) integration. Merrill argues that any quality instruction should meet all the five principles. Task centeredness is based on the proposition that development of competencies is promoted if learners are engaged in solving real life problems. This has been the main focus of contemporary learning theories. Task-based instruction provides specific demonstration of a particular whole task (e.g., van Merienboer, 1997; van Merrienboer & Kirschner, 2007) similar to those things the learners will confront in real life settings. The demonstration principle indicates that learners remember and can apply information better when the information includes specific examples. van Merrienboer & Kirschner (2007) indicate that showing a learner what to do through worked-out examples, and modeling example, in addition to practice, are important dimensions for successful learning. The activation principle emphasizes that learning is promoted when relevant prior knowledge is activated. Stimulating prior knowledge of the learners and making it active for use in working memory, as a foundation for new information, is the key to productive and successful learning. The application principle asserts that learning is promoted when learners are required to use their new knowledge to solve problems. Finally, the integration principle indicates that learning is facilitated when learners are encouraged to integrate new knowledge or skills into their everyday life. Merrill (2002, 2006) indicates that the real intrinsic motivation for learners is learning. Learners have integrated instruction into their life when they are able to demonstrate improvement in skills and modify their new knowledge for use in their everyday lives. These five principles are recognized in the literature of instructional design and technology as the fundamental requirements for quality teaching/instruction and learning. Computer is not the basic requirement for productive learning and the computer alone or itself does not lead to pedagogical innovation, but the use of the computer is part of a more extensive pedagogical innovation based on the principles of effective instruction. Therefore to achieve the modern aims of education it is very important to also focus more attention on the training of teachers to acquire quality knowledge and skills in instructional design related to the principles of effective instruction. In addition, it is also important to expose learners to the effective principles of instruction.

Research Questions
It is evidenced in the literature review that both effective use of a computer and the design of effective learning support by the teacher are equally important for effective learning. Merely purchasing computers and practice softwares is not enough (ISTE, 2008). Nonetheless, it seems in developing countries, specifically Ghana as described in the literature, the need to provide computers in the classrooms has taken precedence over training teachers to acquire adequate knowledge in effective instructional principles for quality learning. In the context of education, more particularly in teaching and learning, as discussed in the literature, focusing most or all attention on the expansion of computers in the classrooms perceiving that it is the computer alone that can promote quality learning is not the optimal means of achieving quality education. This is especially so in Ghana as a developing country where there are limited resources. More importantly, from both theoretical and empirical perspectives, teachers and students perceptions on the elements of the learning environments seem to have a significant impact on students learning. For instance, according to Konings, Brand-Gruwel, & van Merrienboer (2005) students' and teachers' perceptions and conceptions of a learning environment do influence student learning and the quality of learning. Teo (2009) provides an empirical evidence to support the proposition that teachers' beliefs and perceptions about the use of technology (computer) affect the way they use technology in teaching. Therefore, the perceptions of educational practitioners in Ghana (especially students, teachers, and education officers) on the role of computer and effective principles of instruction by the teacher should be empirically investigated and properly addressed. If not it could affect the planning, designing, and implementation of effective learning environments (with computer) towards the achievement of modern aims of education in Ghana. In addition, according to ISTE (2008), to implement technology for learning successfully, among other things, the professional development of teachers is equally important. Teachers, as well as students, not only need training in computer literacy but also in application of various kinds of educational software in teaching and learning (Castillo, 2007). Teachers should be motivated to learn how to integrate computer into their classroom activities and school structure.

This study is intended to explore the perceptions of educational practitioners (teachers, students, and education officers) in Ghana on the role of computer and the teacher in the implementation of the first five principles of instruction for promoting quality education. Also the study explores the participants' recommendations for the training of the students and teachers on the use of computer on one hand, and effective instructional design

principles by teachers on the other hand for the achievement of quality teaching and learning. The goal is to achieve a better means of integrating computer in teaching and learning to promote quality education in Ghana as a developing country.

METHODOLOGY
Participants
The participants of this study were:

a) three hundred 3rd Year students selected from six SHS with 80 from each school and comprising 190 males and 110 females; their ages ranged from 18-22 with average age of 19.
b) seventy one teachers made up of 50 males and 21 females selected from six SHS with ages ranging from 29-59 and averaging 37.
c) twenty four education officers or policy makers – 13 males and 11 females selected from Regional Education offices in Ghana with age range 33-58 and the average of 41.

Research materials
The basic instrument for the study was a questionnaire: 5 point Likert-type scale from strongly agree to strongly disagree comprising 15 items; and three additional questions to identify the participants' recommendations. The scale was constructed based on the first five principles of instruction (Merrill 2002).

The questionnaire consisted of the introduction, Part I, and Part II. The introduction briefly contained the importance of the study, and the fact that participants' responses would be treated as confidential. Part I included participants' profile: age, sex, and name of school or place of work. Part II consisted of the instructions for the participants; the 15 items of 5 point Likert-type scale; and the questions to explore students' recommendations.

The introduction of Part 11 read "Each of the statements in the scale expresses an idea or a perception about strategies for effective instruction/teaching. Please rate this statement to the extent to which you agree. For each statement choose 'A' if you strongly agree; 'B' if you agree; 'C' if you are undecided – which means both computer and the teacher can do it equally well; 'D' if you disagree; and 'E' if you strongly disagree". The statements in the scale were developed based on the first five principles of effective instruction (Merrill 2002): task centeredness; application; activation; demonstration, and integration. Three effective instructional strategies, based on each of the First Five Principles of instruction (Merrill, 2002) were used to construct three statements for each principle (See table 1 for the details), but the statements were reshuffled in the scale. In total the scale consisted of 15 statements with Cronbach alpha of .87. As regards the participants' recommendations, they were asked to choose any one of the following recommendations which in their view was the priority and reflected their perceptions:
- teachers should be trained to use computer to support their teaching;
- students should be trained to be able to use computer to learn in the classroom without the teacher; and
- teachers should be trained to know better how to design their instruction and teaching for effective learning

Table 1: The 15 statements on the first 5 principles of instruction

First five principles of instruction by Merrill
1.Task centeredness
• Using a computer as a technological tool can help learners to solve challenging real life problems better than a teacher
• Using a computer as a technological tool can support learners to gradually acquire knowledge and skills needed to work in real life situations better than a computer
• A teacher can support learners to gradually work on activities similar to real life activities better than a computer
2.Application
• A teacher can help learners apply what they learn in the classroom better than a computer
• Using a computer as a technological tool can help learners use the new knowledge to solve problems better than a teacher can help them
• A teacher can help learners to transfer the acquired knowledge to various situations better than a computer
3.Activation
• Using a computer as a technological tool can help learners to remember previous knowledge better than a teacher

- A teacher can help learners recall the previous knowledge better than a computer
- A teacher can stimulate the recall of previous knowledge in learners better than a computer

4.Demonstration
- A teacher can present specific examples better than a computer
- Using a computer as a technological tool can present good examples better than a teacher
- Using a computer as a technological tool can present lifelike skills or procedures better than a teacher

5.Integration
- A teacher can help learners to defend the acquired knowledge outside the classroom better than a computer
- Using a computer as a technological tool can help learners use the new knowledge in their everyday life better than a teacher
- A teacher can help learners reflect on what they learn better than a computer

Procedure

The questionnaire was pilot tested and reviewed by the researcher and one instructional design professor. The researcher administered the final questionnaire to the participants in their classrooms and offices. The administration took about 25 minutes for the students and 20 minutes for the teachers and the education officers (policy makers). The students were instructed to work independently, and they were supervised by the researcher. Data gathering took approximately 1 month.

RESULTS

The data were collated, frequency distributions and chi-square tests were carried out to analyse the data in order to answer the research questions.

Participants' Perceptions

Table 2 shows the overview of the frequency scores on participants' degree of responses to the statement that computer can facilitate the implementation of the first five principles of instruction better than the teacher

Table 2: Overview of frequency scores: perceptions about computer can facilitate the implementation of the "first five principles of instruction" better than a teacher

Responses	Students		Teachers		Education officers	
	Frequency	%	Frequency	%	Frequency	%
Strongly agree	110	36.67	16	22.54	6	23.33
Agree	46	15.33	12	17.18	4	17.50
Undecided	45	15	12	17.18	3	13.33
Disagree	53	17.73	19	27.32	8	32.50
Strongly disagree	48	15.27	11	15.77	3	13.33
Total	300	100	71	100	24	100

The results of the analysis showed that 37% of the students strongly agreed that the computer can facilitate the implementation of the first five principles of instruction better than the teacher, 15% agreed, 15% undecided, 18% disagreed, and 15% strongly disagreed (figure 1 shows the overview of the students' responses). A chi-square analysis conducted on the students degree of responses revealed significant statistical difference χ^2 (4, N = 300) = 56.3, p = 0.05 indicating that students generally strongly agreed with the sentiment that the computer can facilitate the implementation of the first five principles of instruction better than the teacher.
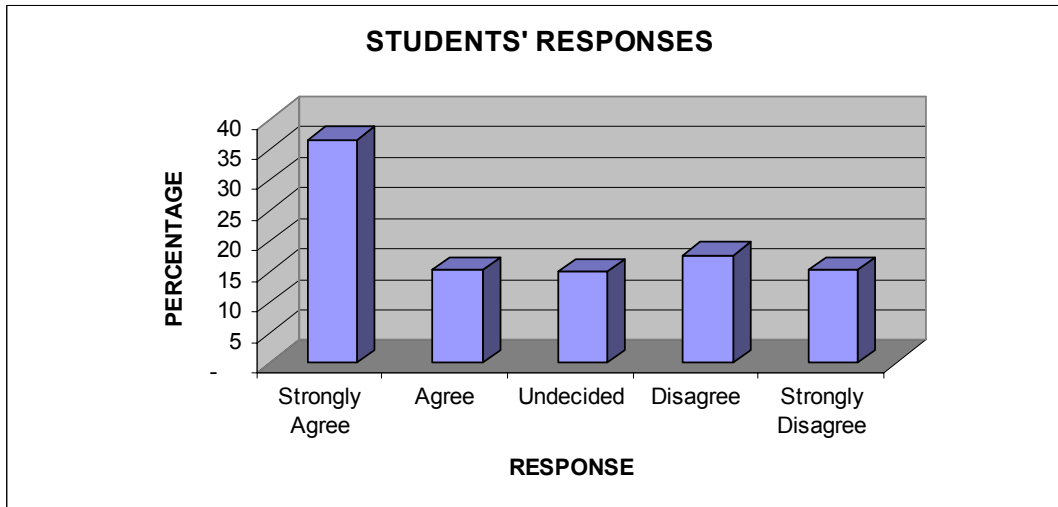
Figure 1. Overview of students' responses

