

Increasing interactivity in blended classrooms through a cutting-edge mobile learning system

Ruimin Shen, Minjuan Wang and Xiaoyan Pan

Ruimin Shen is a distinguished professor of Computer Science and Engineering at Shanghai Jiaotong University (SJTU). He is also the director of the world-renowned e-Learning Lab, and the founding dean of SJTU's Network Education College (16 000 students). Shen's research and development specialty focus on technologies for 'available anywhere and updatable anytime' distance education, including mobile learning and standard natural classrooms. He has peer-reviewed articles published in top-tier journals such as International Journal of Distance Education Technologies, Lecture Notes in Artificial Intelligence, Lectures Notes in Computer Science, Computers and Education. Minjuan Wang is an associate professor of Educational Technology at San Diego State University. Her research specialties focus on the socio-cultural facets of online learning, mobile learning, and technological interventions in language education. She has published peer-reviewed articles in Educational Technology Research and Development, Computers and Education, Educational Media International, TechTrends. She has also published several book chapters on engaged learning in online problem solving, Cybergogy for interactive learning online, informal learning via the Internet, and course design for learners of diverse cultural backgrounds. Xiaoyan Pan is an associate professor of English at SJTU and a prolific author of 50 English books, such as College English Synonyms, Handbook for Advanced Interpretation, English Writing for to-be Postgraduates. She teaches major English courses at the Network Education College. Placing great emphasis on class interactions, she conducts action research on the use of new and innovative systems in her classrooms. She has several papers accepted by international conferences in e-learning and distance education. Address for correspondence: Minjuan Wang, Associate Professor, 5500 Campanile Dr. North ED 280, San Diego, CA 92182, USA. Tel: 619-5943878; email: mwang@mail.sdsu.edu

Abstract

Chinese classrooms, whether on school grounds or online, have long suffered from a lack of interactivity. Many online classes simply provide recorded lectures to which students listen after downloading. This format only reinforces the negative effects of passive non-participatory learning. At the e-Learning Lab of Shanghai Jiaotong University researchers and developers actively seek technologic interventions that can greatly increase interactivity in blended classes. They developed a cutting-edge mobile learning system that can deliver live broadcast of real-time classroom teaching to online students with mobile devices. Their system allows students to customise means of content-reception, based on when and where the students are tuning in to the broadcast. The system also supports short text messaging and instant polls. Through these venues, students can ask questions and make suggestions in real time, and the instructor can address them immediately. Here we describe this system in detail, and also report results from a test implementation of the system with a blended classroom of 1000 students (250 campus and 750 online).

Introduction

A pedagogically detrimental lack of interactivity is a long-standing feature of Chinese classrooms, including both online classes and campus ('ground') classrooms. Many online classes simply provide recorded lectures to which students listen after downloading. This format only reinforces the negative effects of passive non-participatory learning. In addition, teacher-centred presentation is still predominant in many of the higher-educational classrooms.

The researchers and developers from the e-Learning Lab and Network Education College of Shanghai Jiaotong University aim to address these problems through interactive mobile learning. Mobile learning (mLearning), defined as learning with mobile devices such as Palms, PocketPCs, wireless cameras, Web Tablets, cell phones, and any other handheld devices (Harris, 2001; Kossen, 2001; Quinn, 2000), has drawn a great deal of attention in the US, as well as in European and Asian countries. mLearning is the marriage between mobile computing and e-learning (Trifonova & Ronchetti, 2003). With the rapid technological development, mLearning in China will have enormous opportunities in the near future. The traditional instructor-centred curriculum, however, is urgently in need of redesign to adopt the best of the advantages of mobile devices. For instance, several of the distance education departments of institutions of higher education in China are actively seeking ways to adapt their current curriculum for interactive teaching through mobile devices. Thus, in addition to encouraging students' active learning for its own sake, we also hope that the development of mLearning can set an example for the pedagogical changes throughout higher education in China.

