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From the editors…

Welcome to the January-April 2009 issue of Learning Technology.

Mobile learning is used in many different contexts and areas. This issue discusses current research about new and emerging mobile learning technologies, and especially its usage in extreme situations. The issue introduces papers dealing with frameworks for mobile learning, practical learning technology solutions, and summaries of research about particular topics.

The first article, by Romero and Wareham, discusses the usage of mobile devices for just-in-time learning such as in emergency situations. Romero and Warham propose a model that incorporates context information and can be used as mirroring, meta-cognitive or guidance tool.

Subsequently, Borau, Ullrich, and Kroop introduce a project which helps to teach large numbers of adult learners in China. The proposed framework aims at facilitating teachers and learners to access and combine different tools into a personalized mobile learning environment.

The next three papers deal with mobile game-based learning. Kickmeier-Rust introduces the research project 80Days, which aims at developing psycho-pedagogical and technological foundations for successful digital educational games. Mobility is considered in the game on one hand through the virtual mobility of the players, who need to investigate different places on earth in the game, and on the other hand due to its technological basis. Wong, Wang, Tam, Cheung, Lui, and Fok developed a mobile quiz-game system which asks students questions on their mobile devices. Their paper describes the design and possible uses of the quiz system in mobile learning and shares their experiences in system development. Marty and Carron also introduce a mobile learning game, namely the Pedagogical Dungeon, and focus in their article mainly on issues such as immersion, mobility, and supporting teachers to monitor students' progress while playing the educational game.

Subsequently, Ren, Liu, and Ren propose a web-based remote and mobile question and answer system, which aims at improving time efficiency for students when asking questions to teachers as well as allows the efficient management of these communication notes.

In the next article, Chang, Wang, and Lin discuss the usage of wireless sensor networks for improving the usability, flexibility and variability of mobile learning. They propose a framework and describe two practical examples applying this framework, one in a classroom and the other one in a city-wide environment.

Chiong and Weise discuss the application of global optimisation techniques in mobile learning. They provide insights about how global optimisation techniques can be used to improve mobile learning and point out some of the relevant works in this area.

The last article in this issue belongs to the regular article section and deals with interactive response systems. Liu presents a study about students' perception when using interactive response systems within the class.

Furthermore, we would like to draw your attention to the Call for Papers of the Journal of Applied Research in Workplace E-learning, which can be found at the end of this issue.

We hope that this issue helps in keeping you informed about the current research and developments of learning technologies, especially in the area of mobile learning, and can stimulate further discussions, research, and developments in this area.

We also would like to take the opportunity to invite you to contribute your own work in progress, project reports, case studies, and events announcements in this newsletter, if you are involved in research and/or implementation of any aspect of advanced learning technologies. For more details, please refer to the author guidelines at http://lttf.ieee.org/learn_tech/authors.html.

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Just-in-time mobile learning model based on context awareness information

Abstract: In urgent situations, the value of mobile learning is not only ubiquitous, perpetual availability, but just-in-time learning based on context aware information and guidance. Our proposed contribution is a model based on mobile-aware services that adapt to the learning environment, embracing contextual information, mirroring levels, guidance, and metacognitive support adaptable to learner self-regulation in specific crisis situations.

Keywords: *Just-In-Time Mobile Learning, Ubiquitous learning, Context Awareness, Flexible Learning Environment*

Just-in-time learning in extreme situations

Learning with mobile devices or mobile learning (m-learning) expands e-learning capabilities to a much wider range of teaching and learning contexts, including extreme situations beyond the realm of normal desktop applications. In crisis situations, Just-In-Time Learning can help users access knowledge and learning in less time, in a manner adaptable to both their requirements and the learning context.

In traditional learning contexts, we normally face learning tasks where temporal constraints are less significant; or at least, we do not confront an extreme sense of learning urgency. However, given that learning is a major form of adaptation to the environment (Piaget, 1936), we can consider extreme situations where fast learning is essential: poisoning, first aid or even, unexpected baby delivery. In cases when we are alone and do not know how to proceed, we typically ask for external expertise (emergency numbers) allowing us to learn and act via verbal interaction and guidance. Considering the multimedia and web-access capabilities of most mobile devices, enriched interaction can be employed to reduce learning cycles and more easily contend with crisis situations successfully.

Mobile-aware developments form an emergent paradigm, which has recently been applied to mobile learning (Lonsdale et al., 2003; Chen, Chang & Wang, 2008). In this extreme context, the main concern of the users is not learning in the sense of a permanent change in behaviour (Domjan & Burkhard, 1986), but how to effectively solve a problem for which he/she needs new knowledge. Independent of the basic problem, the result of his/her experience will likely convey learning in a relatively permanent manner, given the advantages of experiential learning (Dewey, 1938). Providing new knowledge in this informal learning situation within a mobile-aware Flexible Learning Environment could allow the user to structure learning outcomes and capitalize them in the learners' ePortfolio (Butler, 2006).

Context-aware mobile learning model for just-in-time learning

Mobile learning has been approached as an e-learning modality with "complete independence of both location and time" (Holzinger et al., 2005), where more personalized learning contents could be provided, individually enhancing ubiquity capabilities. In extreme situations the main added value of mobile learning is the possibility to collect awareness data, display it, analyse it, and guide the user considering the Context Awareness (CA) and Activity Awareness (AA) data analysis to propose just-in-time learning solutions. To take into account this contextual information, we need Flexible Learning Environments (FLE) allowing personalized learning solutions, adapted both to the mobile device, the learner and the context.

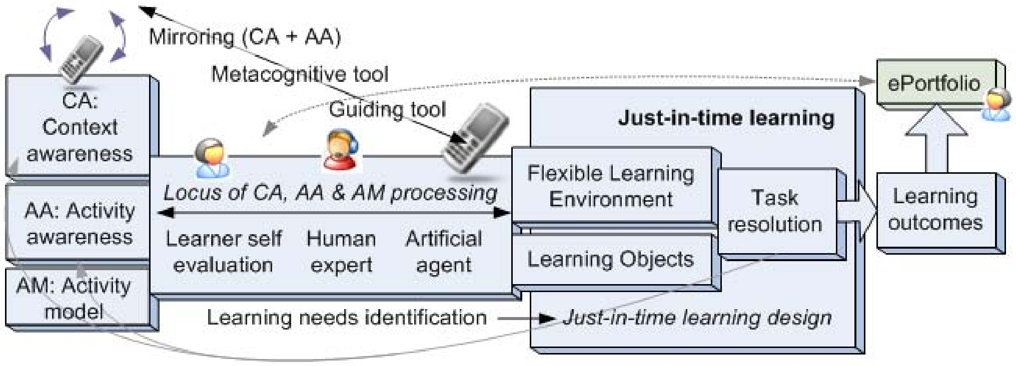

Figure 1: Just-in-time mobile learning model

As can be seen in Figure 1, in the first stage of the process, the mobile device collects Context Awareness (CA) and Activity Awareness (AA) information according to the defined Activity Model (AM). The process of this information could be done by the learner himself/herself, an external human agent, or an artificial agent within or out of the mobile device.