For the teachers, 23% strongly agreed that the computer can facilitate the implementation of the first five principles better than the teacher, 17% agreed, 17% undecided, 27% disagreed, and 16% strongly disagreed (Figure 2 depicts the overview of the teachers' responses). A chi-square analysis conducted indicated no significant statistical difference in teachers' degree of responses to the statement ": computer can facilitate the implementation of the first five principles of instruction better than the teacher". This indicates that teachers are not generally agreed or disagreed with the sentiment that the computer can facilitate the implementation of the first five principles of instruction better than the teacher.
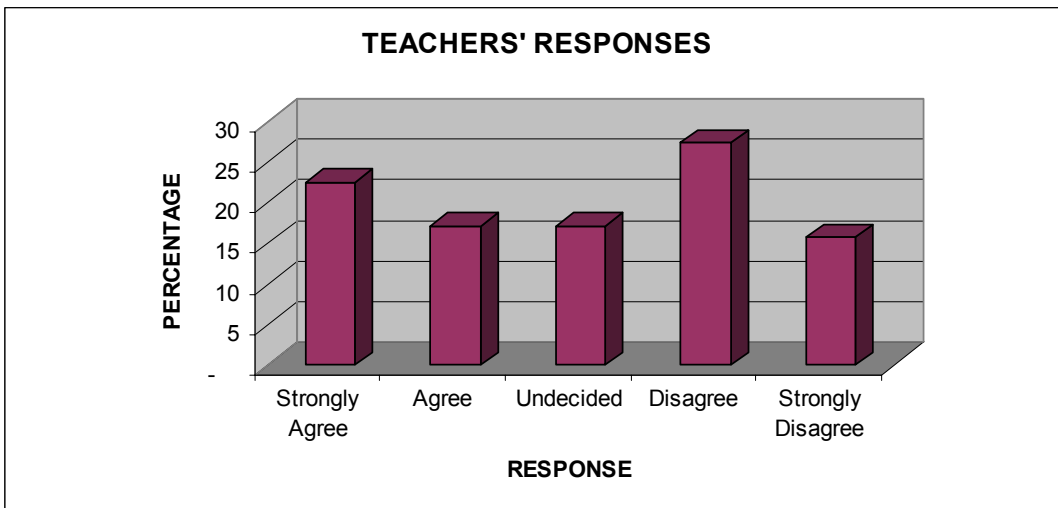
Figure 2. Overview of teachers' responses

For the education officers or policy makers, 23% strongly agreed that the computer can implement the first five principles better than the teacher, 18% agreed, 13% undecided, 33% disagreed, and 13% strongly disagreed (figure 3 highlights the overview of educational officers' responses). A chi-square analysis indicated no statistical significant differences in the degree of responses of policy makers
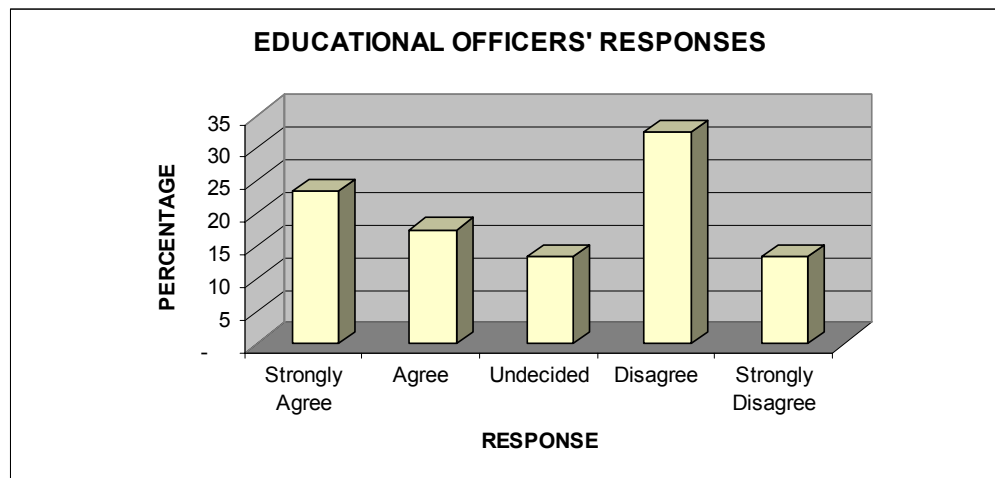
Figure 3. Overview of educational officers' responses

Participants' Recommendations

Thirty five percent of the participants (students = 39%, teachers = 36%, and education officers = 31%) selected the recommendation that "teachers should be trained to use computer to support their teaching" (see table 3). A chi-square analysis revealed no significant statistical difference in their recommendation indicating that 35% of the participants generally accepted this recommendation. Approximately 38% of the participants (students = 43%, teachers = 19%, and education officers = 30%) selected the recommendation that "students should be trained to be able to use computer to learn without the teacher". A chi-square analysis yielded significant statistical difference $\chi 2$ (4, $N = 92$) = 10. 97, p =0.5 indicating more students than teachers and education officers accepted the recommendation that students should be trained to be able to use the computer without the teacher. Twenty three percent of the participants (students = 18%, teachers = 45%, and education officers = 39%) selected the recommendation that "teachers should be trained to know better how to design their instruction for effective teaching". A chi-square test revealed a significant statistical difference in their recommendation $\chi 2$ (4, $N = 102$) = 12.27, $p < 0.05$) indicating that teachers, rather than students, want teachers to be trained to design their instruction for effective teaching.

Table 3: Overview of the participants' recommendations

Participants' Recommendations	Students		Teachers		Education Officers		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1.Teachers should be trained to use computer to support their teaching	117	39	26	36	9	31	152	38.5
2.Students should be trained to be able to use the computer to learn without the teacher	129	43	13	19	7	30	149	37.7
3.Teacher should be trained to know better how to design their teaching/teaching for effective learning	54	18	31	45	9	39	94	23.8
Total	300	100	71	100	24	100	395	100

DISCUSSION OF RESULTS

This study aimed at discovering the perceptions of students, teachers, and education officers in Ghana on the role of the computer and the teacher in the implementation of the first five principles of instruction for promoting quality education. In addition, the study was designed to explore the participants' recommendations for the training of the students and teachers on the use of computer on one hand, and effective instructional design principles by teachers on the other hand for the achievement of quality teaching and learning. The goal is to achieve a better means of designing and implementing effective learning environments (integrated with computer) to achieve the modern aims of education in Ghana as a developing country.

The result of the study indicates that in Ghana, students have strong perceptions that the computer can promote the first five principles of instruction for successful learning better than the teacher. In this regard, from the perspective of Ghanaian students, it is necessary to pay more attention to the expansion of computers in the

classrooms in order to enhance quality teaching and learning. Their perceptions in this sense are in line with Kozma (1994), Schater (1999), BECTOR (2002), Sahhin & Toy (2009) and to some great extent the Government and other individuals of Ghana. Students' perceptions in this comportment indicate that students might think the computer is the absolute solution to their learning problems or the computer might be an essential precondition to their learning problems. Ghanaian students' perceptions in this way are similar to the characteristics of "Digital Natives" or "Net Generations" (Prensky, 2001; Kenedy, Judd, Churchward, & Gray, 2008). Prensky (2001) explained that Digital Natives have spent their entire lives surrounded by and using computers, digital music, cell phones and all the other toys and tools of digital age. He maintained that the Digital culture and environment in which the natives had grown up had changed the way they think and therefore the way they perceive teaching and learning. Digital natives rely heavily on communication technologies to access information and they have a low tolerance to teaching/instruction by the teachers. However, their perceptions are in dissonance with the propositions (Clark 1999; Sarfo & Elen 2007) that effective instructional design by the teacher rather than media (computer) is the better means of achieving quality learning. One possible reason for the students' perceptions not in line with the assertion of Clark (1999) and Sarfo & Elen (2007) is that students might not have adequate knowledge about the strengths and weaknesses of various instructional techniques and media; they might also not have sufficient exposure to the first five principles of instruction and therefore cannot make any concrete decision on effective means of promoting good instructional/teaching principles.

Moreover, the result of the study indicates that not all the teachers have the perceptions that computer can facilitate the implementation of the first five principles of instruction better than the teacher. This particular finding is interesting because whilst some teachers' perceptions in this way are in line with Clark (1999), Sarfo & Elen (2007), and Taiwo (2009); other teachers' perceptions according to the result are in line with the students' perceptions which conform to the contention of Kozma (1994) and others. On one hand the teachers whose perceptions are in line with the use of computer might think that there is the need to cope with the technological changes in teaching and learning. On the other hand, the teachers whose perceptions are in dissonance with the use of computer can be attributed to the fact that, as pointed out by Means (1994), teachers feared that they would be replaced by computers. In other words, the perceptions of teachers in this way are in line with the characteristics of "Digital Immigrants" (Prensky, 2001). Digital Immigrants lack technological literacy and they are foreigners in Digital lands of the net generation. The results suggest that in Ghana, to some degree, students and teachers have different perceptions with respect to the role of the computer and the teacher in promoting the implementation of the first five principles for productive learning to augment quality education

In addition, the result indicates that some education officers (education policy makers) have the perceptions that the teacher can implement the effective principles of instruction for quality learning better than the computer. However, other education officers according to the result have the perceptions that the computer can facilitate the implementation of the effective principles of instruction better than the teacher. It is not surprising that the perceptions of the education officers on the role of a computer, and a teacher in the promotion of good instructional practice for quality learning are similar. This is because the education officers are (experienced) teachers.