Today's mobile terminals have strong computing capabilities with high-frequency CPU (Central Processing Unit). They can put convenient multimedia service applications into practice with friendly human computer interfaces and operation modes, and they can also access abundant network resources through a variety of network connection techniques. In the meantime, computing networks are developing at an astonishing speed as well. In particular, the rapid development of wireless networks transforms cell phones, Pocket PCs, iPods and other personal digital assistants (PDAs) into learning devices. Apart from Bluetooth and WiFi, General Packet Radio Service (GPRS) is one of the primary ways to transfer network data to these mobile terminals. As long as the users' cell phones are situated on a signal location, they can enjoy various network resources and services via GPRS. All these make it easier for users to access learning anytime anywhere. Because of the rapid development of mLearning, distance education has begun to challenge formal schooling and traditional classroom teaching. Although distance education has yet to bridge a gulf between formal and experiential learning (Sharples, 2005), the time is ripe to reconsider the autonomy of the physical classrooms in adult education.

A great deal of creative work has already been directed toward developing mLearning systems and classrooms. For instance, the National Central University in Taiwan has built a Wireless Technology Enhanced Classroom (Liu *et al.*, 2003). This classroom supports everyday activities unobtrusively and seamlessly in classroom contexts through the integration of a number of devices, such as the wireless local area network

(LAN), wireless mobile learning devices and an electronic whiteboard. All these enable teachers and students to fully engage in the process of learning through frequent interaction and collaboration. In Europe, the large-scale Mobilelearn project (www.mobilelearn.org) explores the potential and the architecture of mLearning through its application in health, museum and executive education. As part of this project, a group of researchers from Switzerland designed a MobileGame prototype (Schwabe & Göth, 2005), which orients new students to the university and its surroundings in a fun and engaging way. Because learning is considered a lifelong activity, researchers from University of Birmingham also developed an exemplar of a personal mobile system to assist people of all ages in their personal learning throughout their lives (Sharples, Corlett & Westmancott, 2002). This prototype testing followed the daily activities of children, related those activities to online resources, organised them into visual maps, and also shared the activities with others through a handheld learning device/resource. Their proof-of-concept testing confirmed that a handheld device—with appropriate learning tools and resources, an intuitive interface, and high-speed communication—could effectively help people manage their lives and learn as they live. However, the components of ‘an intuitive interface and high-speed communication’ are still compromised by today’s technology. In addition, mLearning faces the great challenge of creating the concrete context for learning, which ‘involves the familiar dimensions of time and location, ... the learner’s goals and motivation, the surrounding resources, co-learners, and other available conversants’ (Sharples *et al*, 2002).

Aiming to create a ‘real’ context for mLearning and to increase student exchanges in online and blended classrooms, the e-Learning Lab of Shanghai Jiaotong University invented a mLearning system that supports multi-directional communications among instructors and students. This system therefore enables the instructors to experiment with student-centred teaching. In the following sections, we will concisely describe the function and the architecture of the mLearning system. We will also discuss the use of this system in a large ‘blended’ class and our findings on student perceptions of their learning behaviors and experiences.

System description

The mLearning system includes the mobile phone broadcasting sub-system and the classroom management sub-system. The system’s physical framework can be divided into three parts: a classroom cluster, a server and a client on a mobile phone. Instructors, students and system administrators are the three groups involved in this mLearning; and each plays an important role in the successful delivery of course content and materials to mobile devices. The instructors carry out the multimedia instruction via the instructor station, which supports handwriting on the computer screen. During their teaching, the instructors use either PowerPoint slides or handwriting on the screen. Cameras and microphones that are connected to the computer will capture the live scenes of the classroom. A recording program, which is part of the mobile phone broadcasting sub-system, will record all these media components: audio, video, handwriting and PowerPoint presentations. In the meantime, the instructor station will display messages from the students, reporting their learning progress, their questions, or their feedback to the

instruction. These messages are delivered as cell phone text messages through short message service (SMS). To address these messages, the instructor can give oral explanations or can reply through short text messaging. In addition, this mLearning system can also display the screen of all students' mobile devices that are tuning in to his/her live broadcast on a larger screen, through which the instructor can supervise students' learning (Tong, Hu, Han & Yang, 2005) and can also take an instant poll on any aspect related to the instruction, pace, clarity, content, structure, etc.

