The New Era of e-Learning

Mobile Learning & Interactive Class for the New Curriculum

W.W.T. Fok

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Preface

I have the pleasure of contributing this foreword for the excellent book compiled by Dr. Wilton Fok and his colleagues that promotes interactive learning in Hong Kong.

Over the past three years, e-learning has made great strides.   To borrow an analytical framework popularized by a team of US researchers[1], I'll endeavor to review the state of play of e-learning along three dimensions; namely, technology, content and pedagogical practices.

Technology has made the most significant advances among the three dimensions of e-learning.   Three years ago, most schools would consider net books to be the medium of choice for implementing e-learning in Hong Kong, while there were a few schools that had experimented on mobile devices.   Since 2010, an entire new product category in the form of tablets has come into play, changing the market landscape for the better. In addition, smart mobile phones with Internet access are proving to be a viable alternative to computers as a medium for interactive learning. Coupled with a platform such as iClass, these new mobile devices have made interactive learning much easier than before.

Not only technology, but access to technology has also improved over the past few years.   Since the 2010/11 school year, Government has launched a number of initiatives to facilitate e-learning by students of low-income families.   These include a cash subsidy on internet access charges to these families, and complementary support to the parents and students.   In 2011, two social enterprises were set up with the express purpose of providing low-cost hardware and internet access services to such needy families.   It is envisaged that over 400,000 students from

[1]   Koehler, M.J. & Mishra P., Technology Pedagogical Content Knowledge (http://www.tpack.org)used159

300,000 families can benefit from these support measures.

Content in the form of learning software and digital textbooks have become more prevalent in the past three years. While traditional educational publishers still dominate the commercial market of e-learning content, an increasing number of schools and teachers have begun to produce their own school-based resources for use by their students. Government, through Hong Kong Education City, has also compiled a curriculum-based depository of e-learning resources, which is available for use by teachers and students free-of-charge. Government recognizes the need to promote a more diversified market of e-learning resources and has announced its intention to introduce relevant policy initiatives in the first half of 2012.

It is in the area of pedagogical practices that e-learning requires the most attention. This is understandable as front-line teachers need more time to develop a model that best leverages the power of technology to benefit student learning. This is where university researchers, such as those at HKU, can help.

The ultimate goal of e-learning is to bring about a paradigm shift in school education, from the traditional textbook-based, teacher-centred mode to a more interactive and learner-centred one. In the traditional classroom, teachers lecture and students learn, both with the aid of the printed textbook. In the e-learning classroom – often called a "flipped classroom" – students learn by accessing digital resources in a self-directed manner in which teachers act as facilitators. This calls for a new pedagogical approach that is expected to enhance the effectiveness of student learning while cultivating skills that are crucial for our 21st century students. I am of the belief that our students will be increasingly called upon to solve problems collaboratively and be life-long learners who can acquire new knowledge and skills independently using the digital media.

Technology, content and pedagogy are all crucial for the success of e-learning. Among these, it is most important that we develop effective pedagogical practices that draw out the best that new technologies and learning resources have to offer.

I congratulate Dr. Wilton Fok and his colleagues for work well done, and I look forward to seeing their continued contribution in the area of e-learning in Hong Kong!

Mr. Kenneth Chen Wei On
Under Secretary of Education
Education Bureau, HKSAR

Preface

I am extremely pleased to report that the University of Hong Kong is embarking on e-Learning to enhance our teaching and students' learning. Moving into the new 4-year curriculum, we have renewed our commitment of providing the state-of-the-arts technology platform and network environment to:

o Provide **Students** with vast amount of information in their fingertips through a ubiquitous, technologically-driven environment;
o Empower **Students** as self-learners through real or virtual engagement in the learning community (including their peers on campus and around the world, their teachers, and their mentors) with a rich learning experience; and
o Support **Teachers** to play a key role in leading this interactive learning community through innovation and exchange.

This book *The New Era of e-Learning* illustrates many of the above points showing our technological and pedagogical development on e-Learning here at HKU. Some of the developed methods are being applied in the University and some primary and secondary schools in Hong Kong demonstrating the effectiveness of e-Learning for teaching and learning.

I would like to take this opportunity to thank my colleagues from the Faculty of Engineering, Faculty of Education, Faculty of Dentistry, and the Centre for Enhancement of Teaching and Learning for their dedications to development of e-Learning for our next generations.

Professor Roland T Chin
Deputy Vice-Chancellor and Provost
The University of Hong Kong

Preface

The publication of this volume cannot be more timely. In Hong Kong, schools have completed the first cycle of the new senior secondary curriculum and universities are gearing up for the launch of a new academic structure in September 2012. This unprecedented educational reform is motivated by the need to equip students with the skills and capabilities to meet the challenges of a rapidly changing world.

At HKU, we have taken the opportunity to re-examine our undergraduate curriculum, to ask what educational aims the curriculum should achieve, what should be the learning outcomes, and how we might best achieve these learning outcomes. We are also building a new campus to cater for the double cohort of students entering the university in September 2012.

Underpinning the design of the new curriculum as well as the new campus is our understanding of learning as not only a cognitive process but more importantly as a fundamentally social process. John Seely Brown points out in his insightful speech at a 2001 Forum The Internet and the University, "learning is a remarkably social process. … it occurs *not* as a response to teaching, but rather as a result of a social framework that fosters learning."

Therefore, in designing the new curriculum and the physical learning spaces, the questions that we have tried to address are: How can we create an environment which affords access to multiple communities of scholars and practices and encourages students to cross boundaries - disciplinary boundaries, cultural boundaries, social boundaries and physical boundaries? How can we create an environment that fosters learning communities, not only across the university but also between the university and the community? How can we widen the space of learning for our students?

When we talk about making it possible for students to access multiple

communities of scholars and fostering learning communities, we would be remiss not to exploit technology for these purposes. When we talk about widening of the space of learning, we cannot possibly ignore the importance of the digital space and the enormous potential it has for powerful learning. John Seely Brown points out that "Today's digital kids think of information and communications technology (ICT) as something akin to oxygen: they expect it, it's what they breathe, and it's how they live. ... It's an integral part of their social life; it's how they acknowledge each other and form their personal identities." To help students learn, we need to get into their worlds, speak their language and understand their way of being and knowing. Therefore as an integral part of the curriculum reform at HKU, we have formulated an eLearning strategy which sets out to embed technology in pedagogy, not for its own sake, but for bringing about high quality teaching and learning.

The chapters in this volume report on some excellent collaborative work across Faculties and between Faculties and schools in enhancing learning through technology. I wish to congratulate Wilton and his team for putting together this volume, and I look forward to seeing more.

Prof. Amy B.M. Tsui
Pro-Vice-Chancellor and Vice-President
(Teaching and Learning)

Table of Contents

Section II. The New Interactive Technology Developed in HKU   76

Section III.   From Technology to Pedagogy 111

Table of Figures

Section 1: Evolution of e-Learning

Standalone System

Multimedia

Interactive Learning

Networked Environment

Mobile Learning

1 Editor Message

Dr. Wilton Fok

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e-Learning had been introduced in late 1980s when personal computers became popular in schools and homes. CD-ROM and floppy discs were the common carriers of learning materials and text book contents at that age. When Internet was widely adopted in mid 1990s, e-learning had been transformed into another stage. School servers and home computers were connected together through the network. Since then, students and parents can access education contents through the web at home at any time. In the decade of 2000s, various mobile technologies such as WAP, GPRS, 3G, TD-SCDMA and different new mobile devices such as smartphone and tablet PC were introduced. These new Information and Communication Technologies (ICT) provide a platform of high speed mobile data communication between the e-learning server and the students' devices. A new era of e-learning, or mobile learning, was introduced. Students can now learn anywhere, at any time, and by any means.