Furthermore, the result of the study shows that students, teachers, and education officers recommend that teachers should be trained to acquire computer skills. Teachers' recommendation that they need training is in line with research findings of Koc & Bakir (2010). In addition, according to the result, most of the students suggest that students should be trained to use the computer to learn without the teacher, but this is not the recommendation of most of the teachers. Teachers' position in this regard is to avoid being redundant in the classroom in the future, and also could support the fact that they are Digital Immigrants. Moreover, the result indicates that most of the teachers and the education officers recommend that teachers should be trained to acquire instructional design skills but this is not the recommendation of majority of the students. Majority of the students not recommending this could be interpreted to mean that students think only good computer skills of the students and the teachers could promote quality learning but not good skills in effective instructional principles of the teacher.

CONCLUSION
The representativeness of the sample for the present study is debatable and therefore the results should be generalized with careful consideration. However, the results are worthwhile to be reported. Generally, in the present study, students' perceptions about the role of the computer in the implementation of the first five principles expose students' conceptions (or thinking) about the pedagogical role and relevance of the computer as instructional media in this information revolution age. Thus students have the conception that the computer can help them to learn better than a teacher. This indicates how students (or Digital Natives) are determined to

use the computer as a technological tool or as an instructional medium to acquire knowledge in this era of information age. But the important question is "Is determination to use the computer as a technological tool to learn the same as the determination to learn"? On the other hand "Is students' pedagogical belief in computer as a technological tool actually translates into their pedagogical practice to facilitate learning? Further research study should be conducted to answer these research questions. Furthermore, based on the results of the study it can be concluded that (in Ghana) students' perceptions on the role of a computer and a teacher in the implementation of effective instructional principles for effective learning are different from the perceptions of teachers and education officers. This mismatch of perceptions of students and teachers is a very significant finding, and it must be properly addressed by educational (technology) researchers/practitioners and instructional system developers (in Ghana) otherwise any attempt to design teaching and instruction (integrated with computer) by teachers based on the first five principles to facilitate productive learning might result in learning ineffectiveness. Moreover, the findings of the study suggest that students, education officers and the teachers recommend that teachers should be trained to acquire computer skills. However, teachers and students, based on their recommendations, have different expectations for training teachers to acquire skills in principles of effective instruction and training students to acquire computer skills that would enable them to use the computer to facilitate learning without teachers' support. These recommendations of dissimilarities among the teachers and the students are significant finding and calls for attention. Thus, students need efficient exposure in teachers' role in implementing effective instructional principles, and the teachers too need efficient exposure in effective instructional principles as well as integration of computer into teaching and learning.

The results of the study advises computer determinists, educational (technology) researchers/practitioners, educational planners, and the government (of Ghana) on how to make a better decision (for future planning and implementation) for effective principles of instructional design and computer for quality education.

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THE ROLE OF VOLUNTARINESS IN DISTANCE EDUCATION STUDENTS' USAGE OF A COURSE WEBSITE

T. RAMAYAH
School of Management, Universiti Sains Malaysia
ramayah@usm.my

ABSTRACT
This study looks at the usage of a course website among distance learning business management students in a public institution of higher learning in Malaysia. The Technology Acceptance Model (TAM) was used as the basis of the research framework but voluntariness was added as a possible moderating factor. TAM postulates that perceived usefulness (PU) and perceived ease of use (PEU) are key determinants that inevitably lead to the actual usage of a particular technology or system. A total of 67 students responded to the survey out of the 155 students registered as this was a voluntary exercise. The findings show that these two variables were able to explain 64.1% of the variance in usage of the course website. Perceived voluntariness was also found to moderate this relationship. Some implications are discussed as a conclusion.

Keywords: Perceived usefulness (PU); Perceived ease of use (PEU); Voluntariness; Course website usage; Moderating effect

INTRODUCTION
Distance learning has become an integral part of the education process over the past few decades and is growing in popularity as technology advances. This has motivated working adults to further their study more and more through distance learning programs, which are being offered by higher learning institutions. Due to work and time constraints, many working students are enrolling in distance learning courses. Distance learning is making a positive impact in education. Many people who are participating in distance education are unable to attend regular classes because of full schedules and proximity to a learning institution (McHenry & Bozik, 1997). The working adults usually opt for off-campus environment whereby; in one year they have to attend three sessions of videoconferencing and four classes face to face, which are very intensive in nature. Distance Education (DE) is a system of education characterized by physical separation between the teacher and the learner in which instruction is deliver through a variety of media including print and other ICTs to learner who may either have missed the opportunity earlier in life or have been denied the face-to-face formal education due to socio-economic, career, family and other circumstances (Ajadi et al., 2008).

A research by Dabaj (2009), however, found that "although the students registered to the online program by will, they preferred the traditional face-to-face education due to the difficulty of the nonverbal communication, their incompetence of using the technology required, and their belief in traditional face-to-face learning more than online education". As such, apart from these interactions, off-campus students have to heavily rely on the given course website in order to get updates related to course work, assignment details, course notes, reference materials, and course related articles etc (Beck & Ferdig, 2008; Teo, 2009; Sahin et al., 2010). Due to this low interaction, it is thus vital that these off-campus students accept and use the course website as much as possible in order to keep themselves updated and to enhance their awareness of the given course. Can (2010) found that students believe the use of technology "brings some kind of change and variety to the teaching, saves teaching from being monotonous, and contribute to establishing lively, colorful and smooth setting for teaching and learning". Even though there are many advantages of using course websites, the problem of its adoption and usage still exists among students particularly in an emerging economy such as Malaysia. A study by Aypay (2010) of Turkish students in PISA found that ICT usage was not significantly related to academic performance. Although ICT is an important tool, ICT alone does not lead to better performance. Thus the problem of information technology adoption has been researched widely and various attempts have been made to understand and explain the factors that affect the acceptance and usage of any given information technology innovation.

The objectives of the paper are:
1. to study the relationship between perceived ease of use and usage of a course website (CW),
2. to study the relationship between perceived usefulness and usage of a CW, and
3. to study the moderating impact of voluntariness in the above mentioned relationship.

CONCEPTUAL MODEL AND HYPOTHESES DEVELOPMENT
The Technology Acceptance Model (TAM) was developed by Davis (1989) and Davis et al. (1989) to measure, predict, and explain user acceptance of information technology (IT). It is an adaptation of the Theory of Reasoned Action (TRA) model by Ajzen and Fishbein (1980) which asserts that beliefs could influence

attitudes, which lead to intention to use and finally actual usage behavior. TAM introduced two important constructs, perceived usefulness and perceived ease of use. Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his/her job performance; while perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort (Davis, 1989). TAM theorizes that perceived usefulness and perceived ease of use determine user's behavioral intention and actual usage. The causal relationships among these constructs have been validated empirically in many studies. Between the two, perceived ease of use has a direct effect on both perceived usefulness and technology usage (Adams, Nelson & Todd, 1992; Davis, 1989). Over the last two decades the TAM has been one of the most influential research models in studying the determinants of IT usage (Chau & Hu, 2001). Figure1 below depicts TAM.
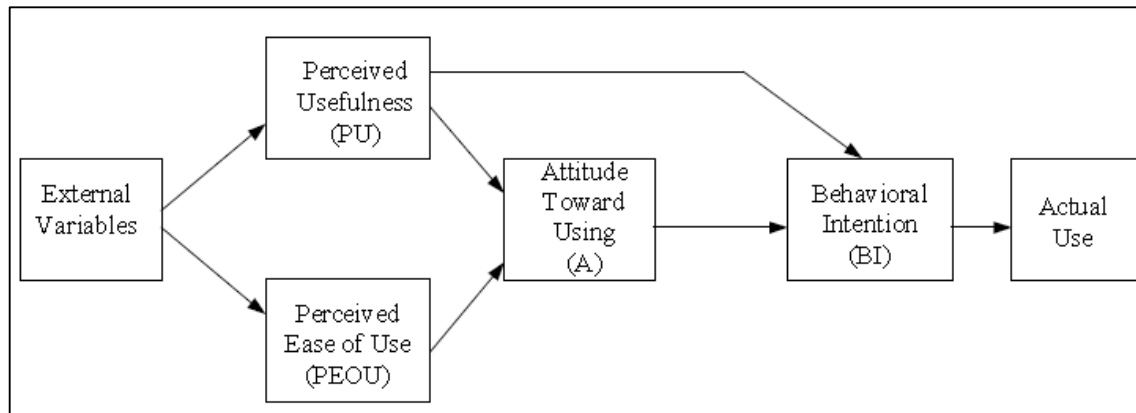
Figure 1: Technology Acceptance Model (TAM) (Davis et al. 1989).

Voluntariness of Use is defined as "the degree to which use of the innovation is perceived as being voluntary, or of free will" (Moore & Benbasat,1991, p. 195). Voluntariness is the extent to which potential adopters perceive the adoption decision to be non-mandated (Agarwal & Prasad, 1997). Although voluntariness is not part of the original set of innovation characteristics proposed by Rogers (1983), it was included by Moore and Benbasat (1991) as a determinant of usage behavior. Venkatesh et al. (2003) have proposed to look at voluntariness as a moderator in the beliefs-intention behavior and as such we would like to test this notion in our current research. Based on this call, this paper proposes the research framework as shown in Figure 2.
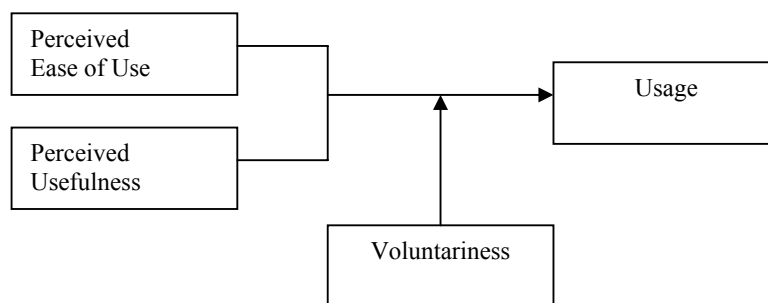
Figure 2: Research Model