When the students connect their smart phones to the GPRS network, they can download and install the client program. When they run the client program just as they would with other applications installed on the mobile phones, they will be able to see the curriculum schedule of that day, and also all the classes that are going on at that moment. Students can choose which class to tune in to, as well as the format in which the live broadcast should be displayed: (1) as text + audio + small video of the real-time classroom, (2) as video of the instructor only, (3) as close-in display of the texts, or (4) as a close-in display of the instructor's facial expressions and other body language. Although the mLearning development team has not collected data on students' usage of each of the display format, the size of the current cell phone screens and cell phone costs limit students' choices. The development team estimates that in the next 2 years, a great majority of the users would choose texts and audio. Considering the current lecture-dominated teaching method in China, the researchers concur with this estimate. Chinese students' high Power Distance Index on Hofstede's cultural dimensions further support our estimate of students' tune-in format. Power Distance Index (PDI) refers to how people respond to other individuals who hold positions that are superior or inferior to their own (Hofstede, 2001). Specifically, many Chinese students still view instructors as authorities who 'distribute' knowledge. They are therefore more comfortable with hearing the instructors rather than seeing or interacting with them, in person or online (Wang, 2007).

Theoretically, the text + audio + small video mode can create the context of learning, that is, the feeling of being in a real classroom with the instructor and many other students nearby. Once a student's mobile phone connects to a class, its screen will be sent to the instructor periodically, so that the instructor can monitor the student's learning status. Meanwhile, students can send short text messages to the instructor and they can participate in polls and other in-class activities. The mLearning server will generate the poll results and immediately send them to the instructor for him to adjust or improve the instruction. The system administrators mainly take charge of maintaining servers and arranging the curriculum schedule. They have the sole ability to change the class schedule, through a web-based application that connects to the system database.

The instructors, students and system administrators cooperate to create a virtual classroom that includes both online and classroom students, and the real-time communication between online students and the instructors. However, their cooperation relies on the support of this mLearning system, which conducts the coding and decoding of



Figure 1: A typical 'blended' learning classroom used at this university

the multimedia-teaching stream and manages the time delay. Figure 1 shows the environmental and technological configuration of the blended learning classroom as used in this university.

System architecture

Figures 2 and 3 illustrate what a student sees on his/her computer screen or mobile devices, when tuning in to an online broadcast.

Figure 4 displays the configuration of this mLearning system. To be visually clear, the broadcasting sub-system is indicated in orange, and the management sub-system is indicated in green.

From the real-time classroom, the multimedia teaching stream—which includes video, audio, handwriting, lecture notes, and other forms of communication—is coded in the classroom cluster. The system will export the multimedia streams in two formats with different coding qualities to accommodate students' different bandwidth. Through the China Educational Research Network or cable network, the streams arrive at the broadcast and the management servers at the University. A powerful database stores class information and messages during the lessons, which provide many opportunities for data mining research. Via GPRS network, mobile phones receive the streams and initiate votes or short text messaging feedback along the reverse direction. The trade-off between stability and latency is established when the stream is played back on the mobile phones.

As the core of this system, the broadcasting server bridges the classroom cluster to mobile phones. As viewed from the broadcasting perspective, each socket provides the