In these contexts, the mobile device could act as a mirroring, metacognitive or guidance tool, according to Soller et al. (2004) categorisation of computer's role in the learning regulation process. Firstly, as a mirroring or awareness tool, the mobile device could display CA and AA, allowing the learner to self-evaluate his/her current learning needs. Secondly, in a metacognitive mode, the mobile device could analyze CA and AA information and display the results of the analysis in order to help the learner to decide how to design his/her personal solution considering the analysis. Thirdly, if the mobile device not only analyses, but also integrates an artificial agent with expertise rules based on the Activity Model, that could provides guidance on the just-in-time learning solution configuration. As such, the increased multimedia abilities of most mobile devices are leveraged both as communication and computational devices. Not only does it permits richer information gathering and analysis as a registration and diagnostic device, but also as a communication media to an external expert, and a media to convey new knowledge to the user.

Concluding remarks

Learning needs time; however, in extreme situations time is scarce. In critical scenarios, context just-in-time mobile learning could provide a ubiquitous and flexible learning solution adapted to the context. The increased media richness of most mobile devices can be leveraged as computational and communication services embracing contextual information, mirroring levels, guidance, and metacognitive support adaptable to learner self-regulation in specific crisis situations.

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Mobile learning with Open Learning Environments at Shanghai Jiao Tong University, China

The recently started project ROLE (Responsive Open Learning Environments) aims at delivering and testing prototypes of highly responsive technology-enhanced learning environments, offering breakthrough levels of effectiveness, flexibility, user-control and mass-individualisation [1]. The ROLE consortium consists of 16 internationally renowned research groups and companies and is funded by the European Commission. ROLE actively seeks input by third parties and has created a discussion group at LinkedIn to facilitate contributions [2].

ROLE researches adaptivity and personalization in terms of content and navigation and the entire learning environment and its functionalities. This approach permits individualization of the components, tools, and functionalities of a learning environment, and their adjustment or replacement by existing web-based software tools. Learning environment elements can be combined to mashup components and functionalities, which can be adapted by individual learners or groups to meet their own needs and to enhance the effectiveness of their learning. This can help them to establish a livelier and personally more meaningful learning experience. The validity of ROLE's research will be assessed in several real-life testbeds.

The largest of the testbeds will be implemented by Shanghai Jiao Tong University (SJTU). In a developing country such as China, one foremost goal is to enable access to education to the largest number of citizens possible. In the recent years, the Chinese government significantly invested in tertiary education with the effect that the number of graduates at all levels of higher education in China has approximately quadrupled over 6 years [3]. One of the main research questions driving research at the e-learning lab at SJTU is how to use technology-supported learning to manage such large numbers of students.

Solutions that will be developed in ROLE have the potential to significantly improve teaching and learning under these circumstances. There, especially mobile access is crucial, less because of curiosity-driven research interests due to the novelty of mobile devices, but out of societal necessity. In developing countries, the penetration rate of mobile phones surpasses that of home computers significantly. Recent figures by the China Internet Network Information Center show this trend quite clearly [4]. The July 2008 survey reports 84.7 million computers connected to the Internet (including desktop and laptop computers) compared to 592 million mobile phone numbers (growing at a rate of 18%). Mobile access to the Internet is explored by an increasing number of users. Of the 253 million Internet users in China, about a third (84.7 million) surf the Web with their mobile phones, 22.65 million more than in the first half of 2008. The proportion of desktop Internet users is actually dropping compared to the proportion of mobile netizens. This trend is visible elsewhere, too. According to the International Telecommunication Union [5], in 2007 the fixed broadband penetration rate in Africa was 0.2%, compared to 27% mobile penetration rate. This clearly shows that the development of learning systems usable by mobile devices is relevant world-wide. The SJTU testbed will thus enable the ROLE consortium to learn about the challenges of mobile Personal Learning Environments (PLE).

More specifically, the ROLE framework and tools will be assessed at the online college of SJTU (Online-SJTU). A great majority of the students in this online college are adult learners who study for their bachelor degree. Most of them work full-time and study in the evenings and on the weekends. Due to their busy schedule, they are often not able to attend classes in person. Thus, all classes offered in this college are also broadcast live via the Web. Students can tune in to the live classes or the recordings from their desktop or laptop computer, but also from the mobile phone.

In China, teacher-centered teaching is still prevalent [6]. In contrast, ROLE will allow students to be more active and to take more control about their own learning processes. How this could look like we illustrate in the following Scenario:

Teacher Li is a novice teacher, and still inexperienced with ICT. He wants to increase active language production of his students in a "English News" class. When preparing his class, Li browses through the different "collaborative problem solving" patterns stored in the ROLE framework. The "joint text production" pattern catches his attention and he decides to use it for his students to produce news articles. He adds the pattern to the course PLE. The pattern then adds the required tools and a guide for the teachers and students that explains them how to best use the tools in this kind of activity. Here, the tools include a mind-mapping tool to derive jointly the structure of the article, a collaborative text editing tool to write it, a Flickr integration to share photos to illustrate it, and a forum for general feedback and reflection about this activity. Later that week in the class room, Li makes the PLE page accessible to his students and the collaborative work starts. The students are now able to interact with their peers, whether present in the classroom, at home or on a business trip. For instance, during the day, student can use their mobile device to upload pictures that illustrate the news story.

Of course this scenario is just one small example of many. However it serves to illustrate central features from a user side: teacher, but also students will be able to access the tools they want to use and to combine the tools to form their Personal Learning Environment.

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Around an Inspiring Virtual Learning World in Eighty Days

Computer games have become a very successful and important part of today's entertainment landscape. With increasing time people spend on computer games, the idea of utilizing the motivational and didactic potential of those games for educational purposes is getting more and more popular and fascinating. The European research project 80Days[1] is inspired by Jules Verne's novel "Around the world in eighty days". The project started in April 2008 and aims at developing psycho-pedagogical and technological foundations for successful digital educational games – successful in terms of educational effectiveness as well as financial turnovers.

In the focus of psycho-pedagogical research efforts is a scientifically sound framework for a non-invasive assessment of knowledge and learning progress embedded in a game and a subsequent comprehensive adaptation to the learner on micro and macro levels. The micro level refers to subtle educational interventions such as feedback or hinting within specific learning situations. The macro level, on the other hand, refers to an educationally appropriate sequencing and pacing of learning situations tailored to the individual learner.

In the first period of the project, research made significant progress by elaborating a joint formal model of cognitive assessment of learning progress (on the basis of Competence-based Knowledge Space Theory) on a probabilistic and non-invasive level, the provision of suitable support and interventions, and open interactive adaptive storytelling (cf. Kickmeier-Rust, Hockemeyer, Albert, & Augustin, 2008). From a technical point of view, in the first project period an accurate analysis of learning and game design requirements has been carried out and the results have constituted the starting point for the study on system architectures and software modules that could have best fulfilled the requirements. Research in the area of open, interactive storytelling achieved a technical realization of the developed formal model in form of a story engine, which implements the psycho-pedagogical model and which drives and adapts the game (Kickmeier-Rust, Göbel, & Albert, 2008). Overall, psycho-pedagogical and technical efforts lead to a compelling demonstrator game teaching geography. Significantly, this demonstrator also represents the first steps towards achieving a multi-adaptive system that not only adapts discrete elements of the game towards educational purposes, but also adapts the story to accommodate wider educational objectives.