In a research looking at a model called Course Website Acceptance Model (CWAM) Selim (2003) proposed to test whether the more useful the students perceive the course website, the more acceptable the course websites are perceived to be. He found course website usefulness to be positively related to usage. This finding was always found to be true in other researches on web acceptance model research conducted by Castaneda et al. (2007) and Ramayah (2005, 2006). Many other researchers have also found perceived usefulness to be the driving factor in acceptance and usage of various technology (Davis, 1989; Mathieson, 1991; Taylor & Todd, 1995; Venkatesh & Davis, 2000; Chau & Hu, 2001; Featherman, 2001; Leong, 2001; Ling, 2002; Gefen et al., 2002; Ramayah et al, 2002; Ramayah et al, 2003; Ramayah & Jantan, 2003; Chan & Lu 2004; Ramayah & Ignatius, 2005; Ramayah et al., 2005; Ramayah & Suki, 2005; May, 2005; Guriting & Ndubisi, 2006; Ramayah & May-Chiun, 2007; Mohd Suki et al., 2008; Lean et al., 2009). Thus the first hypothesis was formulated as:

H1: Perceived usefulness will be positively related to usage of the course website

Selim (2003) also postulated that the easier the course website, the more is its acceptance and usage. This notion was also supported in his research which confirms that ease of use also plays a vital role which is supported by the course website acceptance research conducted by Ramayah (2005, 2006) in Malaysia. The less effort that is required to operate a system, the more it can lead to increase in job performance by regular use of the system (Davis, 1989; Venkatesh & Davis, 2000). Also with less complexity in operating a system, positive attitude could be developed subsequently towards intention and behavior. Several researchers have proposed that a system that is easy to use will be more widely accepted than a the one that is not as easy to use (Jantan et al., 2001; Ndubisi et al., 2001; Ramayah et al., 2002; Ramayah et al., 2003, Selim, 2003; Ramayah, 2005; Ramayah et al., 2005 ; Ramayah & Lee, 2005; Ramayah & Ignatius, 2005; Ramayah, 2006; Ramayah & Lo, 2007). The second hypothesis is as stated below:

H2: Perceived ease of use will be positively related to the usage of the course website

Voluntariness is the context in which the user will accept technology voluntarily. This means there is no obligation on the user to accept the technology. Venkatesh et al. (2003) included moderating variables like voluntariness and experience in their study and found the explanatory power of their TAM model increased from 35% without moderators to 53% with moderators. As such, voluntariness of use as a moderating factor between perceived ease of use, perceived usefulness and usage was included in the current study. Thus the third hypothesis forwarded is as follows:

H3: The positive relationship between perceived ease of use, perceived usefulness, and course websites usage will be stronger for those with higher voluntariness of use

METHODOLOGY
Data Collection
This study collected data at a given institution of higher learning, using purposive sampling with a questionnaire which was self-administered. The questionnaire was divided into 5-parts which include demographic information, perceived usefulness, perceived ease of use, voluntarinesss and usage. Questionnaires were distributed during the intensive face-to-face on campus lecture and students were given 15 minutes to fill out the questionnaire.

Population and Sample
The population for this research consisted of 155 off-campus students, who needed to use the website for the course titled "Business Research Methods". The choice was because the other courses did not use course websites. Students for this class were encouraged to visit the website in order to get the lecture notes, assignment details, related journal resources etc. The students were told that it was a voluntary participation and not compulsory, thus only 67 students returned the completed questionnaire. The demographic profile of the respondents is presented in Table 1.

Measurment Items
The items used to measure perceived usefulness and perceived ease of use as well as usage were adopted from Selim (2003) whereas the instrument used to measure voluntariness was adopted from Venkatesh et al. (2003). Respondents were asked to indicate their agreement or disagreement with several statements on a seven-point Likert scale with 1=strongly disagree to 7=strongly agree.

Table 1: Demographic profile of respondents

Variables		Frequency	%
Gender	Male	27	40.3
	Female	40	59.7
Ethnicity	Malay	36	53.7
	Chinese	31	46.3
Marital Status	Married	41	61.2
	Single	24	35.8
	Widowed/separated	2	3.0
Age		Mean = 35.80	
		Std. Dev. = 5.40	

Goodness of Measures

Factor analysis is a data reduction technique and also used to determine whether items are tapping into the same construct. During factor analysis, factors with eigenvalues of less than one would be rejected and factors with eigenvalues of more than one would be retained for further analysis (Hair et al., 2010). Furthermore during factor analysis, if an eigenvalue is close to 1, then the factor could be considered for inclusion (Hair et al., 2010). To reduce the problem of cross loading, if the difference of loadings of any item across factors was less than 0.10 then the items will be deleted (Snell & Dean, 1992). The results showed a three factor solution with eigenvalues greater than 1.0 and the total variance explained was 85.097% of the total variance. KMO measure of sampling adequacy was 0.849 indicating sufficient intercorrelations while the Bartlett's Test of Sphericity was significant (Chi square= 1338.708, p< 0.01). . These results confirm that each of these constructs is unidimensional and factorially distinct and that all items used to measure a particular construct loaded on a single factor. The detailed results are presented in Table 2.

Table 2: Results of the factor analysis

	Component		
	1	2	3
Pu1	.342	**.863**	-.043
Pu2	.463	**.740**	.050
Pu3	.619	**.712**	.003
Pu4	.365	**.873**	-.016
Pu5	.407	**.868**	.037
Pu6	.300	**.758**	-.090
Peu1	**.855**	.412	.088
Peu2	**.777**	.563	.024
Peu3	**.920**	.307	.075
Peu4	**.875**	.387	.113
Peu5	**.877**	.364	.033
Peu6	**.811**	.450	.017
Vol1	.215	-.039	**.803**
Vol2	-.060	-.137	**.919**
Vol3	.009	.117	**.848**
Eigenvalue	5.527	4.989	2.249
Percentage Variance	36.846	33.258	14.993

Cronbach's alpha reliability analysis was applied to identify how well the items grouped are positively correlated to one another. Cronbach's alpha value of 0.70 and above is considered to be reliable (Nunnally & Bernstein, 1994). An alpha value of 0.70 and above indicates items are homogenous and measuring the same construct. Hair et al. (2010) suggested that alpha value of 0.60 would be deemed the lower value of acceptability. The result of the factor and reliability analysis is presented in Table 3.

Table 3: Reliability analysis results

	Alpha	1	2	3	4	5	6	Item-to-total correlation	Cronbach Alpha if Item deleted
Perceived Usefulness	0.95								
CW improves the quality of the course work I do		-						.884	.940
CW enables me to accomplish course tasks more quickly		0.76	-					.826	.947
CW makes it easier to study the course material		0.82	0.83	-				.882	941
CW Increases my productivity		0.85	0.83	0.81	-			.910	.938
CW enhances my effectiveness in the course work		0.83	0.85	0.86	0.91	-		.933	.936
CW is useful in the course work		0.74	0.54	0.67	0.71	0.73	-	.727	.961
Perceived Ease of Use	0.98								
Using the CW is easy for me		-						.933	.974
It was easy for me to become skillful at using the CW		0.92	-					.920	.976
I find the course website easy to use		0.89	0.87	-				.942	.973
I find the course website to be flexible to interact with		0.92	0.89	0.93	-			.947	.973
My interaction with the CW is clear and understandable.		0.85	0.86	0.93	0.90	-		.927	.975
I find it easy to get the information I want from the CW		0.87	0.86	0.86	0.87	0.88	-	.905	.977
Voluntariness	0.82								
Although it might be helpful, using the CW is certainly not compulsory		-						.612	.819
My use of the CW is voluntary (as opposed to required by lecturers) in my work/studies		0.64	-					.777	.651
My lecturers expect me to use the CW *(reverse coded)*		0.48	0.69	-				.652	.783
Usage	0.88								
I use the CW a lot to do my course work.		-						.707	.854
I use the CW whenever possible to do my course work.		0.82	-					.848	.804
I use the CW frequently to do my course work.		0.67	0.82	-				.834	.803
I use the CW whenever appropriate to do my course work.		0.42	0.54	0.65	-			.586	.905

FINDINGS
Table 4 presents the mean and standard deviation of all study variables.

Table 4: Descriptive analysis

Variables	Mean	Standard Deviation
Perceived usefulness	4.888	1.389
Perceived ease of use	4.920	1.540
Voluntariness	3.955	1.558
Usage	4.504	1.415

To test the three hypotheses generated for this study, a hierarchical regression analysis was employed. The results are presented in Table 5.

Table 5: Results from the hierarchical regression analysis

Variables	Standardized Beta Step 1	Standardized Beta Step 2	Standardized Beta Step 3
Predictors			
Perceived ease of use	0.488**	0.427**	0.252
Perceived usefulness	0.356**	0.405**	1.258**
Moderator			
Voluntariness		0.205**	0.597
Interaction Terms			
PEU*Voluntariness			1.248*
PU*Voluntariness			-1.615**
R^2	0.641	0.681	0.709
Adjusted R^2	0.630	0.666	0.686
R^2 change	0.641	0.041	0.028
F change	0.000	0.006	0.050

**p< 0.01, *p< 0.05

From Table 5, we can observe that perceived ease of use has a significant impact on usage of course website (β = 0.488, p<0.01) with perceived usefulness also having a significant impact on usage (β = 0.356, p<0.01), thus supporting H1 and H2 of the study. Hypothesis 3 was tested by looking at the beta values in the third step, first the R^2 change has to be significant and then we look at the individual beta to see if they are significant. As can be seen the R^2 in the third step is significant (F change = 0.05), hence we can conclude that the interaction terms are significant. Thus H3 was also supported. To see the impact of voluntariness as a moderator, 2 graphs were drawn as shown in Figure 3 and 4. To draw the graphs, the facets were first recoded into two categories ie: Low and High by dividing the respondents into two categories (below median = low, above median = high)