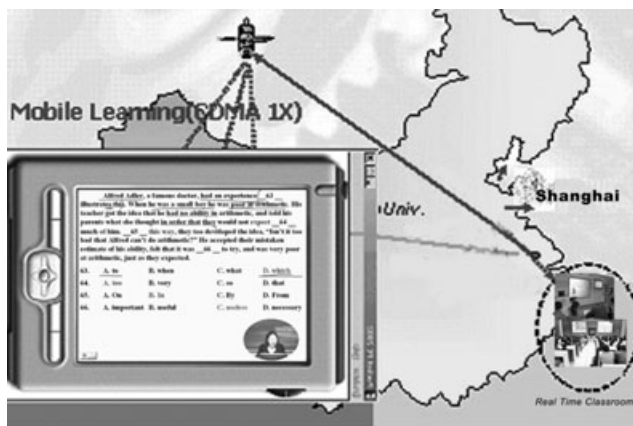


Figure 2: The delivery system and the classroom display on a cell phone

Alfred Adler, a famous doctor, had an experience 63 illustrates this. When he was a small boy he was poor at arithmetic. His teacher got the idea that he had no ability in arithmetic, and told his parents what she thought in order that they would not expect 64 much of him. 65 this way, they too developed the idea, "Isn't it too bad that Alfred can't do arithmetic?" He accepted their mistaken estimate of his ability, felt that it was 66 to try, and was very poor at arithmetic, just as they expected.

63. A. to B. when C. what D. which
 64. A. too B. very C. so D. that
 65. A. On B. In C. By D. From
 66. A. important B. useful C. useless D. necessary



Figure 3: Zoom-in: what the student sees (either on the computer or on the mobile phone)

technical backbone of a virtual classroom, and each virtual classroom transmits the compressed video, audio and screen data to the mobile phones connected to it. The broadcasting sub-system supplies multimedia-teaching streams from a real-time classroom to mobile phones. A few key issues remain to be addressed, including knowing students' learning status and facilitating the effective interaction between students and the instructor. The management sub-system, consisting of course schedule update, short text messaging and feedback through polls, is built to serve such purposes and so to improve instruction quality.

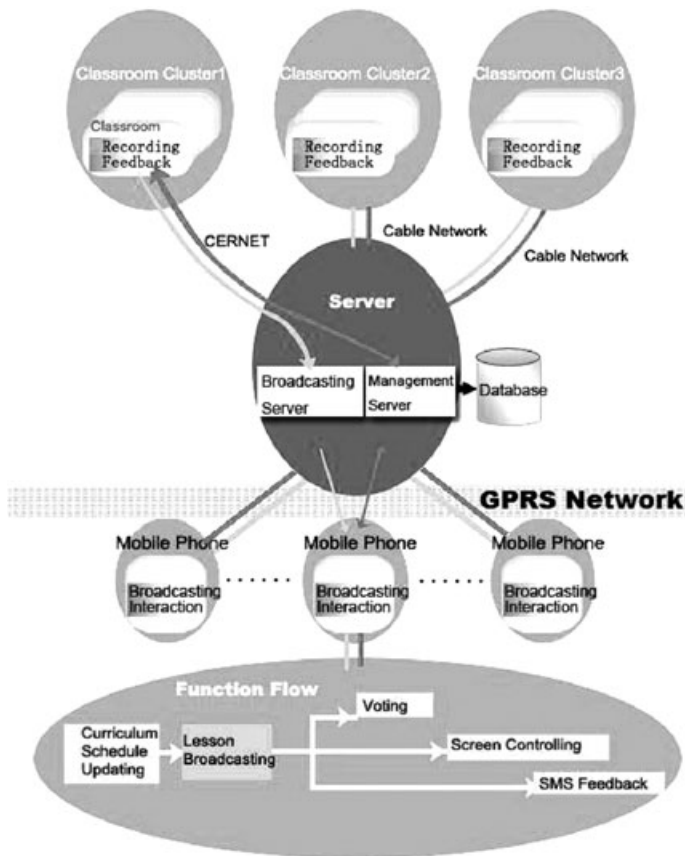


Figure 4: The architecture of the mobile learning system

Case study of system implementation and results

The researchers and developers tested this system in a blended class of 1000 students (with about 250 being on campus and 750 being online). The 7-week class teaches Comprehensive Social English, including use of grammar, vocabulary, reading and email writing. The students were assessed through eight weekly quizzes. Because of the large size of the class, there has been a lack of interactive activities and even short exchanges between the instructor and the students. Using this mLearning system, the instructor asked questions during live sessions and encouraged the students to send in their answers through cell phone text messages. These activities were intrinsically motivating because they prepared students for the ongoing tests. In addition, students who continuously participated in these activities received bonus points towards their grades in this class.