The demonstrator game is teaching geography for a target audience of 12 to 14 year olds and follows European curricula (Figure 1). The game design includes premises, concepts, metaphors, structures, gameplay, learning objectives, contents, background story, game characters, visual design and game props. In concrete terms, an adventure game was realized within which the learner takes the role of an Earth kid at the age of 14. The game starts when a UFO is landing in the backyard and an alien named Feon is contacting the player. Feon is an alien scout who has to collect information about Earth. The player wants to have fun by flying a UFO and in the story pretends to be an expert in the planet earth. He or she assists the alien to explore the planet and to create a report about the Earth and its geographical features. This is accomplished by the player by means of flying to different destinations on Earth, exploring them, and collecting and acquiring geographical knowledge. The goal is to send the Earth report as a sort of travelogue about Earth to Feon's mother ship. Finally, the player sees through the alien's game (of preparing the conquest of the earth) and reveals the "real" goal of the game: The player has to save the planet and the only way to do it is to draw the right

[1] Further information and details can be found on the project website at www.eightydays.eu.

conclusion from the traitorous Earth report. Therefore, the game play has got two main goals: (a) to help the alien to complete the geographical Earth report, and (b) to save the planet, which is revealed in the course of the story, when the player realizes the true intention of the alien. This demonstrator game illustrates an unconventional meaning of mobile learning; it focuses on learning through virtual mobility. Of course, 80Days also considers a more conventional approach to mobile learning. The technological basis for the micro and macro adaptive features developed in the project is individual and based on abstract services that communicate via TCP/IP. This technological approach enables a broad online-based application of this technology, independent from the game technology (Pierce, Conlan, & Wade, 2008).

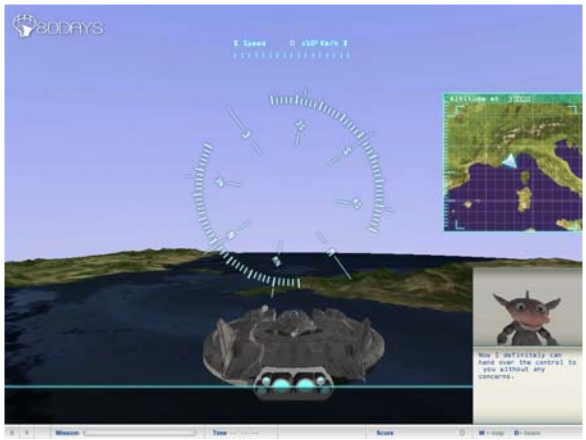

Figure 1: Screenshot of 80Days' first demonstrator game teaching geography for a target audience of 12 to 14 year old children.

The demonstrator game was subject of in-depth evaluation activities. The evaluation work has been geared towards its objectives of defining an evaluation framework and of implementing an array of evaluative activities. In close collaboration of different disciplines, the initial game design concepts were validated with a carefully designed questionnaire, which has been administered at two major locations – Cologne in Germany and Leicester in England. Results of altogether 281 responses (139 in German and 142 in English) have meticulously been analysed and documented. Furthermore, the evaluation plans with adjustments and fine tuning with regard to certain situational constraints such as the technical infrastructure at local schools was implemented. The validation studies have been implemented in two and four schools in England and Austria, respectively, resulting in about 100 datasets. Multi-method approaches have been applied to analyse the empirical data thus collected.

Empirical findings yielded beneficial effect of playing the game, as evident and an overall satisfying usability and user experience. Implications for the future development of the game prototypes and the design of evaluative activities have been drawn. In particular, the theoretical knowledge and practical experience thus gained will contribute to advancing the research area of evaluating usability and user experience in digital educational games.

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A Mobile Quiz Platform to Challenge Players' Knowledge on Mobile Devices

Abstract: Many new mobile technologies including the 3G, WiFi or mobile TV have opened up unprecedented learning opportunities on mobile devices. In addition, such technologies empower the rapid growth of new fields of research like the edutainment for educational entertainment. In a project awarded by the Hong Kong Wireless Development Center, we developed a mobile quiz game system on 3G mobile phone networks in China, Hong Kong or other countries to facilitate learning anytime and anywhere. Our developed mobile quiz system is so generic that it can be readily extended to any wireless network. In this paper, we discuss about the design and possible uses of our quiz system in mobile learning, and also share the relevant experience in system development with the evaluation strategies carefully examined. In 2008, our project also received the Bronze Award of the Hong Kong ICT Awards – Best Lifestyle. After all, our work shed light on many interesting directions for future exploration.

Introduction

New telecommunication technologies or services, such as the High-Speed Downlink Packet Access (HSDPA), IEEE 802.11 based products or mobile TV, are reshaping our living. With the availability of powerful mobile devices connected to a high-speed wireless network, many attractive mobile learning applications [3] realizing the concept of learning anytime and anywhere that can be particularly useful for students to continue learning at home during the outbreaks of new pandemic such as the SARS or lately swine flu in recent years, and actively sought the world-wide attention of educators, students, lifelong learners or professionals in various disciplines. Among many successful applications, the Cellphedia [1] is a Mobile Social Software (MoSoSo) developed in the United States to promote the sharing of knowledge.

In response to a call for applications on the China's 3G network by the Hong Kong Wireless Development Center in 2007, we developed a mobile quiz game platform based on the concept of game rooms with real-time synchronization and the client-server model targeted for a mass of thousands of players participating in any specific event of the Beijing Olympic Games 2008. In addition, our project also received the Bronze Award of the Hong Kong ICT Awards – Best Lifestyle in 2008. Our mobile quiz system is so generic that it is transparent to the underlying network architecture, and can be easily extended to the WiFi or other wireless network. We discuss in detail about the design and possible uses of our quiz system in mobile learning, and also share the relevant experience in system development with the evaluation strategies carefully examined. After all, our project shed light on many interesting directions for future exploration.

This paper is organized as follows. Section 2 details the system architecture design of our mobile quiz system on 3G mobile phones or other mobile devices. Section 3 considers various evaluation strategies on our developed quiz system based on different criteria. Lastly, Section 4 summarizes our work and sheds lights on future directions.

System Architecture and Services

The system architecture of our revised mobile quiz system is shown in Figure 1. Basically, our mobile quiz system includes the following components:

1. Mobile Learning Platform Server;

2. Administration Console Portal;
3. Result Display Unit.

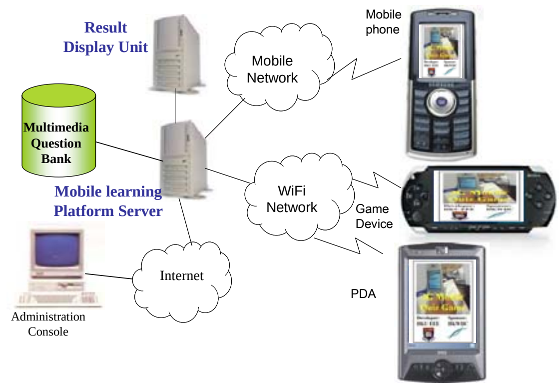

Figure 1: The System Architecture of Our Mobile Quiz Platform

After registration and successful login, the Mobile Learning Platform Server will push some relevant questions, possibly embedded with some video clips, for the user to answer on any mobile devices including the Sony PSP gaming device. The server will only display the correct answer for each round only when all the answers are received from the registered mobile phone or timeout occurred. The Administration Console is to monitor the activities of individuals or groups of players, and the network traffic. Besides, it provides an interface for the administrator to dynamically enter new question sets into the question bank online. The Result Display Unit is mainly to display the latest results/scores attained by the players, and more importantly the statistics of choices such as correct versus wrong answers selected by the players that should be useful for an instant analysis on the spot.