As can be seen from Figure 3, for those with higher voluntariness, the rate of change in usage level does not differ much when the level of usefulness increases, but for those who perceive voluntariness as low, their usage level increases when ease of use increases from low to high.
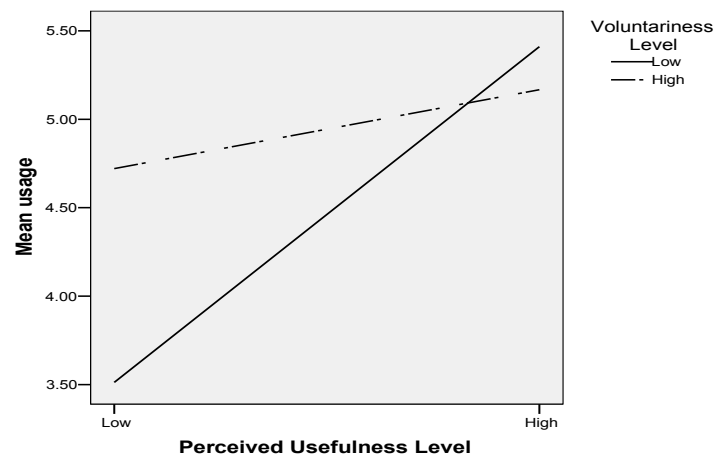

Figure 3: The moderating effect of voluntariness on the PU and usage relationship

As can be seen from Figure 4, for those with higher voluntariness, the rate of change in usage level is greater compared to the ones who perceive voluntariness as low, when the ease of use increase from low to high.
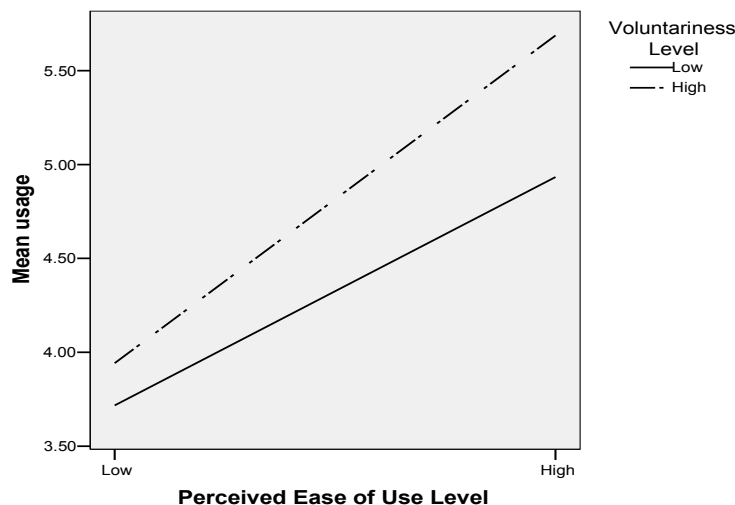

Figure 4: The moderating effect of voluntariness on the PEU and usage relationship

DISCUSSION

It was found that perceived ease of use and perceived usefulness have significant impact on the usage of the course website. These findings concur with the findings of previous researchers (Davis, 1989; Mathieson, 1991; Taylor & Todd, 1995; Venkatesh & Davis, 2000; Chau & Hu, 2001; Featherman, 2001; Leong, 2001; Ling, 2002; Gefen et al., 2002; Jantan et al., 2001; Ndubisi et al., 2001; Ramayah et al., 2002; Ramayah et al., 2003; Selim, 2003; Chan & Lu, 2004; Ramayah, 2005; Ramayah et al., 2005 ; Ramayah & Lee, 2005; Ramayah & Ignatius, 2005; Ramayah, 2006; Guriting & Ndubisi, 2006; Ramayah & Lo, 2007; Mohd Suki et al., 2008). A course website needs to be easy to use before users will even think about using it. Hence, it can be said that PEU is an important determinant of usage of course website.

It was also observed that a given technology should be perceived to be better to have than to be without (Jantan et al., 2001; Ndubisi et al., 2001; Ramayah et al., 2002; Ramayah et al., 2003, Selim, 2003; Ramayah, 2005; Ramayah et al., 2005 ; Ramayah & Lee, 2005; Ramayah & Ignatius, 2005; Ramayah, 2006; Ramayah & Lo, 2007). Hence, perceived usefulness is also an important factor in determining website usage.

As off-campus students are mandated to use the course website due to low interaction, it can be seen from the results that perceived ease of use is more important in determining usage level of the course website as compared to perceived usefulness. Students are more concerned whether it would be easier for them to use the website, rather than whether the given website will be useful for them. This finding supports the research of Brown et al. (2002) which was done in a mandated environment.

The findings of this study can be used by lecturers and university administrators to encourage the acceptance and usage of course website. They can focus on the usefulness and ease of use aspect of the course website when encouraging students to use a given website. They should give students information or training (Akpinar & Bayramoglu, 2008) on how to fully utilize and use the course website which will make them perceive that the given website will be useful for them in achieving better results and which will be easy for them to use, that is to say they do not have to spend a lot of time learning how to use it.

Other than practical contributions, this study also contributes to theory by confirming that the TAM is applicable in the adoption of course website and the two beliefs, which are perceived ease of use and perceived usefulness are strong predictors of course website usage. This study also provided empirical support that the relationship between the two beliefs and the usage is moderated by the level of perceived voluntariness (Venkatesh et al., 2003) thus supporting the notion of model extension to explain a greater variance in the technology acceptance model.

LIMITATIONS

There are also several limitations in this research, the first one being the presence of common method variance as the usage was based on self-report. The sample size is also not very large given the fact that this was the only class that used a course website. Thirdly, the results may not be generalizable as it was based on only one course. Future research may look at expanding the sample size and including a greater breadth of users and also if viable, the usage logs can be used to measure the usage level. Another possible avenue of research would be to look at the role of prior experience or knowledge on this relationship (Somyurek et al., 2008)

CONCLUSION

The findings of this study show clearly that the drivers of a course website use are the ease of use and the usefulness and this positive relationship is stronger with higher perceived voluntariness. Thus to promote higher usage of course websites to complement the face to face course delivery, the website must be designed to take care of these issues.

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APPENDIX

Mean and Standard Deviations of all items used in the survey

Construct		Mean	Standard Deviation
Perceived Usefulness	PU1	5.00	1.311
	PU2	4.88	1.364
	PU3	5.35	1.268
	PU4	4.86	1.171
	PU5	5.03	1.118
	PU6	5.27	1.234
Perceived Ease of Use	PEU1	5.05	1.419
	PEU2	5.03	1.287
	PEU3	5.05	1.462
	PEU4	5.11	1.336
	PEU5	4.97	1.403
	PEU6	5.23	1.389
Perceived Voluntariness	VOL1	3.49	1.678
	VOL2	4.26	1.716
	VOL3	4.48	1.697
Usage	USE1	4.89	1.416
	USE2	4.89	1.276
	USE3	4.32	1.542
	USE4	4.60	1.443

USING INFORMATION TECHNOLOGY BASED EXERCISES IN PRIMARY MATHEMATICS TEACHING OF CHILDREN WITH CEREBRAL PALSY AND MENTAL RETARDATION: A CASE STUDY

M. G. A. D. REIS[a], L. CABRAL[b], E. PERES[c], M. BESSA[d], A. VALENTE[e], R. MORAÏS[c], S. SOARES[e], J. BAPTÏSTA[c], A. AÏRES[g], J. J. ESCOLA[a], J. A. BULAS-CRUZ[c], & M. J. C. S. REIS[e]

[a]Dept. Educação e Psicologia, UTAD, Universidade de Trás-os-Montes e Alto Douro (UTAD), 5001-801 Vila Real, Portugal.
[b]Transdisciplinary Research Centre Culture, Space, Memory   CITCEM, UTAD
[c]ECT-Dept. Engenharias/CITAB, UTAD
[d]Instituto de Engenharia de Sistemas e Computadores do Porto - INESC Porto, ECT-Dept. Engenharias, UTAD
[e]ECT-Dept. Engenharias/IEETA, UTAD
[f]ECT-Dept. Engenharias, UTAD
[g]Dept. Matemática/CM, UTAD
manuelcabral.reis@gmail.com

ABSTRACT
Technology has profoundly changed the way we learn and live. Indeed, such relationship appears to be quite complex, within IT contexts, and especially in socially and technologically rich learning environments, where related skills and learning are progressively required and fostered. Thus, if a satisfactory level of intellectual performance and social competence of a primary school pupil is indeed highly dependent on the type of participation that parents offer their children, IT, in general, and Internet, in particular, may well provide a new paradigm, setting forth that education and communication approach is truly more complex than ever before. It is on the basis of such paradigm that we therefore present a case study where a set of multimedia exercises were used in order to possibly improve the mathematical skills of pupils, one with mental retardation and another with cerebral palsy. Being part of a Web-based system to support students' learning, the referred set of multimedia exercises proved to be the children's favorite, rather than exercises in paper form, which also led the children to show a fair more positive attitude towards learning. Also, we observed that through the mentioned multimedia exercises, the children became far more autonomous, interested, persistent, happy, and able to easily absorb the material as well as more willingly to continue on working.

Key words: Teaching/learning strategies, improving teaching, primary education, cerebral palsy, mental retardation

INTRODUCTION
Technology has profoundly changed the way we learn and live. In fact, according to some authors it seems that we are moving to a "digital learning" (Rogers, 1995; Weller, 2002; Roberts, 2005; Warschauer, 2007; Bull and Hammond, 2008; Willoughby and Wood, 2008). Such is the case of Weller (2002), to whom there are five factors that favor de use of the Internet in education: (i) its social acceptance, (ii) the fact that it does provide a sense of control and therefore ownership for educators, far more than previous technologies due to its many facilities, (iii) the development of the web browser as a generic interface, (iv) it is both an interactive, it works on the information rather than just being a passive recipient, and personal medium, all learners are not the same, (v) it is a sustaining (e.g., a retailer that uses it to supplement its physical shops, for example by means of home delivery from supermarkets) and disruptive technology (e.g., it does not intend Web-based shopping to displace its standard retail outlets, but it hopes instead that both will complement each other, and thus altering the organization in which it is implemented).