The instructor distributed quiz items before the sessions as homework. Students brought their answers to class and sent in their answers through cell phones, and these

answers went through the mLearning system and appeared on the instructor's computer screen. Figure 5 is an example of the quizzes students worked on in class, through this mLearning system.

To assess the effectiveness of this mLearning implementation in this English class, the researchers collected data through a few surveys from both campus and online students; and the survey questions are identical for both groups. The surveys include

- (1) A pre-survey (for all students) that serves as a needs assessment. The pre-survey collects informative data about students' professional background, their experiences in taking online classes, their motivation in taking this class and their perceptions on mLearning via cell phones.
- (2) Periodical polls and debriefing during class (for campus students), asking about their experiences with the mLearning activities and their feedback for further improving such activities.
- (3) A post-survey that solicits online students' perceptions on the mLearning system and activities conducted using this system. Campus students were not asked to complete the post-survey; instead, the instructor asked for their feedback in class.

All 250 campus students replied to the pre-survey and about 50 of them participated in the class polls and debriefing, which were also conducted via short text messages. About 276 (out of 750) online students replied to the pre-survey; about 735 online students replied to the post-survey. The survey response rate increased a great deal for the online group, partially because of the instructor's continuous encouragement and a raffle for prizes.

An analysis of the survey responses from the online students shows some interesting patterns. A great majority of them are working professionals, who take classes from this network college to advance their degree and careers. About 203 of the 276 respondents have never taken an online class before, and they felt intimidated when being in an

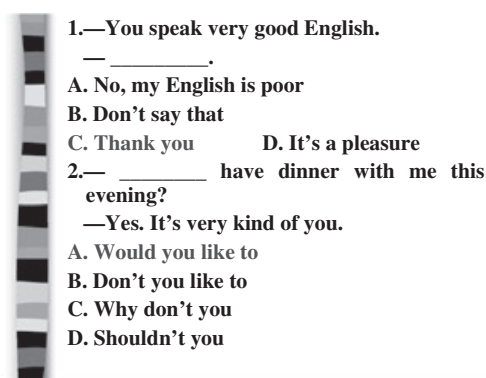


Figure 5: Example of a quiz item students worked on in class

interactive online class. It seems that lack of self-confidence lowered their ability to participate more actively in class activities or online discussions, and this finding conforms to the results from another recent survey on 800 online students from this College. A great majority of the 800 respondents to this survey said they have no idea about how to interact online. They look for rules to follow and often feel lost in blended classrooms, that is, classes that are taught face to face for 'ground' students and via certain online systems for students at a distance (Wang, 2007).

Compared with the online students, the campus students are younger (average age: 25 vs. 35) and they have no or little work experience. These demographics are representative of college-level campus students in China. Although most of them have not taken an online class before, they are eager to be in this blended classroom, and to interact with the 'invisible' online group. When asked about their expectations in taking this class, a handful of them wrote about meeting new people, building a social network and expanding their 'world' beyond campus. It is worth noting that university campuses in China are often surrounded by walls, and many students live on campus. The inclusion of distributed online learners seemed to energise the campus group. Even though they could not see the online students, the awareness of being in the same class with a large number of working professionals was exciting to most.

When asked about their perceptions on mLearning, 85% of the 1000 students did not wish to study using cell phones or PDAs, because of their unfamiliarity with this format of study and the cell phone costs. When asked hypothetically about what course content they like to receive on their cell phones or PDAs, the answers include real-life case studies, interesting stories, and quizzes; the format of the content can be either text only, audio-video only, or a combination of both. About the frequency of participation in interactive activities through cell phones, most indicate that they can live with 'twice a week'.

In addition, among the 1000 students, the students' English skills vary a great deal, from beginning to the advanced level. Encouraging interactivity through cell phone text messages may ensure that individuals can get proper attention. The instructor attempted to address students' text messages soon after she received them. The format of the activities are similar to the interactive TV programmes that are very popular in China, where a question is posed and the audience send in answers through cell phones. The ones who are the fastest in getting to the accurate answers will get prizes from the TV station. Although there were no competitions among the students in this class, they were required to send in their answers within 5 minutes. This helped to ensure the instruction staying on track and the class finishing on time.