Prototype Implementation & Evaluation

To demonstrate the feasibility of our proposal on different platforms, we used the Java 2 Micro Edition (J2ME) technology to build our mobile quiz system containing various game rooms running on a Mac server that can be accessed through any J2ME-enabled 3G mobile phones. We spent around 4 man-months to complete the implementation and testing of our mobile quiz system. A project website [2] was set up to allow the downloading of a client program (.jar) for installation on any mobile devices to access our mobile quiz system as shown in the picture below.

Figure 2: Students from 18 schools are using our mobile quiz platform in a local school contest

As our mobile quiz system is generally applicable to any selected event or course, a detailed evaluation will be conducted in the late 2009 to analyze the effectiveness of the mobile quiz system on motivating and/or enhancing our students' experience in relevant Engineering courses including the Human-Computer Interaction or Distributed Computing Systems.

Conclusion

In this paper, we reported a completed project in which we have successfully developed a 3G or WiFi based mobile quiz system to facilitate learning/revision anytime and anywhere. Our developed mobile quiz system is so generic that it can be readily extended to any wireless network. The design and possible uses of our quiz system in mobile learning, and also sharing the relevant experience in system development have been considered. After all, our work shed light on many interesting directions such as the integration of our mobile quiz platform with existing e-learning systems or powerful search engines for further exploration.

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Mobile Widgets for Teacher Awareness in Learning Games

Abstract: The paper describes examples of game-based learning environments, and focuses on certain issues which need to be addressed in these environments, such as teacher monitoring of students and immersion. The advent of mobile devices will enable new usages for teachers in learning games.

Introduction

Our research work deals with the development of new learning environments. We are particularly interested in studying the different aspects linked to user awareness in these environments. The emergence of online multiplayer games has led us to apply the metaphor of exploring a virtual world, a dungeon, where each student embarks on a quest in order to collect knowledge related to a learning activity. This association of games and pedagogical contents must ensure a coherent world in which a learning session can take place, i.e. a set of activities can be proposed to the users in a logical order. It is particularly important in this approach to create acute and intuitive awareness of the on-going activity for all the participants, and especially for the teacher. This awareness can be context-dependent, e.g. it can vary according to geographical information.

An example of a Learning Game: the Pedagogical Dungeon

Over the last few years, our team has developed several learning environments [1], [2], [3], and has experimented with them with students in our university, in real learning situations. Figure 1 shows a screenshot of the pedagogical dungeon, a learning environment used with students for learning in various domains.

The dungeon represents the place where the learning session takes place. Each room of the dungeon represents a place where a given activity can be performed. Resources are accessible in the room and a quiz has to be answered to open new doors. The dungeon topology thus represents the overall scenario of the learning session, i.e. the sequencing between activities. There are as many rooms as actual activities, and the rooms are linked together through corridors, showing the attainability of an activity from other ones [4].

Need for observation

From this work, we have already observed that it is essential for Computer Game-Based Education to offer the possibility of monitoring the activity performed by the students and of obtaining information or feedback about it. For example, being aware of the learning progression of each student is an important goal for the teacher. S/he wishes to be warned of unexpected situations or particular behaviour: a student is in difficulty; there are too many interactions within a group of people; there is not enough communication in a collaborative task. Being aware of these particular situations helps the teacher to adapt her/his subsequent actions, that is to say the learning session. Hopefully, in computer-based learning environments, participants leave traces that can be used to collect clues, providing the teacher with awareness about the on-going activity. These traces reflect in-depth details of the activity and can reveal very accurate hints for the teacher [4], especially for regulation.

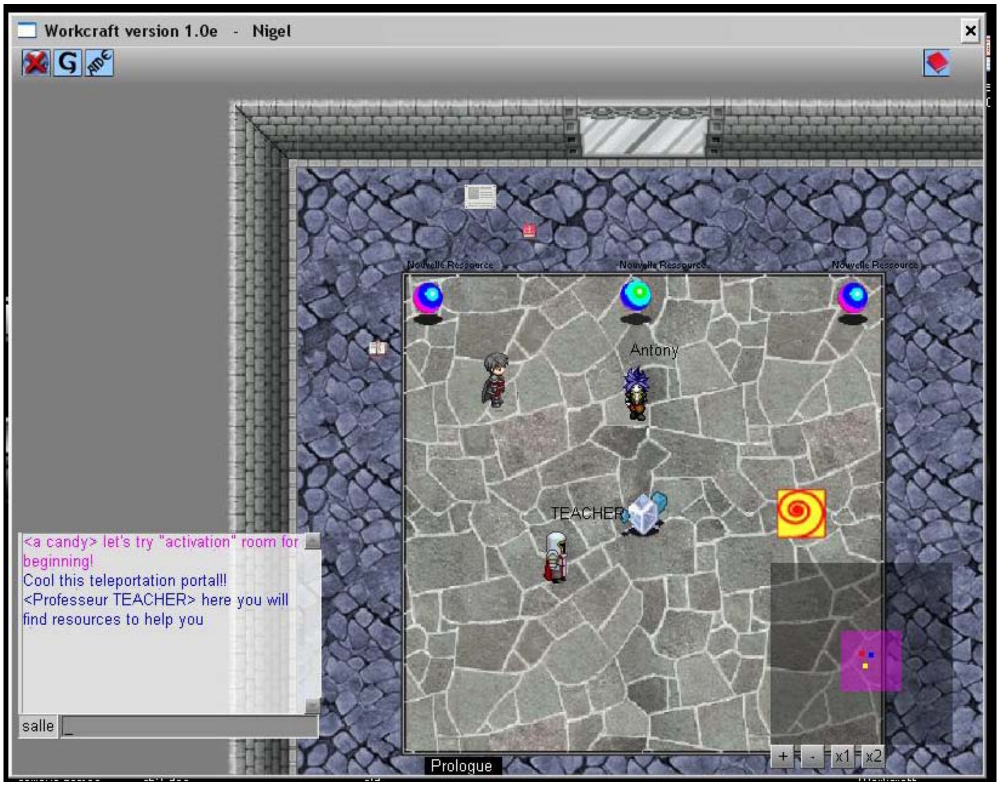

Figure 1: A room in the pedagogical dungeon

Immersion

Traces of activity can be computed to better understand the on-going learning activities, and the results (often presented through indicators) provide the teacher with valuable information. The problem is that most of the time, the teacher has a role in the game (providing help, validating answers, changing the accessible documents). Consulting this additional information provided through indicators results in a cognitive overload. We have pointed out in [5] how to remain immersed in a learning game by directly representing these indicators or hints for the teacher in the game.

Mobility

New ways of learning entail new habits and usages. One of them is mobility. The dungeon enables several activities to proceed in virtual or real places. In some scenarios, we can envisage the learners moving in order to perform certain activities (e.g. a quest in a real museum, with collaborative aspects). The teacher also needs to be aware of what is going on, and we should gather and adapt the above-mentioned indicators in order to present them on a mobile device, e.g. a PDA. A GPS is available in such devices and thus provides geographical information concerning the various learners equipped with them. We use this information in order to adapt the teacher awareness: when approaching a particular student, some associated information (performance of learning activities by this student, percentage of failure) is displayed on the teacher's device. The teacher can thus better adapt the interaction with this student.