Thanks to the contributions from the teachers and researchers at the University of Hong Kong, as well as the inputs from some principals and

teachers from a few primary and secondary schools in Hong Kong and mainland China, this book was able to be published. It is a collection of knowledge and experience of e-learning development, in both technology and pedagogy, in Hong Kong and the region. We would like to take this opportunity to share this knowledge with educators, teachers, students and parents through this Knowledge Exchange project.

In Chapter 2, Dr. Iain Doherty, Director of the e-Learning Pedagogy Support Unit of the Centre for Enhancement of Teaching and Learning of the University of Hong Kong, shared his overseas experience in Pedagogy and Technology. The application of such agile devices for teaching and learning was very common and mature in some overseas countries such as US, Australia and New Zealand. Dr. Doherty has drawn an overview of the application of mobile learning in the "Agile Space" and the pedagogical affordances of using tablet PC such as iPad for teaching and learning. Some activities and resources examples were quoted and shared.

In addition to the evolution from the fixed line internet to the mobile wireless data network or from desktop PC to tablet PC and smartphone, e-learning also evolved in the mode of learning. It evolved from a standalone system which students learnt through a computer in a single way (student to machine mode), to a network learning environment with other students (student to student mode). In recent years, with the invention of video conference facilities and high speed internet, a Class to Class Model was introduced. Thanks to the efforts of our teachers and students, a real

application of an on-line class between a Hong Kong local school and a reconstructed school in Sichuan after the Sichuan earthquake was conducted. This new mode of e-learning also facilitates the knowledge exchange between students with different cultures and backgrounds from different schools and countries. It is a good means of global interflow for the new curriculum.

In chapter 4, Dr. Vincent Tam, Senior Teaching Consultant of the Department of Electrical and Electronic Engineering of the University of Hong Kong, introduced a new application for learning language. Learning Chinese writing is sometime difficult. The sequences of pen strokes are not easy to remember.

Dr. Tam's developed an application called iWrite to facilitate students to self-learn Chinese writing on tablet PC. The performance of the prototype implementation was evaluated.
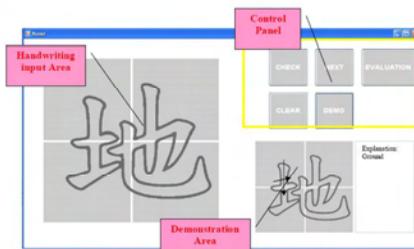
In the new era of e-learning, an essential feature is demanded - interactivity. One-way information dissemination from teacher to students is no longer effective. A two-way interactive teaching and learning environment is a key factor to enhance learning experience. The interactive class can shorten the education feedback loop and improve the teaching effectiveness. In Chapter 5, the importance of interactive class in the curriculum reform is discussed. An early version of wireless interactive devices was introduced in 1990s. Students can make their choices via multiple choice questions through simple hand devices. Another generation of interactive mobile device was developed by a few colleagues in the Department of Electrical and Electronic Engineering. The PSP game devices were used to provide more features such as the

connectivity to the Internet through WiFi and interactive prompting messages on the device screen. However, it was still not sophisticated enough to cope with the latest demand on mobile learning, which requires real-timeliness, interactive and user-friendliness.

In order to meet the demanding requirements of mobile learning, a new system called "iClass" was developed by the e-Learning Technology Development Laboratory of the Department of Electrical and Electronic Engineering of HKU. Students can install iClass on smartphone and tablet PC to interact with the teachers and their peer groups through drawings and text. A detailed description of this system, with the operation manuals of the iClass Students Apps and iClass Teachers Apps are listed in Chapter 6, 7 and 8 respectively.

iClass is a new technology to facilitate interactive class. However, just technological invention is not sufficient to revolute the era of e-learning. The development of its pedagogical applications is equally important to magnify its performance and effectiveness. A few pedagogical applications have been developed for various subjects such as mathematics, general science, liberal studies, creative writing, synonyms learning and fine arts. These application examples are illustrated in Chapter 9.

iClass was evolved from a student project to a practical application. It was first introduced in HKU and was deployed in some courses in a few faculties. In Chapter 10, a few real applications of iClass deployments in the a summer program of the Faculty of Engineering, a university common core course, a course on environmental policy and a Journal-based Learning (JBL) course in the Faculty of Dentistry are shared. These application examples show the versatile potential of the system for teaching and learning in various disciplines.

Besides iClass, the Faculty of Dentistry also uses other e-learning tools for their Problem Base Learning (PBL). A blended approach was used for PBL. New e-learning technologies such as Web 2.0, Learning Management System, interactive white boards were used to build a digital repository. These tools also provide a large-scale video and 3D visualization for students to learn in an enhanced e-learning environment during the lectures and tutorials. These new experiences of e-learning for Problem Base Learning are shared by Dr. Susan Bridge and her team in Chapter 11.

In addition to the deployment at the University of Hong Kong, iClass was also tried out in the pilot projects in a few primary and secondary schools in Hong Kong and China. In Chapter 12, the principals and teachers from the Kwun Tong (Sau Ming Road) Government Primary School, the PLK Chee Jing Yin Primary School, the Kau Yan Primary School and the Pui Ching Middle School have also shared their experience of using tablet PC

and smart phone for interactive teaching and learning in their classes.

The iClass trials in primary and secondary schools triggered a good debate on the future development road map of ICT for education. Ms. Edith TSE, the headmistress of a government school in Hong Kong, shared her views in Chapter 13 of this book. Three aims for e-learning are identified: to broaden the educational experiences to keep in track with future cyber world; to educate students with Cyber ethics; and to rethink teaching strategies and learning effectiveness. Two application examples of using iPad in her school for self-regulated learning in digital classroom and for an innovative pedagogy on Task Based Lesson (TBL) are also recorded.

This book introduces the latest developments on both technologies and pedagogical applications of e-learning in the era of new curriculum reform. We would like to exchange our experience and knowledge with principals and teachers for the betterment of a learning environment for our next generations.

2 Pedagogy and Technology: Where Might We Go with Agile Devices?

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2.1   Introduction

There is a long history of introducing technologies into teaching and learning. In each case it would be fair to say that expectations with respect to transforming teaching and learning have been very high. It would be equally fair to say that these expectations have not been realized. This mismatch between technological expectations for teaching and learning and the reality that has followed holds true from the earliest days of radio, through to the introduction of sixteen-millimeter films, then video with the process continuing with the personal computer (Reiser, 2001). A 2004 report makes it particularly clear that the hype around eLearning far exceeded the reality of the teaching and learning situation (Zemsky & Massy, 2004). Now we find ourselves in the new technology space of Tablet devices. This space has been defined by one commentator as an "agile space". The agile space signals, ". . . a new technology space in between handheld and portable.

Devices which fit this space are particularly useful for teaching and learning purposes, as they offer the flexibility needed for modern learning practices. It has taken the iPad to really cement this space although there will be countless others arriving in the market fairly soon. Whether or not they will offer the right blend of features successfully of course remains to be seen." (Wilson, 2012).