During the several activities, the instructor received an average of 126 text messages per session from both campus and online students. Interestingly, campus students were more active in participating in the quiz activities through their cell phones. Among the 142 students who participated in these activities, almost 98% were from the campus class. A few constraints prevented online students from actively participating in these

activities: their work schedule, 'noisy' study place and lack of access to high-speed Internet for attending the live sessions.

The instructor did a text message (through SMS) poll in one session, asking students why they participated and did not participate in these activities, what worked and what did not work. Many of the 250 campus students replied to this instant polls. According to the SMS responses, students were motivated to participate for the following reasons: (1) to get bonus points, (2) to enjoy exchanging with the instructor, (3) to enjoy this 'new' way of learning, and (4) to follow the 'trend' of being interactive. Some students were discouraged from participating, because of (1) their lack of preparation before class; (2) their inability to keep up with the activities; (3) their lack of interest in participating; and (4) difficulty of typing letters on cell phone pads. Because the instant polls were kept anonymous for the sake of truthfulness, it is impossible to correlate these responses to the students' pre-survey responses on goals, motivations and learning preferences. Based on the researchers' observation of the live classes, the 'do not feel like' type of students can be the ones who prefer to be left alone, taking notes and studying without interacting. Further study is needed to examine these students' class performance, that is, their grades on all exams.

The post-survey asked online students about their satisfaction with this English class, whether they participated in the class activities and their perceptions on the effectiveness of such activities. Interestingly, although expressing fear about interacting online, a larger number of the post-survey respondents were either satisfied or very satisfied with this online class (*somewhat satisfied* [496, 67%], *satisfied* [187, 25%], or *very satisfied* [40, 5%]. And they listed the following reasons:

- (1) High-quality online broadcast
- (2) Convenience in studying and in tuning in to the broadcast at their own pace
- (3) Possibility to repeat viewing the course content
- (4) The proper pacing and clarity of the instruction
- (5) Effective learning (learned a lot)
- (6) The activities were new and engaging
- (7) The instructor was lively and responsible
- (8) Being exposed to a new way of learning
- (9) The course changed how students perceived online classes (as a place where they can participate and construct new things).

The last comment is what the researchers and developers have hoped to accomplish in this pilot implementation. It seems that the opportunities to interact and to get instant feedback helped to reduce the transactional distance between the instructor and the students. Transactional distance (Saba, 1988) refers to the amount of structure and dialogue governing the communication relationship between student and teacher and is dependent upon course structure, level of dialogue between each learner and the teacher, and learner self-direction in learning. When the dialogue among participants decreases, students' perceived psychological distance with others (transactional distance) increases.

By contrast, the 17 who were not satisfied with the conduct of this English class felt that they are physically too far away from the instructor, and therefore could not communicate with the instructor and other students to the level of their satisfaction. There were also a few other reasons, such as

- (1) The pace was too fast
- (2) Could not keep up with the speed of text-messaging
- (3) Were not accustomed to such interactive activities
- (4) Content was not interesting.

In summary, when attending the class online, students used their mobile phones to send in short text messaging to communicate with the instructor, including questions, suggestions, requests or any other type of feedback. The instructor addressed these messages either by writing on the screen or giving an oral explanation, which the entire class could see or hear. Because of the format of the class activities (answering quiz questions), there were limited cell phone exchanges among students during class. Instead, students carried meaningful dialogues on the class's forum (discussion board). Some expressed their excitement about being able to interact during class; some shared their confidence about doing well in this class; some reached out to others, for forming study groups either online or face-to-face. On the other hand, students could also give the instructor immediate feedback on the instruction. Through instant polls, students evaluated the instructor's lecturing pace, legibility of handwriting and voice volume. The mLearning system captures students' votes and displays the vote results on the mobile phone screen where the poll was conducted (See Figure 6). The first column indicates ratings of the lecturing pace as being 'too fast'; the second item indicates ratings as being 'appropriate'; and the third are ratings as being 'too slow'.