Conclusion

Learning Games are interesting environments in which the teacher needs to remain aware of the progression of a learning session. Allowing mobility in Learning Games brings a new dimension to these environments, and can also provide additional geographical information used to provide the teacher with better contextual awareness. We study these features in the "Learning Games Factory" project, funded by the CEC. A set of widgets dedicated to collaboration indicator representation for the teacher is currently being developed, and experiments are scheduled for autumn 2009.

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Towards Web-based Remote and Mobile Q&A System – WeQaS

Abstract: In this article, we analyze the disadvantages in traditional face-to-face question and answer activities usually in office hours. To overcome its disadvantages, a web-based remote mobile Q&A system – WeQaS is proposed. Through a case study, we find that this sort of system can improve time efficiency and productivity, backup Q&A communication notes, invoke students' enthusiasm, and especially, support mobile distance learning.

Keywords: *Mobile Learnging, Distance Learning, Remote Q&A System, Web-based Eduction*

Introduction

Question and Answer (Q&A) is a frequent educational activity between students and teachers. As lecture time is limited to accommodate only few on-site questions, most students always hope to ask questions after class in regular time. Teachers normally reserve office hours after the lecture to answer students' questions encountered in study. However, on one hand, such a face-to-face Q&A is unavailable to remote students. On the other hand, even though they can make conversations by phone, they still feel inconvenient to exchange handwriting notes. Furthermore, a traditional face-to-face Q&A has some disadvantages as follows:

1) Low efficiency and productivity. Most students may ask similar questions, but the teacher has to answer these questions many times. It wastes office time. Thus, both efficiency and productivity are low.
2) Lack of documentation. The Q&A details are not documented during the office hours. Because teachers may not have enough time to write down answers, students have to scribe answers but the scribed notes may not catch exactly what teachers mean.
3) Potential Loss. To avoid congestion in office, teachers always set up a timeslot for each student. This may result in heavy communication overhead to negotiate a time slot. Moreover, some students who are unable to finish the conversation within assigned time slot will have to stop suddenly and leave. It is always a frustrated experience for students and may result in none interest for further Q&A.

To deal with the above problems in the traditional face-to-face Q&A system, we present some ideas on designing a web-based remote mobile Q&A note system – WeQaS, to facilitate communications between remote students and teachers, and both of them can be mobile users.

Web-Based Remote and Mobile Q&A System

The design objective is to support on-line document-enabled Q&A system for remote and mobile access. The Google mobile [1] provides more recent advances in services and development tools.

The major modules of WeQaS are listed as follows:

1) Account management. A teacher can initiate accounts and authorize access rights to students. Or, students create their account by providing their student ID.
2) Login. Only authorized students and the teacher can access the system.
3) Appending questions. Students can append questions in the system which are displayed anonymously or by name, depending on students' preference. The questions can be read by all students or only by teacher.
4) Attaching answers. The teacher can attach answers to corresponding questions. The question and answer modules can be edited simultaneously.

5) Classifying. The teacher can rate the importance of the questions according to her experiences and current questioning frequency. The highly rated questions will be highlighted or replicated to a separate column called Frequently Questioned Answers (FQA). Several keywords are assigned to questions and answers for classification.
6) Note management. It provides management functions of the notes in Q&A system, such as search, sort, highlight, hide and export. The contents can be searched by keywords. The documented Q&A, called notes, can be sorted by time or keywords. The teacher can highlight some notes for emphasis or hide some notes for privacy. All notes can be exported to local machine.

Case Study

We firstly use freeware Evernote [2] to do a case study. Although our proposed system WeQaS has many distinctions with it, feedback from students can gain some experiences and guide further design.

Using Evernote, students can post the questions in notes and the teacher can manage the notes, e.g., categorization, sort, etc. The teacher can append the answer behind the question. The important notes can be moved to a separate folder. More specifically, two major types of notes are provided in the system: one is text; the other is ink, which is similar to a handwriting scratch file. The attribution can be assigned to a given note, such as title, author, date, and tag (category).

Note that Evernote is not a tailored design for remote and mobile Q&A with respect to some shortcomings. It cannot hide notes. That is, all notes can be read by all authorized users so authorized user's privacy is not protected. The access control policy is rough. All authorized users can modify the notes or attach answers. Whereas, our design surmounts such weakness and together supplements some further improvements.

Comparisons

To the best of our knowledge, no web-based educational system exists for facilitating Q&A. Someone may argue that why not use other existing web-based educational tools to avoid cost to develop a new system. We thus give comparisons between WeQaS and some well known tools to make it clear.

Blackboard [3]: Blackboard is a comprehensive remote education aid system. However, it has no module that is specific for facilitating Q&A between students and teachers.

Chatroom: The chatroom always rolls in real time. It is not easy to give answers in the chatroom because questions may be sequentially mixed in a batch.

Mailing list (e.g., Google group) [4]: It may generate a bulk of emails regarding the questions and answers that certain students are not at all interested in.

Forum: It is not easy to regulate posting behavior of students in forum. In fact, students should have mere right to post questions, not answers.

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Enhancement of Mobile Learning Using Wireless Sensor Network

Abstract: Wireless sensor network (WSN) technology has figured out that our living environment can be embedded with numerous sensors, and the sensors can be connected as a novel interaction platform that can extend the usability, flexibility and variability of mobile learning. In this study, a framework which supports micro- and macro-WSN enhanced mobile learning is proposed. Based on the framework, two practical examples, one in classroom and the other one in a city-wide environment, are demonstrated to show the potential of using WSN in mobile learning.

Key words: Wireless sensor network enhanced mobile learning

Introduction

Novel mobile and wireless technology provide new possibilities for learning and have demonstrated the potential of using handheld devices in education. Wireless sensor network technology enables spatially distributed autonomous sensors to monitor physical environmental conditions cooperatively [1]. The deployment of an ad-hoc and multi-sensor WSN is very dynamic, depending on the purposes of requests. The coverage of a WSN could be as small as a single classroom or as large as a whole city. Combining the traditional mobile learning devices, including PDA, Tablet PC, cellular phone, etc., with WSN, it can enhance the functions and extend the territory of mobile learning.