Leaving aside the notion of a "space" for a moment, if we are to make sense of Tablet devices from a teaching and learning perspective then it is important to understand what it is that makes these devices different from alternative devices such as Laptop computers and Netbook computers. This is a really a question of trying to determine the unique value of Tablet devices for teaching and learning. Equally, however, it is important to consider these new devices from a pedagogical perspective because the question of uniqueness aside, it may still transpire that these devices can contribute positively to the teaching and learning process. The pedagogical perspective can be understood as containing four main components: pedagogical philosophy (how we think people learn), high level pedagogy (broad teaching and learning approaches such as problem based learning), pedagogical strategy (a particular and detailed way of going about teaching) and pedagogical tactics (the detailed methods such as use of a discussion board to promote learning) (Goodyear, 2005).

We will use Goodyear's pedagogical perspective throughout the chapter to think about the potential educational value of Tablet devices. First, however, we look at what characterizes devices in the agile space. It should be noted that whilst this chapter will focus on the iPad as a particular device, the Tablet market obviously comprises of devices from other manufacturers with alternate operating systems. One thinks for example of the Galaxy Tablet with the Android operating system. Much of what is said in this chapter with reference to Tablet applications applies

equally to these other devices because the applications for built for the iPad area also available for the Android devices. Furthermore, the content in this chapter concerning teaching and learning approaches and principles applies equally to the range of devices in this space because the teaching and learning principles are independent of their instantiation using a particular device.

2.2   The Agile Space

As mentioned in the previous section, devices in the agile space may offer new features of potential benefit to teaching and learning. That said it is important to understand that it is not the features per se that provide potential teaching and learning benefits. Rather it is the educational affordances of these features. The term "educational affordances" refers to what an educator can potentially do with respect to teaching and learning in virtue of the properties of any particular technology under consideration. For example, a personal computer with an Internet connection allows a student to connect to the Internet. This in and of itself is not an educational affordance. The educational affordance is, for example, the ability of students to search for information related to a particular problem set by the teacher. One can imagine any number of technological features that provide for pedagogical affordances. For example, discussion boards provide a space for students to collaborate and learn online. Email provides for the opportunity for student to interact with one another and with the teacher in order to be supported in their learning. Virtual worlds provide the opportunity for students to have simulated experiences in, for example, a virtual hospital that they might not otherwise have due to limited exposure to particular experiences in real hospitals.

According to Wilson (2012) there have traditionally been four technological spaces: the desktop space, the portable space, the handheld space and the server space. If we are to come to a conclusion about

whether or not devices in the agile space really do have unique features that offer new opportunities for teaching and learning we need to be clear about the key features of the four other spaces in relation to the new agile space. Devices in the desktop computer space have become increasingly powerful. They are used for a variety of reasons from document editing through to video editing. The desktop space might be demarcated most fundamentally in terms of the power of machines with fast processors, a large RAM allocation and powerful video cards. Devices in the portable space include laptop computers and netbook computers. These devices range from those that are highly portable and generally less powerful through to portable devices with a capacity that can almost match devices in the desktop space. When compared with the desktop space one would identify the major difference with the portable space in terms of various degrees of portability and relative power. This might sound somewhat obvious but this is an important point when one is thinking about just what it is that is different with respect to the features of devices in the agile space. Personal Digital Assistants (PDAs), mobile phones and portable media devices such as the iPod define the handheld space. These devices have nowhere near the power of the devices in the desktop space and portable space. However, a number of the devices in the handheld space do provide the same functionality of the devices in the first two spaces. For example, PDAs have word processing applications, web browsers and email clients. Finally, devices that provide services to client computers such as desktop computers define the server space. These services might include the provision of network drives and shared printing services. Devices in the server space have an entirely different function from devices in the other four spaces and for this reason the server space will not be considered in this chapter.

It is now time to try to become clear about what it is about the agile space that might provide for new teaching and learning opportunities. Wilson is

not convincing in this respect (2012). For example, the argument that iPads are extremely portable really carries no weight because the same is true of, for example, any 10-inch Netbook. Certainly it is true that the iPad has a much faster boot time and that the operating system is extremely efficient but these two facts in and of themselves do not immediately suggest educational affordances. The long battery life of the iPad (up to 10 hours) as compared with laptops and netbooks (about 4 hours) is certainly helpful for students who are in classes for eight hours a day but again it is hard to see a distinct pedagogical affordance in this fact. Finally, it is true that the touch interaction with the iPad interface is very different from the point and click interface of desktop and portable devices but we must ask again whether this is a pedagogical affordance. Ultimately Wilson leaves us with the single notion that, "Developers are finding ways to utilise the best of handheld and portable spaces to produce imaginative apps which allow users to work and create in new ways that other devices don't easily accommodate" (2012). Whether or not this is actually the case remains open to question. For example, contrary to Wilson's estimation of the potential of iPad for teaching and learning, Murray and Olcese write that, "Our study suggests that there is a paucity of applications that truly extend capability, much of what these application allow can be done with other devices, and this leads us to conclude that the current trajectory will not revolutionize teaching and learning. The lack of collaboration capabilities underlie this point, as do the overwhelming number of application that are simply drill and practice or focused on delivering content for consumption, not creation or re-use" (Murray & Olcese, 2011).

2.3   Pedagogical Affordances

We have defined a pedagogical affordance in terms of an educational action that might be undertaken in virtue of the properties of any particular technology under consideration. We further suggested that affordances might be understood in the context of pedagogical

philosophy (how we think people learn), high level pedagogy (broad teaching and learning approaches such as problem based learning), pedagogical strategy (a particular and detailed way of going about teaching) and pedagogical tactics (the detailed methods such as use of a discussion board to promote learning) (Goodyear, 2005). It is the pedagogical philosophy that most fundamentally determines how a particular educator goes about teaching and engaging students in learning. The pedagogical philosophy is, we believe, also the most important concept in terms of understanding whether or not any particular technology is potentially beneficial with respect to teaching and learning. The reason for this is that there must be a fit between the technology and the way in which an educator wishes to go about teaching students. With these points in mind we will briefly outline four pedagogical philosophies in order to provide a context for critically examining a range of iPad applications in order to make a judgment concerning their potential utility for teaching and learning.

Three pedagogical philosophies have remained central to teaching and learning practice over the years. These are: Behaviorism, Cognitivism and Constructivism (Gillani, 2003; Mergel, 1998; Naidu, 2006; George Siemens, 2005). Social Constructivism provides a variation on the latter. A fourth and very controversial pedagogical philosophy, Connectivism, is arguably a new theory of learning that offers us an alternative philosophy to the three already outlined. Whilst there is risk in summarizing four theories in a relatively short space, it is important to understand the fundamentals of these theories in order to provide a framework for making a judgment about the potential utility of iPads in education. It is also useful to think about high level pedagogies, pedagogical strategies and pedagogical tactics. Each of these will be addressed to some degree in the body of the chapter as we consider the features of particular iPad applications.