The voting result was calculated for this classroom and returned to mobile phones and the web browser on the instructor station. Based on the results, the instructor made timely adjustments to improve her classroom presentation. The instruction

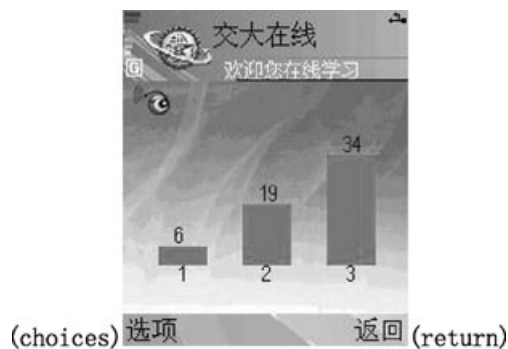


Figure 6: Results from class poll on the instructor's speech. (1: too fast; 2: appropriate pace; and 3: too slow)

quality is likely to improve because of the increased frequency and quality of communication between the student and the instructor. And the post-survey responses from the online students indeed confirm this hypothesis. Students' timely feedback and status of participation in class activities helped the instructor in the following three ways:

First, the instructor made on-the-spot adjustment when the poll shows her speaking too fast or not explaining a key point clearly. Second, the instructor learned a great deal from students' spontaneous answers to some of her quiz questions. The language the students used seemed more authentic and interesting than the one used in well-prepared answers. The mLearning system enabled her to share these answers with all students. Third, the instructor was able to frequently evaluate the alignment of course content with the students' language levels, and then adjust the course content to better meet students' needs.

According to the instructor's reflection, this new way of teaching opened up a 'door' for her. The active student participation and the two-way interaction energised her and better engaged her in the teaching process as well. She has now begun to redesign her entire curriculum, and to explore other ways to create longer periods of student interaction and participation.

Conclusions and future work

In summary, this model of mLearning can be used in many other classes. The mLearning system described in this paper is innovative in the following ways:

- (1) Using the Symbian S60 Smart Phone Platform, the system broadcasts real-time classroom activities—including video, audio, lecture notes and handwritings—to students' computers and laptops during the regular broadband network, or PDAs and mobile phones via the GPRS network. During this broadcast, all activities occurring in a real classroom are synthesised onto the receiving devices and are then played back in real time. Students can customise their means of receiving the broadcast based on their broadband or GPRS network condition or their preferences.
- (2) The developers propose a self-adaptive playback mechanism on the mobile phones to help maintain a good balance between the stability and latency of broadcast, to ensure the real-time interactions between the instructor and the students.
- (3) Based on the TCP/IP protocol, the researchers and developers created a system to enable the instructor to monitor all online students' mobile phone screens without excessive delay, to facilitate instructor supervision of students' learning activities and to provide guidance when necessary. The system also provides several teaching-assisting mechanisms such as a real-time poll and text-messaging exchanges, to enable the instructor and the students to freely and timely communicate about their learning status and about students' suggestions for better teaching.

The pilot use of this system in this English class has produced encouraging results, in both system function and teaching and learning effectiveness. In particular, the

researchers have seen gradual changes on the students and the instructor, in their perceptions of teaching and learning. For instance, many online students now see the online learning environment as a community they can be part of, instead of a non-interactive 'TV station' that they passively watch. No doubt, the opportunities for them to interact with the instructor in class and at the convenience of their thumbs greatly reduced their sense of transactional distance and power distance from the instructor. As previous studies reveal (Saba, 1988; Wang, 2007), a low number on both dimensions (transactional and Power Distance Index) is the foundation for forming thriving learning communities in any learning settings.

Because the mLearning system implementation reported in this paper is only a pilot, much work remains to be done in the future. For system development, better technologies must be sought to improve the delivery of video and audio streams from live classrooms. In addition, audio interaction should be an option in this mLearning system, which can solve the problem of slow typing on a cell phone. When mLearning is widely used in the Network Education College (currently serving 15 000 students), lowering the associated costs will be a primary issue for both the students and the institution. As this study shows, cell phone costs or qualities hindered some students' participation, especially those with lower incomes and less capable cell phones. The costs to the institution can go up to ¥400 000 (\$52 287) per year, for purchasing laptops, cameras, LCD projectors and other audio-video equipment. Considering the popularity of tests and exams in China's entire educational systems, the e-Learning Lab plans to develop mobile-based exams and put them in use in the near future. Owing to the limitation of current cell phone features and high costs, these exams will be limited to multiple choices and short answers.