Consequently and unsurprisingly, Internet can be used to successfully supplement face-to-face teaching. At present, for example, many are the campus based universities using the Internet, not to replace their traditional face-to-face mode of delivery, but rather as a means of supplementing it (e.g., web pages can be used to provide additional information, and e-mail may be used as a means of contacting tutors of large courses). Surely, there are topics that better suit its use, such is the case of a course on "Introduction to Information Technology", and a teacher especially designed course thought of to address the teachers willing to learn about computer conferencing. Both cases are examples of courses that were using effectively the technology forms as an integral part of the academic content of the course, without forgetting pedagogic suitability. For example, the resource based learning, where students can be presented with a wide range of resources, often external to the university, and may acquire their own learning experience from these resources within the overall framework of the course. On the other hand, Internet's practice brings advantages to Institutions as they may obviously gain from the use of Internet in education, both on campus and while potentially reaching new audiences. Meanwhile, it may also

obtain advantageous opportunities from the fact that it can be seen as a Computer Assisted Learning delivery mechanism, as proven by a fair number of courses that are now using the Internet to deliver simulations, visualization aids and interactive tools.

Additionally, mathematics is a fundamental human activity, namely a way of making sense of the world which turns out to be the object of children's natural curiosity and interest, which, at the same time, come to school with a particular understanding of mathematical concepts and problem-solving strategies as discovered through their explorations of the environment surrounding them. According to Johnson (2004) and the Expert Panel on Mathematics report (2004), primary education is an important time of transitional growth in students' mathematical thinking. In order to become more accurate in their work, both in reading problems and in working out solutions, primary students need more practice to reinforce what they are learning, a process which traditionally takes place on paper. In general, after students have completed practical set of exercises (or homework), they often have to wait for their teacher to check it and provide a correspondent feedback. However, interruptions such as these may well reduce the pupils' interest in learning, besides preventing them from learning efficiently.

The researching works of the Expert Panel on Mathematics (2004) show that mathematically literate students think flexibly about how to best solve a problem. Even so, most approaches that even mathematically literate students adopt are provided from general textbooks or tutoring books. Unfortunately, these materials are usually designed for average learners, and it is often difficult to find the best-fitting content for pupils with differing abilities. For example, in Portuguese (primary) classes there is only one textbook designed for all pupils, even though literate students still may need a higher-level tutoring, while illiterate may need a lower-level tutoring. Therefore, the depth and flexibility of ability as obtained from these textbooks are undeniably restricted. Even if some programs based on e-learning technology may provide personalized contents for learners by collecting the learning process, primary school students may still become restless and unfocused when staying in front of computers to work on mathematics during long periods of time. Usually, such is the regrettable case of children with mental retardation, in which case both teachers and parents do have an important word to say. In fact, as Warschauer (2007) points out, "the teacher must be centrally involved, actively instructing and mentoring students, especially at the initial stages of work on a project. Unfocused instruction can leave students rudderless, and this is particularly harmful to at-risk students, such as those with learning disabilities, limited literacy, and language skills, or insufficient background knowledge".

Together with these referred principles and thoughts, here we present a case study of two children: one with mental retardation and one with cerebral palsy. The clinical statuses of these children were previously established by a team of experts, according to the Portuguese legislation. The Ministry of Education asked our team to intervene at the educational level to ensure the learning of these children. To this end we have followed the methodology proposed by Yin (1984). Using such methodology, the researcher is allowed to conduct the research in its working context. We have used a set of eleven multimedia exercises and their corresponding paper format, i.e., in total we observed, recorded and analyzed the children's behavior in twenty-two cases (eleven on paper and eleven on the computer), as it will be reported in section 4. These multimedia exercises are a subset of the ones available in a Web-based system to support students' learning, explained in section 2.2. The prompt feedback about the exercises accuracy, added to the training with different exercises sets about the same subject, besides the utilization of video, color, sound, etc., that positively reinforce children's senses, are elected as the main advantages of these exercises.

The remaining of the paper is organized as follows: The next section presents the more recent programmes that the Portuguese government have launched to help IT settlement, as well as our team's efforts in the dissemination and use of IT resources, namely the ones related with Internet's usage, and with the Web-based e-Exercise-book system. Furthermore, in section 3 we present a review of how children can learn through the use of exercises and games and section 4 is dedicated to the presentation of the collected data and some of our main retrieved achievements. Finally, in section 5 we present this work's major and significant conclusions.

Portuguese reality
Governmental programmes
The Portuguese computational park is very diverse, ranging from scholar and personal desktops to laptop computers, or from low-processing capabilities (e.g., computers running under a Pentium I processor and lower) and low-memory, both main RAM memory and secondary hard-drive memory, to high-processing capabilities and high-memory. Additionally, whereas in some rural areas the Internet connections are limited to 128Kbps (Kilobits per second), in urban areas Internet may reach from 256Kbps up to 16Mbps (Megabits per second) with ADSL (Asymmetric Digital Subscriber Line) connections. This is a consequence of the several different

programmes being implemented during the last decades (Santos, 2001; Reis, 2002; Reis 2003; and also de governmental sites http://www.umic.pt/ and http://www.fccn.pt/).

Besides these difficulties, it was also elsewhere recognized the necessity to call on specific training for teachers, based on Internet contents (Pratt, 2008; Reis et al., 2008); in the Portuguese specific case, for instance, the teachers also reported the lack of time to meet the program as recommended by the Portuguese Ministry of Education.

The Programme "Internet in the Schools", launched by the Portuguese Ministry of Science and Technology (MST) in 1997, aimed at the development of Information Technology in the Portuguese schools. Each school (basic teaching, 2nd cycle — 5th and 6th grade, and secondary — 7th to 12th) was provided with at least one multimedia computer with Internet access. For more information and further details about the organization of the educational system in Portugal and other countries, please visit the following site: http://www.eurydice.org.

In the year of 2006, the "ESchool" Programme (e.escola—http://www.eescola.net/indexA.aspx) enabled both teachers and students, from the 5th up to 10th grades, to purchase a low 150 euro cost laptops. More recently, some protocols have also been set by the national government with Intel, the leading telecommunications operators (Optimus, TMN, Vodafone, and Zon, all Portuguese Telecom operators), Microsoft, "Magic Box" (Caixa Mágica), and the local members, allowing primary schools students accessing portable computers with Internet access, known as "Magalean" (Magalhães), for a maximum cost of 50 euro (http://www.eescolinha.gov.pt/portal/server.pt/community/e-escolinha/200/apresentacao). Additionally, a huge effort is being lately made in equipping all the classrooms with interactive multimedia boards.

The existence of computers at schools, as this Portuguese example shows, is obviously necessary to integrate IT effectively in the learning process, but it is by no means sufficient. Setting-up infrastructures is a relatively simple process when compared to its actual handling, since both the necessary training and the change of habits of the entire school community, that lead to an everyday practice, are the result of a slow and gradual process, which entails a number of technical and cultural difficulties, Reis et al. (2008); Brown et al. (2008); Pratt (2008); Gil and de Vasconcelos (2007); Wishart (2004); Watson et al. (1998). Moreover, several researchers claim that it is what teachers think and believe that ultimately shapes the activities in the classroom, Hargeaves (1993); Lampert and Ball (1998); Pijlc and Meijer (1997).

Web-based E-Exercise-book System overview
The lack of tools supporting the authoring and automatic checking of exercises sustaining specific topics in primary education (e.g., ordering and numbering in mathematics), drastically reduces the advantages in the use of e-learning environments on a larger scale.

For a complete description of the system presented in this subsection please refer to Peres et al. (2010). The Web-based "Collaborative E-Exercise-book" system is a Web application divided in a back-end, and a front-end. In short, the back-end works as the administration component of the system, and the front-end is the system's work area. The user must be registered, and in order to get full system's features and advantages s/he must pass through the authentication (login and password) process. A non-registered user may do random exercises but s/he has no access to its completed work (set of solved exercises), neither to statistics nor to new exercises areas. On the other hand, a registered student has indeed access to its own personal area, where s/he can see (and do) the work as recommend by his/her teacher.

Meanwhile, the registered teacher may post new exercises, recommend students' home-work, and access statistics. The statistics module grabs all the information of every student. The information that may be queried by the teacher concerning a student (individually), a group of students or even the entire class, includes grades, time spent per exercise, number of tries, who has done its set of exercises (complete homework or the exercises individually), among others.

Furthermore, the mentioned system also has a forum/discussion area intended to promote the interaction amongst teachers, parents and students. We believe that this area, in particular, may be used not only to increment the use of IT by teachers and students, but also to promote teacher-student-parent communication, especially if all parts, namely teachers, students, and parents, are expected to share their thoughts, worries, activities, strategies, etc., thus allowing a truly collaborative work through this system.

Consequently, teachers, pupils and parents are given the chance to post and e-mail questions/opinions to other participants in the discussion/forum area, including text message, photos, audio and video, in order to foster rich contexts for discussion.

This process of discussion is divided into three steps, as follows: the first step consists in preparing the question/opinion (e.g., write the question/opinion on a paper and then take a picture of it or record the question in sound or video); the second step sends the multimedia message by e-mail (individual e-mail accounts are set for each participant); and the third, and final, step focus on the system which analyzes the message and then publishes it in the discussion community (the e-mail's subject line becomes the topic title of the discussion and the e-mail's body is the body of the discussion).

We want that in the near future this system may be used in English-speaking countries, and so the system is already prepared to support different languages (Multilanguage support). The user must choose the desired language and then translate (and upload) the exercises' contents into the system database. From the exercises point of view, they do not need adjustments, because it all depends on the templates (the templates must be designed in English, as well as everything they contain, such as video, images, text, speech, music, etc.).

Figures 1 and 2 show the screenshots of two examples of multimedia exercises used in this study; Indeed, in figure 1, the student is asked to drag and drop the animals into the circle, and in figure 2, the student is asked to sort the numbers in ascending order. As can be seen, the character in this template "says" "*Olá! Ana*" (*Hello! Ana*; this information was retrieved from the user login name). Also, all the exercises provide automatic feedback to the student about its respective accuracy, by simply clicking the "*Verificar*" (*verify*) button.

Fig. 1. Sample exercises: drag and drop the animals into the circle.