Broadly speaking, Behaviorists view the learning process in terms of an end point defined as an exhibited change in behavior. That is, the learner has learned when they are able to do something that they could not do before. This something might be exhibiting knowledge through being tested or demonstrating a particular skill. From the Behaviorist perspective the educational process centers on eliciting desired responses through, for example, drill and practice exercises. Cognitivists focus on the workings of the memory and Cognitivist theories are characterized by beliefs about how information is stored and retrieved in human memory. Since Cognitivists are interested in the workings of memory and the way in which human beings process information, the educational process is considered in terms of learning designs that enable students to efficiently store and retrieve information. It should also be understood that Cognitivists are concerned not just with information storage and retrieval but also with, for example, whether or not knowledge is meaningful for / usable by students. Constructivists believe that the learner actively constructs or at least interprets new knowledge in terms of prior ideas, concepts and experiences. This prior knowledge plays a pivotal role in terms of what is being learned and the learning process must therefore take account of prior beliefs and knowledge. Social Constructivists hold the same view with respect to building knowledge but posit additionally that knowledge construction is a social process.

Connectivism is an emerging and by no means non-controversial theory (G. Siemens & Tittenberger, 2009; George Siemens, 2005). The founder of Connectivism – George Siemens – writes that "*Learning is a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing*" (George Siemens,

2005). There are challenges in making sense of this concept. For example, traditionally we would distinguish between data (unprocessed facts / information), information (processed data) and knowledge (perception of fact or truth based on a significant degree of justification). Data is transformed into information and consolidated into knowledge by an individual. Therefore, it would seem that learning is an internal process and that knowledge does reside within the individual. With this point in mind, attention needs to be given to some of the core concepts in Connectivism including the idea learning can reside within an organization or database. Equally, whilst we might agree that connections that enable us to learn are very important, we might query whether these are more important than our current state of knowing. However, issues aside, it does seem that Siemens has brought to the fore the fact that we live in a networked age and that in virtue of this fact our own knowledge is connected to a knowledge network that is far more extensive than was previously the case.

In the next section of this chapter we are going to consider iPad applications in terms of their potential pedagogical affordances. These potential affordances can be understood in relation to the pedagogical philosophies previously outlined. For example, from a behaviorist perspective it would be useful to have applications that provided for drill and practice exercises in order to learn basic facts. From a Cognitivist perspective, it would be useful to have applications that facilitate information storage and retrieval through allowing the educator to structure information in such a way that new knowledge might be integrated within an existing knowledge structure. From a Constructivist perspective it would be useful to have applications that enabled students to work through their prior beliefs and knowledge in relation to new information. From a social Constructivist perspective it would be useful to have applications that allowed students to connect with one another so

that each student might inform and be informed by multiple perspectives. Finally, from a Connectivist perspective it would be useful to have an application that supported the student's role within a network of learning. The applications will also be considered to some degree in terms of the other three components of Goodyear's model. For example, we might consider iPad applications in relation to problem based learning (high level pedagogy), strategies to generate student interactions (pedagogical strategy) and particular interventions such as critiquing discussion board postings (pedagogical tactics).

2.4   iPads and Students

Whilst the pedagogical case for the use of the iPad in teaching and learning has to be made we also need to bear in mind that, "*Contemporary 'digital age' university students in developed countries are familiar with social networking through Facebook, instant communication via Twitter and mobile technology through their smartphones. They compare these with university e-mail and e-learning systems, projected lecture slides and handwritten assessment tasks. They have expressed a desire for more varied forms of communication and more vibrant learning methods*" (Manuguerra & Petocz, 2011, p.65). This is a finding that has been confirmed in studies from the United Kingdom (Conole, Laat, Dillon, & Darby, 2006; Joint Information Systems Committee, 2008). In addition to the fact that students are conversant with and using a range of technologies, there is also an indication that they differ in their understanding of learning. "*The world they encounter in higher education has been constructed on a wholly different set of norms. Characterized broadly, it is hierarchical, substantially introvert, guarded, careful, precise and measured. The two worlds are currently co-existing, with present-day students effectively occupying a position on the cusp of change*" (Committee of Inquiry into the Changing Learner Experience, 2009, p.9). Thus whilst a pedagogical advantage is important when introducing new technologies, there is also the question of meeting

students preferred teaching and learning styles. That said, it is important not to make assumptions with respect to students' familiarity with technologies and applications. For example, whilst the distinction between the digital native and the digital immigrant has been much touted, the reality revealed by research is much more nuanced (Gray et al., 2009; Kennedy et al., 2009, 2008).

2.5   iPad Applications

As we progress through this section considering the potential pedagogical affordances of the iPad we can ask ourselves two questions (Murray & Olcese, 2011). Firstly, are we seeing applications that might improve the teaching and learning process? Secondly, are we seeing applications that allow students and teachers to do things in the learning environment that would not otherwise be possible? These two questions are obviously not mutually exclusive. For example, teaching and learning might be improved in virtue of the fact that a particular application allows students and teachers to do things in the learning environment that would not otherwise be possible. However, from a conceptual and practical point of view it is useful to distinguish between these two questions. The reason for this is that by doing so we might identify applications that improve teaching and learning but it might equally be the case that the same or

similar applications are available on alternative devices in, for example, the portable space. However, if we identify agile space applications that make something possible in teaching and learning that would not otherwise have been possible then we might make a particular case for the use of the iPad or a similar device in teaching and learning.

2.5.1 Teaching and Learning Activities with the iPad

iClass is a very good example of an iPad application that facilitates student activities within the classroom. iClass is an application that aims to provide a convenient, user-friendly, and effective way to facilitate interactivity in an ordinary lecture. iClass has a number of functions that are potentially useful in teaching and learning including: a drawing tool, keyword submission, peer review of work, an eBook reader, multiple choice questions, a QR code reader and a web browser. Students in a lecture connect to an iClass classroom and they can work collaboratively using the tools. They can also submit their work for display at the front of the lecture theatre using, for example, a computer connected to a projector. Whilst iClass has some excellent functionality for promoting collaborative learning (Social Constructivism) and for allowing students to access a network of knowledge (Connectivism), iClass is only as useful as the teaching and learning processes that determine its actual use in the classroom. In other words, the teacher needs to design teaching and learning activities that engage students with one another in order to deepen their learning (Dunlap & Sobel, 2007). The question whether iClass does in fact improve student learning is one that will be answered over time on the basis of a research agenda. However, having sat in on an iClass session, it is clear that iClass promotes student interaction and, with the right sorts of activities, iClass can promote student learning through engaging students with one another in order to explicate difficult concepts in a group setting. Our judgment is that iClass does enable students and teachers to do something that they were not able to do before. However, the something more is not given in collaborative learning and

sharing. This sort of activity is perfectly possible using, for example, paper and pen. The something new that the iClass application offers is an integrated environment that provides students and teachers with a space where they can easily interact in a variety of ways. Another way to put this would be to say that the whole is more than the sum of the parts as iClass provides for a seamless collaborative teaching and learning experience.

A second application that has potential in terms of teaching and learning activities is the iPad white board. There are a number of these applications in the Apple store and features differ as between the various applications. On a basic level the iPad with the white board application can be connected to an LED television or a projector. The iPad then acts

as an interactive white board allowing the teacher to upload content such as a PDF or an image file. Uploaded content can be annotated in various ways including the use of both the drawing tool and text. The more sophisticated white board applications allow all participants to connect with one another so that any particular white board can be shared. They also allow for multiple white boards to be open simultaneously so that students can be working in separate groups. Finally, a number of white board applications also allow for the white board activities to be saved and either uploaded to a shared directory or emailed directly to the group. Again, white boards have been around for a long time and so the question is whether or not the iPad white board application is extending possibilities in the classroom. Our answer would be yes for the same reason that we came to a positive judgment about iClass. First, these white boards allow for seamless real time collaboration (Constructivism) either around a single white board or around multiple white boards. Secondly, the iPad white boards allow for images and PDFs to be uploaded from a server or downloaded from the web for use as teaching resources during teaching and learning activities. This offers a significant degree of flexibility within the teaching and learning process. Finally, the white board activities can be quickly and easily shared after the class thus providing for a permanent record of teaching and learning for all participants.