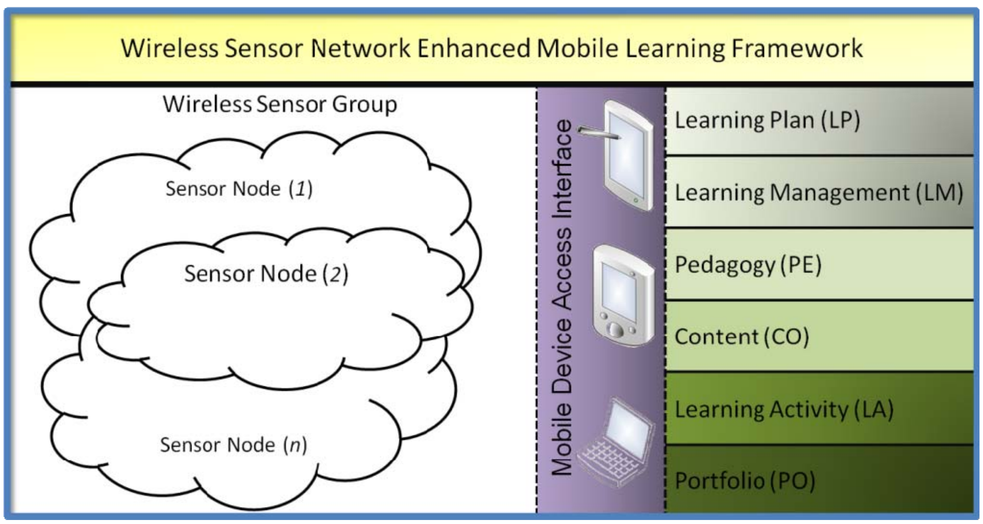

Figure 1: Wireless sensor network enhanced mobile learning framework

Wireless Sensor Network Enhanced Mobile Learning Framework

In order to design wireless sensor network enhanced mobile learning (WSNEML), a framework composed of a wireless sensor group, a mobile device access interface, and a set of learning components is proposed (Figure 1). The wireless sensor group is a set of autonomous sensors organized as a network to detect and monitor the physical environment. The data or commands can be accessed or executed on the handheld devices via the mobile device access interface. In addition to the hardware network architecture and handheld device, a set of learning components including learning plan (LP), learning management (LM), pedagogy (PE), content (CO), learning activity (LA) and portfolio (PO), are required in the framework. The framework was applied in two extremely environments, one is a micro-WSNEML covering a small space like a classroom and the other one is a macro-WSNEML throughout Taipei City, as elaborated below.

Micro-WSNEML: Classroom Gesture Detection Wireless Sensor Network

In a computerized classroom, such as a computer laboratory, each child is equipped with one desktop for learning. The design concept of this computerized classroom is one-computer-one-child, which was argued that it is adult-oriented, not child-oriented. Children have their unique requirements in using information technology in classroom. Instead of using monitor, keyboard, and mouse, an alternative way is allowing children to input their message via their body motion, such as gesture, which is a more nature way to use technology in classroom [2]. The classroom gesture detection wireless sensor network is a set of ribbons equipped with wireless utilization and a set of handheld devices [3]. The ribbons are embedded with gesture detection chips and can communicate with the handheld devices wirelessly. All the students in the classroom wear ribbons, and their gesture signals were captured and sent to the handheld devices for further process. By using the hardware and software, the classroom can be rearranged from one-child-one-desktop to many-children only few handheld devices for learning. For the learning components in the gesture detection classroom, the learning plan is fluency building; the learning management is in the classroom; the pedagogy is question posing and answering; the content is the item bank; the learning activity is competition games; and the learning portfolio is the student gesture motions. Figure 2 shows the architecture and the learning components of the micro-WSNEML.

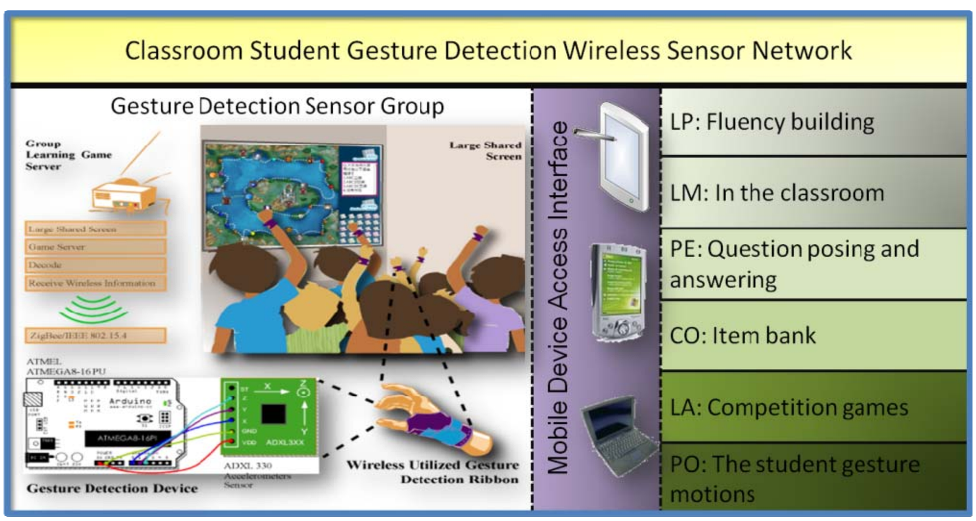

Figure 2: Classroom Gesture Detection Wireless Sensor Network

Macro-WSNEML: City-Wide Weather Science Inquiry-Based Learning Wireless Sensor Network

Taipei weather inquiry-based learning network (TWIN) is a city-wide macro-WSNEML that was intended to provide a distributed wireless weather sensor network throughout Taipei City and to promote weather science inquiry-based learning activities [4]. The TWIN was composed of sixty school-based weather sensor nodes. The school-based weather sensor node is comprised of a wireless weather sensor station, a data receiving console connected to an

Internet-connected computer, and a school server. The sensor station can automatically detect temperature, humidity, barometer, UV radiation, rainfall rate, wind direction and wind speed every five minutes. Based on the actual weather data, the data receiving console can then generate other weather data, such as dew point, wind chill temperature, temperature-humidity-wind (THW) index, and heat index. The wireless weather sensor stations are solar powered, and each is equipped with a wireless module to enable the station working twenty-four hours a day and seven days a week independently. Moreover, students can access real time or historical weather data through the handheld devices. For example, when students work on a project which is to compare weather status at different height of a mountain, they can carry out a field survey by using probes to get real time data and instantly retrieve the data at different location from the TWIN via tablet PC. For the learning components on the TWIN platform, the learning plan is weather science study; the learning management is on the TWIN platform; the pedagogy is inquiry-based learning; the content is the archive of the TWIN, the learning activity is weather inquiry tournaments; and the learning portfolio is the inquiry-based learning progress logs. The TWIN has the advantages including gathering actual and real-time data, exploring the environment not constrained to geographic restriction, learning in effective and task oriented ways, and owing personal digital archive. Figure 3 shows the architecture and the learning components of the macro-WSNEML.

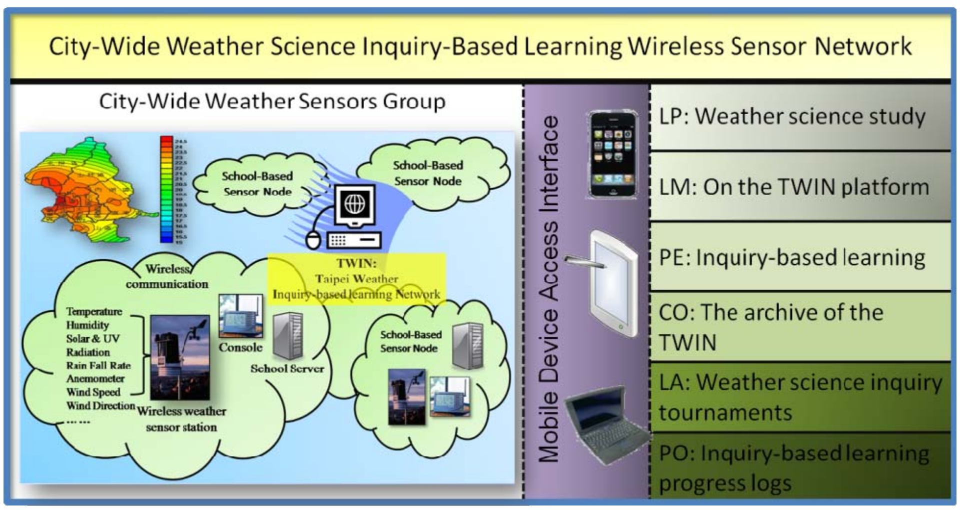

Figure 3: City-Wide Weather Wireless Sensor Network

Conclusion

Novel technology brings new types of learning. Mobile learning has demonstrated the potential of using handheld devices in learning. Sensor-based technology has shown the potential in which our learning environment can be embedded with numerous sensors collecting the physical information. Consequently, enhancement of mobile learning using WSN can extend mobile learning to a more attractive environment. This study proposed a WSNEML framework that can guide designers to implement such an environment. Two different types of pilot studies are proposed and demonstrated the potential of applying the WSN in mobile learning.