It shall be remarked that this set of exercises represents a promising didactic strategy concerned with promoting the rich teaching practice that brings together both "inductive" and "deductive" methods, obviously depending on the particular dynamic of the teaching/learning process. Also, and according to Zabalza (1994), the affective and motivating attitude of the teacher, along with the more "technical-objective" one shall be object of major concern, as the child is frequently put at the center of all our decisions. This means that it is the pupil who has to be able to withstand all the technical and emotional situations which s/he is exposed to, therefore justifying the study of the attitudes and cognitive strategies and actions from which that is brought out, Zabalza (1994).

Furthermore, the set of exercises used in this study were built specifically to deal with the special needs of the children under consideration, using a model based on the constructivist approach, particularly inspired in the work of Papert (1980, 1993, 1996), also agreeing with the guidelines and educational programs offered by the Portuguese Ministry of Education. For example, with the exercise presented in figure 1 we aim to contribute to an improvement of the following skills: to form sets of two, three, four, five or more objects / elements, to form sets by classes, establishing relationships between sets. With the exercise presented in figure 2 we aim to

contribute to an improvement of the following skills: to read and to write numbers to 10; to perform counts in increasing and decreasing order to 10, to sort in a logical order numbers, figures and patterns.

Fig. 2. Sample exercises: sort the numbers in ascending order.

Learning through exercises and games, and children with special needs

The most effective educational practices should be built upon all the ways in which humans are especially gifted at picking out certain kinds of information and causal patterns. All too often, educational approaches have adopted deficit model in which it is assumed that children enter the schools with bundles of misconceptions that need to be overridden and corrected. A primary goal of education should be to generate explanatory ideas that are just at the right level of detail, that is, the right grain size. However, this is not an easy challenge to be faced with. It requires several things, such as: knowing what students are already and more acquainted with, knowing what they could potentially know after a reasonable period of instruction, and knowing what kinds of new knowledge would do them the most good when it comes to expanding their understanding of the world and enabling them to make more informed decisions and more effective actions in relevant contexts.

As stated by Keil (2008), "children acquire most of what they know secondhand, through others", and most of the knowledge "occurs in many nonschool settings such as through television, museums, toys and other artifacts, the Internet, or even in various games and activities such as chess, cooking, or running a lemonade stand".

Modern teaching and researching communities agree that it is through the strategic didactic approach based on the use of exercises and games, that learning becomes potentially effective, regardless of the educational model or philosophy used. For example, proponents of socio-cultural theory claim that learning is primarily a social process mediated through interactions using tools Vygotsky (1978); Wertsch (1992). Accordingly, Vygotsky (1978) does consider that mediation occurs through the use of 'semiotic' and 'material' tools. The semiotic tools include symbols, signs, and spoken languages. Material tools include such items as pens, spoons, and particularly networked (Internet) computers. Most importantly, not only do these tools simply facilitate the set of activity that might take place in the educational process and setting, but also they fundamentally shape and define the type of activities that might be developed, Wertsch (1992).

Furthermore, Seymour Papert (1980) proposed the use of tools, particularly the computer, considered as "a mighty education tool", in serving the process of building knowledge, from which the "constructionist" theory would emerge, adapting the very beginnings of the cognitive constructivism of Jean Piaget in order to make a better use of technology.

Becoming competent in mathematics, for example, one can be conceived of as acquiring a mathematical disposition (see, for example, Corte and Verschaffel, 2006; Council 2001). Traditionally, the dominant form of learning in schools has been the known teacher directed learning or guided learning, that is, "a trainer or teacher takes all the relevant decisions and the learner can and should follow him or her. Within such learning model, it is the teacher who decides about the goals of learning, the learning strategies, the way how to measure outcomes

and takes care of feedback, judgments, and rewards", Simons et al. (2000). However, besides guided learning, there are two additional types of learning experiences as identified by Simons, Linden and Duffy, Simons et al. (2000), namely the: experiential and action learning. Also, there has been a strong and widespread awareness regarding the advantages of novel classroom practices and cultures thought of to facilitate and support learners through the gradual and progressive acquisition of adaptive mathematical competence. Indeed, such practices and cultures are therefore expected to create the necessary conditions for a substantial shift from a poorer guided learning experience towards a richer experiential one, as well as action learning, regarded as a successful learning strategy from the didactics standpoint, Fontoura (1971), resulting in a balanced and integrated use of the three ways of learning: constructive, self regulated, and contextual or situated, Corte (2007).

The constructivist view of learning has become common ground among educational psychologists (see, for example, Phillips, 2000; Simons et al., 2000; Steffe and Gale, 1995). Actually, constructivism implies that constructive learning is self-regulated. According to Zimmerman (1994), self-regulation "refers to the degree that individuals are metacognitively, motivationally, and behaviorally active participants in their own learning process". Moreover, De Corte (2007) emphasizes that "constructive and self-regulated learning processes should be preferably chosen and studied in context", and because learning is collaborative, the learning efforts are distributed over the individual student, his/her partners in the learning environment, and the (technological) resources and tools that are available, Salomon (1993).

What's more, De Corte (2004) stresses that "starting as much as possible from tasks and problems that are meaningful and challenging for students, learning environments should initiate socially supported constructive learning processes that enhance students' cognitive and volitional self-regulatory skills". It is expected that students will be able to use their acquired knowledge and skills to solve a given mathematics-related situation and further corresponding problems in everyday life, something that Bransford and Schwartz (1999), and Bransford et al. (2006), call "preparation for future learning".

When it comes to children with special education needs, according to Jeffs et al.(2003) "Technology as a teaching tool immediately, profoundly, and positively impacted the education of individuals with mental retardation (…). The introduction of the computer as a teaching tool (…) can be viewed as the greatest agent of change (…) for individuals with mental retardation". In particular, and as stated by Zentel, Opfermann, and Krewinkel, (2006) "A Computer can be used as an effective learning tool to support the acquisition of basic learning skills". In addition, and according to Wehmeyer (1998), the work with this medium supports the increase of self-determination, of independence, and integration skills, and allows for "positive changes in inter- and intrapersonal relationships, sensory abilities and cognitive capabilities, communication skills, motor performance, self-maintenance, leisure, and productively", Parette (1997).

The ways that computers can support writing by students with learning disabilities was studied by MacArthur (1996), with an emphasis on applications that go beyond word processing. Williams (2005) used ICT in a special educational needs environment to develop a multimedia learning environment. He examined the benefits and barriers of ICT usage, and attitudes and experiences of special educational needs teachers were also explored. The special educational needs working environment was found to have changed greatly in recent years. There was now a more formal and structured curriculum, and many attempts at activities designed to foster inclusion. Difficulties faced by teachers included a lack of and poorly functioning equipment, a paucity of appropriate learning materials, and unusual challenges posed by the differing needs of learners. The needs of teachers included ways of facilitating evidence of progress, lesson plans classified according to cognitive and accessibility levels, and administrative information. Advantages of using ICT ranged from enhancing the learning experience by offering a more personalized environment, to "liberating pupils" from problems such as physical cutting and pasting. Also, in Portugal the work of Esteves et al. (2008), for example, introduces software directed to young children less than 13 years old with special needs at vision and sound levels, addressing the usability.

METHOD
As previously mentioned, we have conducted a case study of two children, one with mental retardation and one with cerebral palsy. The clinical statuses of these children were previously established by a team of experts, according to the Portuguese legislation. The Ministry of Education asked our team to intervene at the educational level to ensure the learning of these children. These children belong to the same group of schools, namely the "Agrupamento de Escolas de Santa Marta de Penaguião" (Portugal), where one of the co-authors worked during the 2008/09 academic year. They were the only children with these kinds of disabilities. More than quantitative we wanted that our work to be qualitative, and so we have used the case study methodology proposed by Yin

(1984). By using this methodology the researcher can conduct its "participant observation" research in its working context.

We have used a set of eleven multimedia exercises together with its corresponding equivalent paper format. As explained in subsection 2.2, these exercises were built specifically to deal with these special needs, using a model of constructivist inspiration. Two examples of these exercises are presented in figures 1 and 2. This means that, in total, we have used several data sheets to observe, record and analyze the pupils' behavior in twenty-two cases (namely, eleven on paper and eleven on the computer). Obviously, this set of exercises agrees with the objectives proposed by the Portuguese Ministry of Education, and trying to contribute to develop the desired skills. The pupils were presented with the referred exercises between the months of April through June of the 2008/09 academic year.

Table 1 presents the obtained results concerning the child with cerebral palsy. As we can observe from the results regarding the paper exercises, on average, there was 28.0 (362.1 – 334.1) seconds less total time, the run time of the exercise itself was higher, precisely 13.6 (267.7 – 254.1) seconds. The "total time" includes de "execution time" plus the time the child is focused in the teacher's explanation of how to solve the exercise (i.e., what the child is asked to do). Hence, the "difference" row represents the extra time the child was more attentive to the teacher and the exercise itself. This also implies that although the child took less time to solve the paper format exercises, namely exercises number 1 (5 seconds), 9 and 10 (20 seconds) she was, overall, more attentive (on average, she was more 41.6 (108 – 66.4) seconds attentive per exercise).

Also, the mode (most frequent case) is the same for the indicators "anxiety", "attention", "withdrawal" and "difficulty solving the exercise" and in both types of multimedia and paper exercises. We may also conclude that there were always more manifestations of interest, persistence, less anxiety and greater willingness to continue on solving multimedia exercises rather than in paper format. It is also clear that, on average, hear less help, more joy, less anxiety, less apathy, more attention, less disinterested, less withdrawal, fewer difficulties in solving the exercise, easier to perform/run the exercise and less indifference.

These facts are also reinforced by the child's comments noted in our "diary-board" when she said "It's fun playing this! And now teacher...? Teacher, and now, what will I do?" or "Let's make another?", referring to the multimedia exercises, or "I no longer work more!", "This is boring!", "When we work on the computer?" or "I'm sick of work! It's just work, work, work, ...!", when commenting on the paper exercises.

When it comes to the child with mental retardation, as we can see from the results in table 2 dealing with the paper exercises, on average there was 6.7 (179.7 – 173.0) seconds less total time of concentration, the run time of the exercise itself was higher, 34.4 (144.4 –110.0) seconds. This fact is also reinforced by the data in row "difference", meaning that the child was more attentive to the teacher's explanation, on average, she was more 41.1 (69.7 – 28.6) seconds attentive per exercise.