2.5.2   Teaching and Learning Resources with the iPad

In this section we will look at teaching and learning resources for the iPad. The range of resources that we consider will by no means be exhaustive. Rather the core of the review is based on resources that were sought out for two presentations that were delivered within the Faculty of Medicine and the Faculty of Dentistry at The University of Hong Kong in February 2012. In the case of both Medicine and Dentistry, a search of the Apple Application store and Google using the key words: medical, medicine, education, iPad, application: and "dentistry, dentist and education, iPad,

application" respectively yielded a number of results. However, the applications themselves turned out for the most part to be digital versions of textbooks. This is in and of itself not necessarily a bad thing from a teaching and learning perspective. However, one is reminded of the criticism of the sorts of resources that were produced in the early days of eLearning when there was a telling accusation that eLearning was nothing more than digital page turning. As we progress through the review there is, therefore, a need to consider very critically whether or not iPad electronic textbooks are really adding value to the teaching and learning process.

Looking at Medicine we see applications that include E-Anatomy, ICD9 2012 Consult, Inkling Books and All Patients. The E-Anatomy iPad application costs $3.99 and one can buy individual modules from within the application. The initial purchase provides the brain axial MRI and cranial nerves illustration fully activated within one of the modules. The other 2 other modules are completely in demonstration mode until they are purchased as part of one of three different packages. Each module costs $69.99, bringing the total cost for the entire application to $213.96. E-Anatomy is, in our judgment, nothing more than a digital textbook with a search function. It is, therefore, difficult to imagine that E-Anatomy improves student learning given that exactly the same modules might be available in hard copy format. Additionally one might say with a high degree of confidence that E-Anatomy does not extend what might be done in terms of teaching and learning. In a similar vein, ICD 9 2012 Consult consists of a digital "textbook" of searchable diagnoses. Again, it is difficult to see how a digital version of a diagnostic tool actually improves teaching and learning. It is equally difficult to see how the application extends what might be done in the classroom.   Certainly the textbooks might be used in the context of: problem based learning (high level pedagogy) or as a reference resource for collaborative student

projects (pedagogical strategy). However, overall, these two applications do seem to repeat the mistake of providing students with the option of digital page turning.

Whilst remaining in the realm of the digital textbook, Inkling is a textbook application that was built exclusively for the iPad platform. Inkling features "interactive textbooks" and once one has downloaded the free Inkling app, one can view various textbooks that Inkling offer. Inkling conceptualizes what they are doing in terms of working with a platform as opposed to working with a book. Thus, in addition to offering media rich content along with drill and practice quizzes (behaviorism), Inkling books allow students to connect with one another in real time (Social Constructivism and Connectivism) in order to share notes and collaborate. In one sense of course students have always been able to connect with one another in order to learn together. With the hard copy book students could meet in a café or phone one another to discuss a particular problem. The difference here is in the nature of the interactions. First students are not physically present with one another. Secondly, whilst notes would previously have had to be copied and distributed, with Inkling books all notes are immediately available within the application. One can also imagine an Inkling book being used within the classroom in the context of problem based or case based learning (high level pedagogy). For example, the teacher might set a particular chapter as a reading exercise and ask students to submit notes regarding a case prior to a class. These notes could then be displayed and discussed in the classroom thus maximizing the use of class time for collaborative learning guided by the "expert".

Finally iTunes U is emerging as an alternative course management system. The iTunes U application for the iPad allows the user to browse courses in iTunes U. Once a course has been selected it can be downloaded to the

iTunes U application. Any particular course typically consists of an overview including learning outcomes and course content including text, audio and video files. However, iTunes U courses also contain a section to allow students to take notes. The notes are of two sorts: course notes and book notes. Course notes cross between the different books that might be used in any particular course whilst book notes are specific to the book that is being studied. Whilst it is true that we are once again looking at digital page turning, as with Inkling the use of different media extends the standard textbook with respect to the range of media used and arguably, the use of different media has the potential to improve teaching and student learning (Holden & Westfall, 2008). However, books rich with media are available on other devices and so these sorts of courses do not necessarily extend what can be done in the classroom.

It was not intended that this section be exhaustive in terms of a review of the resources available for the iPad. Rather the purpose of this section was to provide examples of resources from two different disciplines in order to provide a context for understanding the questions concerning whether iPad applications can improve student learning and whether iPad applications allow teachers and students to do something different in the teaching and learning process. From this review, iPad applications are still a long way from being game changers for teaching and learning. However Inkling books do provide for social and collaborative learning experiences – either within or outside the classroom – thereby extending the possibilities for might be done around the delivery of resources to students. To some degree Inkling books might function in the same way that iClass functions. That is, they might form the basis for engaging and interactive classroom activities (Social Constructivism) designed to engage students at a deep level with course content (pedagogical approach).

2.5.3   Supports

Educational support refers to providing students with the various aids that

they require if they are to achieve the intended learning outcomes for a program or course. Supports can be of two types: those that are contributed during the course and those that are built into the course. Support contributed during the course might consist of meeting with students to discuss difficult concepts or contributing to a student discussion forum in order to facilitate the understanding of concepts. Support built into the course might include providing students with a marking rubric in order to help them to understand what is required in order to achieve at various levels or providing students with clear statements of intended learning outcomes and assessment activities in order to help them to see the relationship between the two entities. If we conceive of student support in these two ways then there are a number of iPad applications that help to support students. However, these applications are not unique to the iPad. This means that whilst making use of them might improve student learning – particularly if support was previously lacking – the applications themselves do not allow educators to do things that they could not previously do with students.

If we think in terms of support that is contributed during the course then there are obvious iPad applications that allow teachers to interact with students. For example, a range of communication tools can connect teachers with students. These tools include, for example, Skype that provides for real time communication either one to or one to many. There are other tools in a similar vein including Vtok and FaceTime. Another application is Yammer. Yammer is an enterprise social networking tool that can connect educators and students. Since it is internal to an organization – in this case an educational institution – Yammer provides for a secure environment to connect with students. Yammer also allows for the creation of groups so students can divided into working groups to collaborate with one another. The iPad also provides a platform for delivering supports that are built into any particular program / course.

iTunes U allows teachers to provide students with, for example, the learning outcomes for the course, marking rubrics and answers to frequently asked questions. In this respect, iTunes U functions in the same way that a traditional Learning Management System (LMS) functions i.e. as a delivery mechanism. We might also think in terms of the mobile access to, for example, a Learning Management System such as Moodle which has a mobile application, albeit it one that is built for the iPhone at the present time. However, the only real difference between a mobile LMS application and the desktop application is the mobility of the former. Devices in other spaces – for example, laptop computers or netbook computers – offer mobile access through the standard interface.