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Global Optimisation and Mobile Learning

Introduction

Mobile devices, such as cellular phones and Personal Digital Assistants (PDA), have become part and parcel of our everyday life. These mobile technologies and their wide adoption in the society are influencing not only the way we live, but also the way we learn, the way we work, and the way we socialise. According to [1], there are estimated to be more than 1.5 billion mobile phones in the world today.

The rapid advancement of these portable technologies is also changing the way educational institutions work. It has opened up new possibilities for extending learning opportunities to all social-economic levels and a completely new dimension to the progress in education and training known as *mobile learning*. Through mobile learning, educational and training programs that were once delivered only through a face-to-face setting or networked computers can now be done almost anywhere, anytime.

Global Optimisation

Global optimisation, on the other hand, is a branch of applied mathematics and numerical analysis that focuses on finding the best possible solutions based on a set of criteria expressed as mathematical functions, commonly known as objective functions [2]. Global optimisation approaches can generally be divided into two types: *deterministic* and *stochastic*. The most successful example of the deterministic type is perhaps the Branch and Bound[2] methods, but they are not so attractive anymore in recent years due to the large and dynamic problem spaces that need to be tackled in today's real-world problems. A more appealing choice is therefore the stochastic solvers, such as Genetic Algorithms, Particle Swarm Optimisation, Ant Colony Optimisation, and so on. These methods are mostly inspired in part by nature and natural systems. For an overview of some popular nature-inspired methods and their practical applications, see [3].

So, what does global optimisation have to do with mobile learning? An undeniable fact is that all of us desire optimal outcomes. Very often we tend to find various alternatives in order to maximise our gain by minimising the cost we need to bear. Likewise, various aspects of the mobile learning environment need to be optimised so that the mobile learners can take full advantage of it. Global optimisation methods have been widely used in many e-learning activities. For example, very recently an e-learning decision support framework based on a set of soft computing techniques is introduced in [4] with the aim to improve e-learning experience. This framework can discover an e-learning system's usage patterns and contribute to alleviating instructors' workload. The identification of students' learning behaviour allows instructors to predict the performance of their students and pinpoint weaker students for personalised feedback. Besides that, we see the use of Genetic Algorithms for providing intelligent assessment services in an e-learning environment [5] and for classifying students in order to predict their final grade based on features extracted from log data in a web-based educational system [6], the use of Ant Colony Optimisation for the pedagogic material of an online teaching website for high school students [7, 8] and for sequencing of e-learning activities [9], as well as the use of Particle Swarm Optimisation for arranging a set of learning

[2] A general optimisation algorithm that systematically enumerates all candidate solutions and discards fruitless candidates by using upper and lower estimated bounds of the quantity of solutions being optimised.

resources in order to present them in a personalised way to the learners [10]. Note that these examples are by no means a comprehensive list, but a snapshot of some interesting works that applied global optimisation methods to e-learning over the last couple of years.

Examples of Global Optimisation in Mobile Learning

While substantial works have been done on e-learning with global optimisation, its applications to mobile learning are still rare. Lately, an adaptive testing system for supporting versatile educational assessment has been presented [11]. In this work, the authors integrate computer based test with mobile learning for both formative assessment and self-assessment. Students are assessed through a process that uses item response theory, a well-founded psychometric theory. The problem with the use of item response theory is that a large item bank is indispensable to a test, yet when the system has a large item bank, the test item selection becomes a very tedious job. To solve the problem, Particle Swarm Optimisation method is used to speed up the searching and selection process. Furthermore, for controlling the test item exposure, an item exposure mechanism is combined with Particle Swarm Optimisation to prevent the same test item from appearing twice. When a test item was responded or an adaptive test was finished by a student, this system applies maximum likelihood estimation as an underlying psychometric theory to estimate the student's ability and give immediate feedback by showing the results to the student.

Apart from Particle Swarm Optimisation, an improved Genetic Algorithm with association rules has been proposed in [12] to analyse the vast amount of learners' profile data in a web-based mobile-learning system. The authors show that interesting relationships can be found with this method within minimal execution time. If fully developed, it is able to create an efficient mobile-learning system that understands its learners.

Concluding Remarks

Although brief, these works demonstrate the potential of global optimisation in mobile learning. Genetic Algorithms have been applied extensively in mobile robots with huge success (see [13, 14]). Similarly, swarm intelligence and other global optimisation methods have contributed greatly to the field of telecommunications and distributed systems (see [15, 16]). It is therefore just a matter of time before these methods are adopted extensively in mobile learning.

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Exploring Students' Perceptions toward Using Interactive Response System

Abstract: This article reports a one-semester project using the NXTudy Interactive Response System (IRS) in a classroom. The Technology Acceptance model was extended to formulate students' perceptions, attitudes and actionable feedback in terms of using the proposed IRS. A survey was conducted and the results confirmed that "perceived usefulness" was the most important factor in the model. Teachers should explain the importance of using technology before the class starts and constantly repeat the benefits to enhance students' understandings, so that students feel the usefulness of the technology, and further boost the intention to use, satisfaction and the willingness to recommend others to use the technology.

Keywords: *TAM, IRS, perceptions, usefulness, satisfaction, suggestion*

Introduction

Intel Teaching Program (Intel, 2007) had trained over 3300 primary and secondary school teachers the skills of applying information technology into their teaching, and planned to expand the program to reach 13 million teachers in more than 40 countries – and their one billion students by 2011. Technology can be a powerful tool to help students develop and strengthen their skills in succeeding in the global economy.

Some studies have explored the technological effects on students' learning, such as podcasting, Wiki, open source software, web-based systems. However, those studies focused on "out-of-classroom" systems which enable learner autonomy to study by their own outside the classroom. Little research has investigated students' perceptions toward applying "in-classroom" technology, such as Interactive Response System (IRS). The urgent call for this research comes from the proliferation of IRS introduced to the campus, such as NXTudy. IRS is able to assist the teaching strategy to help students achieve better learning performance. Therefore, the purpose of this study is to build a model to evaluate students' perceptions of using IRS and propose suggestions for teachers to support their teaching strategy.

Teaching with IRS

NXTudy is an IRS which is composed of two parts: a remote controller and a server. The remote controller is controlled by students and the main function is to answer the questions given by teachers. The server includes a PC and IRS system whose function is to present the teaching material on the screen and receive students' signals. A sensor receives the signals from the remote controller and transfers the data to the server. The structure of NXTudy is shown in Figure 1.