Having the multimedia exercises for reference, on average, we can also conclude that the child needed less assistance, had more joy, less anxiety, less apathy, more attention, less disinterest, less withdrawal, less resolution difficulties, found it easier in run, less indifference, more absorption, more persistence, less sadness, and showed more will to continue on doing the exercises. We have not registered any changes in the manual dexterity/fine motor. Also, the mode (most frequent case) is the same for all indicators except for "disinterest", being bigger for the paper exercises.

The child's comments *"When may I go to the playground?"* when working with paper format exercises, and *"the computer is more fun"*, *"When done, I go to my computer?"*, or *"may I work on the computer?"*, when working with the computer, both recorded in our "diary-board", have clearly and undoubtedly shown that the child elected the multimedia exercises as the favorite ones.

As can be further observed, the child with mental retardation began to experience the most difficulties in solving the multimedia exercises, which warranted some extra help, but after this situation was overcome, the child not only revealed less indifference, but also showed more interest and willingness to continue on solving the multimedia exercises. Such behavior may be due to the fact that the student was not familiar with the use of computers to solve exercises, however, throughout the school year we perfectly noticed the progressive development of a positive "familiarity" attitude towards the computer.

These facts seem to be partially untrue in 7 (4%) of the 187 values. More precisely, and having for reference the multimedia exercises, in exercise number 1 we have observed more anxiety, in exercise number 2 more

resolution difficulties and less easy in run, in exercise number 3 more help, in exercise number 4 more indifference, in exercise number 6 less joy, and in exercise number 11 less attention.

CONCLUSIONS

Students with disabilities have a set of unique characteristics that hinder their integration in school and consequently their learning. With this work we, somehow, have contributed to promote the indispensable and necessary inclusion, significantly improve teaching practices (in both personal and professional dimensions) and positively promote the educational success of children with disabilities.

However, we must remember that nothing is worth this teacher effort if the student does not have an active participation in the process, being fundamental to "strengthen the capacity of the subject itself to manage its projects, its processes, its strategies" Perrenoud (1999).

Only through the knowledge of the medical history and the development process of a disabled child, the most common causes and recognized characteristics of disabilities and their educational possibilities can we, in fact, develop in consciousness, an individual educative program and consequently an educational program that caters the child's needs and contribute to an effective learning and development of skills and capabilities.

Finally, we may conclude that the studied children prefer multimedia exercises (using the computer) rather than exercises in paper format (using more traditional materials) and exhibit a more positive attitude towards the former. Holistically, and based on the multimedia exercises, we can state that the total time that the children were focused was higher, the total run time was lower, the help was lower, the joy was greater, the anxiety was lower, the apathy was lower, the attention was greater, the disinterest was lower, the withdrawal was lower, the difficulty in solving the exercises was lower, the ease in running the exercises was greater, the indifference was lower, the interest was greater, the persistence was greater, the sadness was lower and the will to continue on solving exercises was greater.

Indicator	Multimedia format														Paper format													
	Exercise number											Avg	Std	Mod	Exercise number											Avg	Std	Mod
	1	2	3	4	5	6	7	8	9	10	11				1	2	3	4	5	6	7	8	9	10	11			
Time focused	60	80	82	155	96	210	600	540	600	900	660	362.1			50	70	80	140	80	180	550	545	580	800	600	334.1		
Execution time	50	45	30	60	60	90	420	360	540	600	540	254.1			45	50	40	70	60	120	470	405	520	580	585	267.7		
Difference (time)	10	35	52	95	36	120	180	180	60	300	120	108			5	20	40	70	20	60	80	140	60	220	15	66.4		
Help	1	2	2	2	2	2	3	3	3	3	3	2.4	0.7	2	2	2	2	2	2	3	3	3	3	3	3	2.5	0.5	3
Joy	3	3	3	3	3	3	3	3	1	3	3	2.8	0.6	3	2	2	2	2	2	2	1	1	1	2	1	1.6	0.5	2
Anxiety	1	1	1	1	2	2	2	2	2	1	2	1.5	0.5	2	1	1	1	2	2	2	2	2	2	2	2	1.7	0.5	2
Apathy	1	1	1	1	1	1	2	2	2	1	1	1.3	0.5	1	1	2	1	2	1	1	2	2	2	1	2	1.5	0.5	2
Attention	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3	2	2	3	2	3	3	3	2	3	3	2	2.5	0.5	3
Disinterest	1	1	1	1	1	1	1	1	1	1	1	1.0	0.0	1	1	1	1	2	2	1	2	2	2	1	2	1.5	0.5	2
Withdrawal	1	1	1	1	1	1	1	1	1	1	1	1.0	0.0	1	1	1	1	1	1	2	1	2	2	2	2	1.5	0.5	1
Manual dexterity/f.motor	3	3	3	3	3	3	3	3	2	2	2	2.7	0.5	3	3	3	3	3	3	2	2	2	2	2	2	2.5	0.5	2
Resolution difficulties	1	2	1	2	2	3	3	3	3	3	3	2.4	0.8	3	1	1	2	3	3	3	3	3	3	3	3	2.5	0.8	3
Easy in run	3	2	3	2	3	1	1	1	1	2	2	1.9	0.8	2	3	3	2	2	1	1	1	1	1	1	1	1.5	0.8	1
Indifference	1	1	1	1	1	1	2	1	1	1	1	1.1	0.3	1	1	2	1	2	2	2	2	3	2	3	3	2.1	0.7	2
Absorption	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3	2	2	2	2	2	2	2	2	2	2	2	2.0	0.0	2
Persistence	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3	2	2	2	2	2	2	2	2	2	2	2	2.0	0.0	2
Sadness	1	1	1	1	1	1	1	1	1	1	2	1.1	0.3	1	2	2	2	2	2	2	3	3	3	2	3	2.4	0.5	2
Will to continue	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3	2	2	2	2	2	2	2	2	2	2	2	2.0	0.0	2

Table 1 – Recorded indicators of involvement and success for the child with cerebral palsy (1—None, 2—Low, 3—High): Avg—average, Std—standard deviation, Mod—mode.

Indicator	Multimedia format														Paper format													
	Exercise number											Avg	Std	Mod	Exercise number											Avg	Std	Mod
	1	2	3	4	5	6	7	8	9	10	11				1	2	3	4	5	6	7	8	9	10	11			
Time focused	20	25	20	30	40	50	60	90	371	540	731	179.7			18	25	20	30	35	45	55	85	350	540	700	173.0		
Execution time	10	17	18	25	30	40	50	60	180	420	360	110.0			12	20	18	26	30	40	52	70	250	490	580	144.4		
Difference (time)	10	8	2	5	10	10	10	30	191	120	371	69.7			6	5	2	4	5	5	3	15	100	50	120	28.6		
Help	1	1	2	2	2	2	2	2	2	2	2	1.8	0.4	2	1	1	1	2	2	2	2	2	2	3	3	1.9	0.7	2
Joy	3	3	3	3	3	2	3	3	3	3	2	2.8	0.4	3	3	3	2	3	3	3	3	2	2	3	2	2.6	0.5	3
Anxiety	2	1	1	1	1	2	1	2	1	1	2	1.4	0.5	1	1	1	1	1	1	2	2	2	1	2	2	1.5	0.5	1
Apathy	2	1	2	2	2	2	1	2	1	1	2	1.6	0.5	2	2	2	2	2	2	2	1	2	2	1	2	1.8	0.4	2
Attention	3	3	3	2	3	3	3	3	3	3	2	2.8	0.4	3	2	3	3	2	2	2	3	3	3	3	3	2.6	0.5	3
Disinterest	1	1	1	1	1	1	1	1	1	1	1	1.0	0.0	1	1	1	1	2	2	2	2	2	1	1	2	1.5	0.5	2
Withdrawal	1	1	1	1	1	1	1	1	1	1	1	1.0	0.0	1	1	1	1	1	1	1	1	1	1	1	2	1.1	0.3	1
Manual dexterity/f.motor	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3
Resolution difficulties	1	2	2	2	2	2	2	2	2	2	2	1.9	0.3	2	1	1	2	2	2	2	2	2	2	3	3	2.0	0.6	2
Easy in run	3	2	2	2	2	2	3	3	2	2	2	2.3	0.5	2	3	3	2	2	2	2	2	2	2	2	2	2.2	0.4	2
Indifference	1	1	1	2	1	1	1	1	1	1	1	1.1	0.3	1	1	1	1	1	1	1	2	2	2	2	2	1.5	0.5	1
Absorption	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3	3	3	3	2	3	2	2	3	3	3	3	2.7	0.5	3
Persistence	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3	3	3	3	2	3	3	3	3	2	2	2	2.6	0.5	3
Sadness	1	1	1	1	1	1	1	1	1	1	1	1.0	0.0	1	1	1	1	1	2	2	1	1	1	1	2	1.3	0.5	1
Will to continue	3	3	3	3	3	3	3	3	3	3	3	3.0	0.0	3	3	3	3	3	3	3	2	2	3	3	2	2.7	0.5	3

Table 2 – Recorded indicators of involvement and success for the child with mental retardation (1—None, 2—Low, 3—High): Avg—average, Std—standard deviation, Mod—mode.

We would also like to stress out that the use of computers has enabled the development of both tactile and motor coordination by touching / pressing buttons (using the keyboard) and mouse, and this fact was more evident in the case of child with cerebral palsy.

These conclusions agree with the views of the different researchers presented in section 3. In particular, the exercises helped children to acquire basic leaning skills, increased self-determination, independence, and integration skills, and also allowed for positive changes in inter- and intrapersonal relationships, sensory abilities and cognitive capabilities, communication skills, motor performance, self-maintenance, leisure, and productively.

We believe that the prompt feedback about the exercises correctness, added to the training with different exercises sets about the same subject, besides the utilization of video, color, sound, etc., that positively reinforce the different child's senses, definitely contributed to capture and motivate the child.

In fact, according to Warschauer (2007), "New technologies do not replace the need for strong human mentorship, but, indeed, amplify the role of such mentorship". Obviously, it is already remarkably recognized that the students must become into contact with the new teaching/studding tools progressively, in order to take part in the learning environment as smoothly as possible.

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