2.5.4   Assessment

Formative assessment is assessment that is used to identify an individual's current strengths and weaknesses relative to desired knowledge and / or skills with the intention of improving on the student's knowledge or skills. Summative assessment is typically completed at the end of a learning period with the aim of providing a final evaluation of individual's mastery of a knowledge or skill. Assessment methods include but are not limited to essays, short-answer questions, multiple choice questions, self-assessment, peer assessment, learning portfolios, case studies, problem solving and project work.

The Inkling interactive textbooks mentioned above provide multiple choice questions that allow students to test themselves on the content on the text books (Behaviorism). This is useful for formative purposes and potentially provides students with a way to determine whether or not they have learned basic facts for any particular discipline. Courses provided through iTunes U also provide for students to engage in formative assessment.   The form of assessment varies contingent upon the course and ranges from relatively straightforward multiple choice questions to more sophisticated exercises that require students to answer short answer

questions regarding what they have learned in any particular course. Based on this relatively limited review, we are not seeing anything new with respect to assessment on the iPad platform. This is confirmed to some degree by Apple's marketing of their new iBook authoring application. The marketing text for the "Chapter Review" capability of the iBook authoring tool reads, "*Let readers test their knowledge using a variety of question types: multiple choice, choose the correct image, label the image, or a mix of all three. Authors can include six possible answers to each question*" (Apple Inc., 2012). The issue is once again one of replicating what is already being done in other mediums. However, this is not to be entirely negative about these kinds of resources. It is simply to say that the use of these resources in and of themselves is unlikely to improve student learning. It is also to say that these resources are not extending educational possibilities.

Beyond assessment activities such as quizzes that are built into teaching and learning resources such as Inkling text books, there are a number of iPad applications that students might use to complete assessment activities. For example, office applications such as Documents to Go and Quick Office provide word processors to enable students to complete assignments using their iPads. If students use a reference manager such as Mendeley Light for the iPad then they will always have access to their full reference library when writing assignments using their iPads. Finally, if the teacher sets up a public folder using a service such as DropBox then students can submit assignments electronically. Alternatively students might make use of a mobile learning management system interface such as the mobile interface for Moodle to submit their assignments. There are additional applications for the iPad that would support alternative assessment strategies. For example, the mind mapping tool MindJet might be used to support a strategy of asking students to map the

relationship between a particular set of concepts. MindJet has an email function so that the completed mind map might be submitted to the teacher. However, again, these tools are available on other devices and we are not seeing something pedagogically unique with respect to the iPad.

2.6   Discussion

Having reviewed a range of iPad applications it seems appropriate to conclude that very few provide the opportunity for teachers and students to do something that would have not otherwise been possible. Thus we have some sympathy with the view that, "*there is a paucity of applications that truly extend capability, much of what these application allow can be done with other devices, and this leads us to conclude that the current trajectory will not revolutionize teaching and learning. The lack of collaboration capabilities underlie this point, as do the overwhelming number of application that are simply drill and practice or focused on delivering content for consumption, not creation or re-use*" (Murray & Olcese, 2011, p.48). This raises an interesting question of the responsibility of the educational community with respect to pedagogy. We might fairly criticize application developers for replicating what has been done in teaching and learning for many years but this begs the question of innovation in education. In other words, what have educators done to push the boundaries with the respect to pedagogical approaches in the classroom? To put this another way, is the lack of inventiveness in the application space the result of a lack of inventiveness in the educational space? It is not the purpose of this chapter to answer this question, but given that the core pedagogical philosophies have remained firmly in place for many decades, there is definitely a question to answer.

2.7   Conclusions

If we start with the notion that there is a teaching and learning process and that technologies should only be employed when they enhance this

process and /or when they allow teachers and students to do something that would not otherwise have been possible, then we see that there is still a question whether the iPad should be used in teaching and learning. However, we also see signs that applications are emerging that do have the potential to change what teachers and students are doing. iClass for example offers interactive possibilities that would not have been possible in the same way before the creation of the application. Digital textbooks, whilst potentially repeating the mistake of the early days of eLearning, may yet prove themselves to be a valuable resource for teaching and learning. The question here will really have to do with whether the design of the book leverages the potential of various media types to support teaching and learning. These points aside, when all is said and done with the iPad, there is no denying that the iPad has defined a new agile space that has the potential to change the way that we work, learn and interact with one another. Working in this space has the potential to allow educators to engage in teaching approaches that would not previously have been possible and working in this space may also align teachers with the teaching and learning preferences of their students.

2.8   Appendix 1 iPad Applications

o   iClass – http:// http://www.eee.hku.hk/~iclass/
o   Whiteboard – http://www.gummybearstudios.com
o   E-Anatomy – http://www.imaios.com/en/e-Anatomy
o   ICD9 2012 Consult – http://www.regularrateandrhythm.com/
o   Inkling Medical - https://www.inkling.com/store/category/medicine/
o   iTunes U – http://www.apple.com/education/itunes-u/
o   Documents to Go –
     http://www.dataviz.com/products/documentstogo/
o   Skype –
     http://www.skype.com/intl/en/get-skype/on-your-mobile/download/ip

ad-for-skype/

o   Yammer – http://www.yammer.com

o   Moodle Mobile –
    http://itunes.apple.com/app/my-moodle/id461289000

o   Documents to Go – http://www.dataviz.com/DTG_iphone.html

o   Quick Office –
    http://itunes.apple.com/us/app/quickoffice-pro/id310723177

o   Mendeley – http://www.mendeley.com/

o   DropBox – https://www2.dropbox.com

o   MindJet – http://www.mindjet.com

2.9   References

o   Apple Inc. (2012). Apple Education iBooks Author Gallery.
    Retrieved February 28, 2012, from
    http://www.apple.com/education/ibooks-textbooks/gallery.html

o   Committee of Inquiry into the Changing Learner Experience. (2009).
    Higher Education in a Web 2.0 World. Bristol: Committee of Inquiry
    into the Changing Learner Experience.

o   Conole, G., Laat, M. D., Dillon, T., & Darby, J. (2006). JISC LXP
    Student Experiences of Technologies: Final Report. Joint Information
    Systems Committee,. Retrieved from
    http://www.jisc.ac.uk/media/documents/programmes/elearningpedag
    ogy/lxpprojectfinalreportdec06.pdf

o   Dunlap, J. C., & Sobel, D. (2007). Designing for Deep and
    Meaningful Student-to-Content Interactions. *Tech Trends*, *51*(4),
    20-31. doi:10.1007/s11528-007-0052-6

o   Gillani, B. (2003). *Learning Theories and the Design of E-Learning
    Environments*. Lanham, Maryland: University Press of America Inc.

o   Goodyear, P. (2005). Educational Design and Networked Learning:
    Patterns, Pattern Languages and Design Practice. *Australasian
    Journal of Educational Technology*. Retrieved from
    http://www.ascilite.org.au/ajet/ajet21/goodyear.html

o   Gray, K., Kennedy, G., Waycott, J., Dalgarno, B., Bennett, S., Chang,
    R., Judd, T., et al. (2009). Educating the Net Generation: A Toolkit of