"Technology English" is a one-semester subject for the undergraduates in a university in Taiwan. 248 students in total enrolled in this subject. Students received 30 minutes training of NXTudy at the beginning of the semester to ensure their proficiency in the operation of remote controllers. NXTudy was used as a quiz tool followed by the regular teaching and also used as a tool for the middle and final exam. At the end of the semester, students were asked to fill in the questionnaire designed by the framework described in the next section. 245 questionnaires were collected and 6 questionnaires were discarded due to their incompletion, which results in a return rate of 98%.

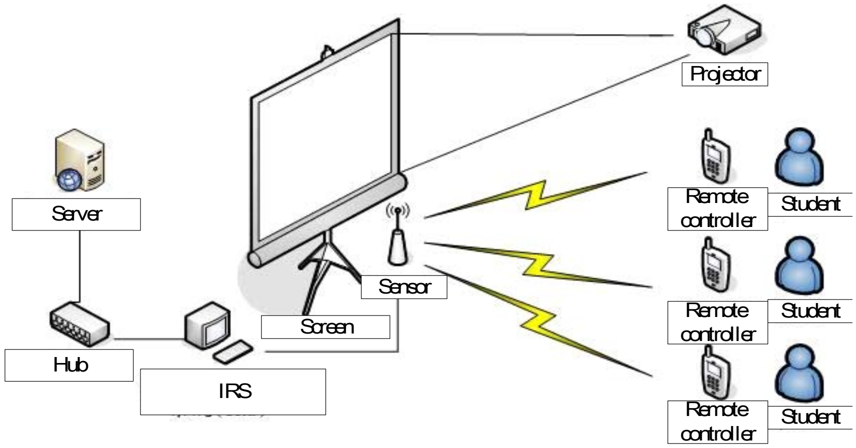

Figure 1: The structure of NXTudy

The Framework and Hypotheses

This study extended TAM (Davis, 1989), by adding two factors: “user satisfaction” (Wixom & Todd, 2005) and “suggestion to use” (Zeithaml et al., 1996). The former stands for the subjects’ feelings or attitudes toward consequences or outcomes while the latter represents the subjects’ willingness to recommend others to use the technology. To aggregate past literature, a framework is proposed in Figure 2.

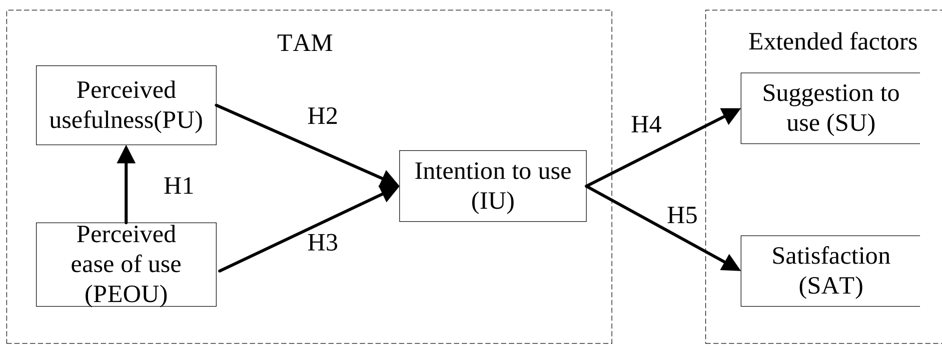

Figure 2: The proposed framework

The following hypotheses are investigated:

H1: Students’ PEOU affects PU.

H2: Students’ PU affects IU.

H3: Students’ PEOU affects IU.

H4: Students’ IU affects SU.

H5:Students’ IU affects SAT.

Data Analysis

The SEM (Structural Equation Model) model was constructed by LISREL 8 .72 and is shown in Figure 3. It presents a good model fit and thus H1, H2, H4 and H5 are supported. Only H3 is not supported. PU mediates the effect of PEOU to affect IU and further affect SU and SAT, which implies that the subjects' intention is affected by the extent of usefulness and ease of use. But the effect of PEOU needs to transit by PU, which means that how useful the subjects perceive is the pivotal issue. Thus PU is regarded as the most important factor in the model.

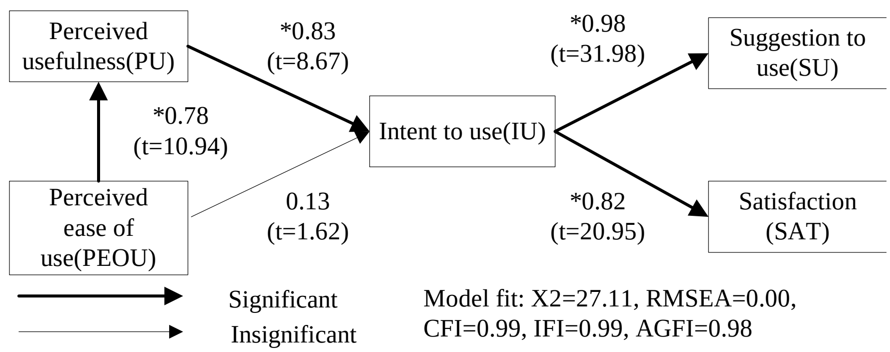

Figure 3: Tested model

Discussion

This study makes two contributions. Firstly, this study extended the TAM, by considering the characteristics of integrating technology into the classrooms, and it incorporated two factors: "user satisfaction" and "suggestion to use" to build a new model. Such integration can help to build a conceptual bridge extended from design and implementation decisions to system characteristics to the prediction of usage, user satisfaction and actionable feedback (such as recommend others to use). Furthermore, by theoretically extending the TAM, it can fully examine the role of the IT artifact and bring more IT research streams.

Secondly, the results prove that perceived usefulness is the most important factor, which implies that teachers should focus on this factor for the success of using technology. Once the students' perceptions of usefulness are well-established, the degree of intention to use and satisfaction would be higher, likewise they would recommend others to use the technology and diffuse the influence of technology in teaching. Therefore apart from repeating the benefits of the technology, ensuring the elimination of the problems and obstacles that hinder students' usage of the technology appropriately can strengthen the perception of ease of use, and further enhance the perception of usefulness. In some cases, having teaching assistants with expertise in computer technology would be helpful, because they may help solve the technological problems to reduce students' frustration in operating the technology.

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Call for Papers: Inaugural issue of the Journal of Applied Research in Workplace E-learning

Impact: Journal of Applied Research in Workplace E-learning, a publication of the E-learning Network of Australasia (ElNet), has been established to address the paucity of research publication avenues with a particular emphasis on e-learning in organisational and workplace settings. It will be a fully online journal, publishing refereed and non-refereed contributions from both researchers and practitioners relating to the design, implementation, evaluation and management of workplace e-learning across a range of sectors and industries.

Submissions are invited for the special, inaugural issue of the journal, the theme of which is **"Current issues and future directions in workplace e-learning: Mapping the research landscape"**. This issue will include peer-reviewed articles that address one or more of the following areas:

1. Summary and synthesis: *Where are we now?*

- Identification and analysis of major issues, themes and trends in the field of workplace e-learning research
- Review of key studies and seminal pieces of literature in this field, and how future research efforts might build upon the work already done

2. Gap analysis: *What do we need to know more about?*

- Discussion of areas have been under-emphasised or neglected in the field of workplace e-learning research
- Exploration of how these areas/gaps might be addressed

3. Planning and designing: *How should we move forward?*

- Setting the research agenda for workplace e-learning
- Future directions for workplace e-learning research and its application to practice

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Submission of final articles for publication: 1 August 2009

Publication of inaugural issue (online): 1 September 2009

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