For research, the demographics of the mLearning participants (98% from campus classes) raise the need to test this teaching-learning modality with multiple campus audiences (eg, fully-online classes vs. non-online classes vs. 'blended' classes). Future testing will also provide more venues for students to interact with the instructor and classmates, such as QQ (a popular instant messaging and gaming system), the Internet, MP3 and audio system, so that there can be a better integration of internet and mobile devices. Through pilot-testing this system with more classes, many pedagogic issues can be addressed. For instance, how can the system help build an effective virtual learning environment among large numbers of online students? How will this system work for students in Math, Science and Economics classes, which require more thinking and problem solving? What are the best ways for the instructor to facilitate blended classrooms that include both face-to-face and online students? What are students' experiences in using this mLearning system and in participating in these online activities? These and other questions warrant serious attention in the coming years. The mLearning research and development team has just completed another round of testing with three classes, International Finance, Computer Science and Advanced English. We have collected a large amount of survey data and will report them in future articles.

Acknowledgements

We profusely thank the mLearning development team (Ren Tong, Yi Gao, Yuxin Shen, Linlin Fu), for their invention of this wonderful system and their continuous support for its implementation. We also thank Professor Charles Calleros for his editorial assistance.

References

- Harris, P. (2001). *Goin' mobile; learning circuits*. Retrieved July 2, 2007 from <http://www.learningcircuits.org/2001/jul2001/harris.html>
- Hofstede, G. (2001). *Culture's consequences: comparing values, behaviors, institutions, and organizations across nations* (2nd ed.). Thousand Oaks, CA: SAGE Publications.
- Kossen, J. S. (2001). When e-learning becomes m-learning. *Palmpower Magazine*. Retrieved March 6, 2007, from <http://www.palmpowerenterprise.com/issues/issue200106/elearning001.html>
- Liu, T.-C., Wang, H.-Y., Liang, J.-K., Chan, T.-W., Ko, H.-W. & Yang, J.-C. (2003). Wireless and mobile technologies to enhance teaching and learning. *Journal of Computer Assisted Learning*, 19, 3, 371–382.
- Quinn, C. (2000, Fall). mLearning: mobile, wireless, in-your-pocket learning. *Linezine: Learning in the New Economy*. Retrieved August 1, 2007, from <http://www.linezine.com/2.1/features/cqmmwiyp.htm>
- Saba, F. (1988). Integrated telecommunications systems and instructional transaction. *The American Journal of Distance Education*, 2, 3, 17–24.E.
- Schwabe, G. & Göth, C. (2005). Mobile learning with a mobile game: Design and motivational effects. *Journal of Computer Assisted Learning*, 21, 3, 204–216.
- Sharples, M. (2005). *Learning as conversation: Transforming education in the mobile age*. Paper presented at the Seeing, Understanding, Learning in the Mobile Age, Budapest, Hungary.
- Sharples, M., Corlett, D. & Westmancott, O. (2002). The design and implementation of a mobile learning resource. *Personal and Ubiquitous Computing*, 6, 220–234.
- Tong, R., Hu, Z. W., Han, P. & Yang, F. (2005). A novel mobile learning assistant system. *Lecture Notes in Computer Science*, 3583, 340–348.
- Trifonova, A. & Ronchetti, M. (2003). *Where is mobile learning going?* Paper presented at the e-Learn 2003 Conference, Phoenix, AZ.
- Wang, M. J. (2007). Designing online courses that effectively engage learners from diverse cultural backgrounds. *British Journal of Educational Technology*, 38, 2, 294–311.

Copyright of British Journal of Educational Technology is the property of Blackwell Publishing Limited and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.