Resources for Educators in Australian Universities. Strawberry Hills, New South Wales: Australian Learning and Teaching Council Ltd. Retrieved from http://www.netgen.unimelb.edu.au/outcomes/toolkit.html

o Holden, J. T. ., & Westfall, P. J. L. (2008). An Instructional Media Selection Guide for Distance Learning. USA: United States Distance Learning Association. Retrieved from http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED501248&ERICExtSearch_SearchType_0=no&accno=ED501248

o Joint Information Systems Committee. (2008). Effective Practice in a Digital Age: A Guide to Technology-Enhanced Learning and Teaching. Joint Information Systems Committee. Retrieved from http://www.jisc.ac.uk/publications/documents/effectivepracticedigitalage.aspx

o Kennedy, G., Dalgarno, B., Bennett, S., Gray, K., Waycott, J., Judd, T., Bishop, A., et al. (2009). Educating the Net Generation: A Handbook of Findings for Practice and Policy. Strawberry Hills, New South Wales: Australian Learning and Teaching Council Ltd. Retrieved from http://www.netgen.unimelb.edu.au/outcomes/handBook.html

o Kennedy, G., Dalgarno, B., Bennett, S., Judd, T., Gray, K., & Chang, R. (2008). Immigrants and Natives: Investigating Differences Between Staff and Students' Use of Technology. *Asclite Melbourne Conference, Hello! Where are you in the landscape of educational technology?* (pp. 484-492). Melbourne. Retrieved from http://www.ascilite.org.au/conferences/melbourne08/procs/kennedy.pdf

o Manuguerra, M., & Petocz, P. (2011). Promoting Student Engagement by Integrating New Technology into Tertiary Education: The Role of the iPad. *Asian Social Science*, *7*(11), 61-65. doi:10.5539/ass.v7n11p61

o Mergel, B. (1998). Instructional Design and Learning Theory. Retrieved from http://www.usask.ca/education/coursework/802papers/mergel/brenda.htm

o   Murray, O. T., & Olcese, N. R. (2011). Teaching and Learning with iPads, Ready or Not? *TechTrends*, *55*(6), 42-48. doi:10.1007/s11528-011-0540-6

o   Naidu, S. (2006). E-Learning: A Guidebook of Principles, Procedures and Practices. Commonwealth Educational Media Centre for Asia. Retrieved from http://www.cemca.org/e-learning_guidebook.pdf

o   Reiser, R. A. (2001). A History of Instructional Design and Technology: Part I: A History of Instructional Media. *Educational Technology Research and Development*, *49*(1), 53-64. doi:10.1007/BF02504506

o   Siemens, George. (2005). Connectivism: A Learning Theory for the Digital Age. Retrieved from http://www.elearnspace.org/Articles/connectivism.htm

o   Siemens, G., & Tittenberger, P. (2009). Handbook of Emerging Technologies for Learning. Learning Technologies Centre, University of Manitoba. Retrieved from http://ltc.umanitoba.ca/wikis/etl/index.php/Handbook_of_Emerging_ Technologies_for_Learning

o   Wilson, I. (2012). The Agile Space. *iPads in Education*. Retrieved from

o   Zemsky, R., & Massy, W. F. (2004). *Thwarted Innovation - What Happened to e-learning and Why? A Final Report for The Weatherstation Project of The Learning Alliance at the University of Pennsylvania in cooperation with the Thomson Corporation.* (pp. 1-76). Pennsylvania: The University of Pennsylvania. Retrieved from http://www.irhe.upenn.edu/Docs/Jun2004/ThwartedInnovation.pdf

3 Evolution of e-Learning Models

E-learning as the latest mode of teaching and learning has become more and more familiar to the general public in recent years. Thanks to the rapid development in computer science and information technology, real-time communications via mobile devices ranging from PC, laptop to smart-phone has prevalently integrated into our daily life and further liberated e-learning from the restriction of time and venue. The concept of "interactive class" promoted and realized by our iClass system is a vigorous sprout growing on the giant tree of e-learning. Before we enter the world of iClass, let's have a journey through the history of e-learning first.

3.1 Student-to-Machine Model

E-learning is capable of facilitating various study modes, such as distance learning, self-study or independent learning, edutainment, interactive learning and so on. Computer and internet can lead us into the universe of knowledge where multimedia technology has revolutionized the form of information and web 2.0 interactivity has enhanced our learning experience. However, at the early stage, e-learning was not as colorful or interesting as we described.

Figure 3-1 student-machine model

Traditional e-learning system always used Student-to-machine (S2M) model. Students learned from   PC without human interaction or internet connection. Learning materials were stored in a floppy disk, a CD or a DVD. Students could insert the disk into the computer and then start to go through the materials on the screen or do exercise.

Later on, as internet was developed and applied, students were able to access online information with their computers. However, at this stage, real-time communications or interactions were still unavailable, which means that internet was a huge library with computer being the browser while readers of the same library could not share their experience or knowledge.

3.2   Student to Student (S2S) Model

You may still remember the period when everyone was talking   about BBS, online forums and chat rooms, when people for the first time had the fantastic experience of communicating with someone else far away from them. At this stage, e-learning entered the Student-to-Student (S2S) model. With the help of the instant messaging website, students could share their opinions and knowledge with other students and even their teachers. This was the first time for e-learning to include the elements of person-to-person interaction on computers.

Even today, e-learning of this form is still active in daily teaching practice. Learning management systems such as Moodle and Blackboard are able to group teachers and students from one class together. Teachers can put up syllabus, announcements, assignments etc. on the forum while students can express their ideas on a certain topic by replying the

questions posted on. They can share their views and ideas and learn from each other.

3.3   Class to Class Model

As real-time communications extend from text and image to video and sound, people nowadays can call their friends with Skype and FaceTime, or have a live chat via MSN, or even have a multiple participant live chat via Google+. E-learning has also been evolving along with this trend. Students can attend lectures of the top universities all around the world at home.

Facilitated by the latest multimedia technologies, a new model for learning has been evolved. Two or more classes from different schools can conduct on-line class simultaneously. Students with different backgrounds, cultures and languages can share the exchange their ideas as well as learn from each other through such kind of class-to-class interaction. A series of interactive classes were tried out among students from in Sichuan after the 5.12 Earthquake and Hong Kong.

Figure 3-2 Class-to-class interaction between schools in Sichuan and Hong Kong

Soon after the disaster, a team of teachers and students from the University of Hong Kong worked together on the redevelopment of school in Sichuan. They designed and installed an e-learning system

48

consisting of modem, router, gigabit switches, file server and 30 sets of client terminals. After a month of preparation and on-site installation work, the first Sichuan-Hong Kong online interactive class was successfully held in the multimedia room of Yuanjia Primary School which was also built and furnished by the team. Students from both cities were able to talk to each other, take part in the Knowledge Contest, play games together and present performance.

Students in Hong Kong and Sichuan both benefited from this type of class-to-class interaction a lot as they shared knowledge, enhanced mutual understanding as well as experience different cultures from each other.

3.4   Interactive class

Can online interaction become an organic part of routine class? iClass is the answer to this question. Aiming to provide a convenient, user-friendly and efficient platform for everyday interaction of different disciplines and different educational institutions, iClass makes real-time communication and knowledge sharing between teachers and students and among students of the same class more handy and interesting.

With mobile devices such as iPhone, iPad and Android smart-phones, teachers can post up questions or assignment in class and students can respond immediately. Moreover, teachers can review students' work as soon as they submit it. Students can view peers' work and share their works via SMS platform such as Facebook. With five modules: Drawing, Keywords, MC Questions, Peer Review and Web Browser, a wide variety

of in-class activities can be conducted with timely response. Even extra-curriculum activities or groups such as Mobile Quiz Game or debate team can be well facilitated by iClass system. More examples will be illustrated later in the Cases and Scenarios part of this book.

4 Learning Chinese on Tablets by iWrite

Vincent W.L. Tam, K.W. Yeung, Ralph Cheung and Daniel Churchill

4.1   Abstract

With the continuously blooming economy in China in the past decade, the learning of Chinese has become very important for both Chinese and foreigners all over the world. Typically, among the four basic skills including listening, reading, speaking and writing to master any language, learning to write Chinese characters with the correct stroke sequences is often the most difficult part for most foreigners, or sometimes even Chinese students, due to the complicated structures and the diversity of Chinese characters. In many cases, due to the limited time in classes, students cannot be given sufficient practice to learn to write Chinese characters in correct stroke sequences. There are several Web-based e-learning software that allow students to practise the writing of Chinese characters or other skills mainly on desktop computers with the Internet access. With the decreasing prices and increasing popularity of portable computing devices nowadays, ultra-mobile PCs (Tablets), the Apple's iPad/iOS devices and various Android-powered tablets such as the Samsung Galaxy Tab may provide a more potential e-learning platform with great convenience for students to practise the writing of Chinese characters at their own pace anytime and anywhere. Therefore in this project, we propose to develop an adaptive e-learning platform, namely the *iWrite* system, for foreigners or local students to practise the writing of Chinese characters in correct stroke sequences on tablets. To demonstrate the feasibility of our proposal, we firstly implemented a prototype of the *iWrite* system using C# and the Microsoft Digital Ink Library for pen-based mobile computing devices like the Tablets. Our earliest prototype of the *iWrite* system can systematically categorize all the stored Chinese characters in its database according to four basic

structures, and include Chinese characters of all the basic structures into each training exercise. In each step of the training exercise, a template of the selected Chinese character will be displayed for the students to follow in the correct stroke sequence using a stylus pen or mouse. After the student finishes writing the character, the *iWrite* system will employ some efficient and intelligent heuristics to check whether the stroke sequence of the inputted Chinese character is correct or not. In case the direction of any stroke or the sequence of strokes is incorrect, an error message will be displayed. Then, the student can check on the animation button to display the correct stroke sequence of writing the specific Chinese character through animated GIF files. At the end, the student will receive an evaluation report showing at which specific structure(s) of the Chinese characters that the concerned student is relatively weak. In the subsequent exercises, our *iWrite* system may adaptively provide more such structures for the concerned student to practise. A preliminary evaluation was conducted with some encouraging feedbacks collected. Our *iWrite* system was awarded as the eInnovation Competition Award — Best Student Project in the 2009 International Conference on ICT in Teaching and Learning (ICT2009). Besides, the system was successfully extended onto the iPad/iOS platform providing attractive user interface with audio functions to practise Chinese pronunciations and other flexible features in which part of our work will be integrated into a contract research project collaborating with an international school in Hong Kong. Furthermore, a more careful evaluation was planned around the upcoming December in which the *iWrite* system would be available for foreign students for trials in some selected Chinese courses in the University of Hong Kong. After all, there are many interesting directions for further investigation including the integration of relevant course materials such as e-books or pointers to online databases of other existing mobile learning platform such as the iClass system, and a thorough study of the pedagogical changes brought by our integrated system for mobile learning.

4.2   Introduction

The learning of Chinese has become very important for both Chinese and foreigners all over the world due to the continuously blooming economy in China in the past decade, and China is taking up a more and more significant role in economic development and political influence in the global stage. Typically, among the four basic skills including listening, reading, speaking and writing to master any language, learning to write Chinese characters with the correct stroke sequences is often the most difficult part for most foreigners, or sometimes even Chinese students, due to the complicated structures and the diversity of Chinese characters. In many cases, due to the limited time in classes, students cannot be given sufficient practice to learn to write Chinese characters in correct stroke sequences. There are several Web-based e-learning software that allows students to practise the writing of Chinese characters or other skills mainly on desktop computers with the Internet access. With the decreasing prices and increasing popularity of portable computing devices nowadays, ultra-mobile PCs (Tablets), the Apple's iPad/iOS devices and various Android-powered tablets (Android, 2012) such as the Samsung Galaxy Tab (Samsung, 2012) may provide a more potential e-learning platform with great convenience for students to practise the writing of Chinese characters at their own pace anytime and anywhere. Therefore in this project, we propose to develop an adaptive e-learning platform, namely the iWrite system (Yeung, 2009; Tam, 2009), for foreigners or Chinese students to practise the writing of Chinese characters in correct stroke sequences on the Tablets, Apple's iPad/iPhone/iPod Touch (iOS, 2012; iPad2, 2012) or the Samsung Galaxy Tab.

To demonstrate the feasibility of our proposal, we implement a prototype of the *iWrite* system using C# and the Microsoft Digital Ink Library for

53

pen-based mobile computing devices. Our prototype of the *iWrite* system can systematically categorize all the stored Chinese characters in its database according to four basic structures, and include Chinese characters of all the basic structures into each training exercise. In each step of the training exercise, a template of the selected Chinese character will be displayed for the students to follow in the correct stroke sequence using a stylus pen or mouse. After the student finishes writing the character, the iWrite system will employ some efficient and intelligent heuristics to check whether the stroke sequence of the inputted Chinese character is correct or not. In case the direction of any stroke or the sequence of strokes is incorrect, an error message will be displayed. At this instant, the student can check on the animation button to display the correct stroke sequence of writing the specific Chinese character through animated GIF files. At the end, the student will receive an evaluation report showing at which specific structure(s) of the Chinese characters that the concerned student is relatively weak. In the subsequent exercises, our iWrite system (Yeung, 2009) may adaptively provide more such structures for the concerned student to practise. A preliminary evaluation was conducted with some encouraging feedbacks collected. Our iWrite system was awarded as the eInnovation Competition Award — Best Student Project in the 2009 International Conference on ICT in Teaching and Learning (ICT2009). Moreover, the system was successfully extended onto the iPad/iOS platform providing interactive user interface with audio functions to practise the pronunciations of Chinese phrases, words or simple sentences, and other flexible features in which part of our work will be integrated into a contract research project collaborating with an international school in Hong Kong. Furthermore, a more careful evaluation was planned around the upcoming December in which the *iWrite* system would be available for foreign students for trials in some selected Chinese courses in the University of Hong Kong. After all, there are many interesting directions for further investigation including the

integration of relevant course materials such as e-books or pointers to online databases online databases of other existing mobile learning platform such as the *iClass* system (iClass, 2012), and a thorough study of the pedagogical changes brought by our integrated system for mobile learning.

This paper is organized as follows. Section 2 reviews some previous works about the use of tablets and pen based computing in education. Section 3 details the system design of our proposed pen-based Chinese writing system, *iWrite*, on tablets or mobile phones to enhance learners' experience on mobile devices for learning to write Chinese, especially for foreigners. We give an empirical evaluation of our proposal on various criteria in Section 4. Lastly, we summarize our work and shed lights on future directions in Section 5.

4.3 Related Works

In this section, we would review some previous works on applying the Tablets and pen based input methods for learning to write Chinese that is relevant to the subsequent discussion of our proposal.

● Tablets for mobile learning: In 2006, the first powerful Ultra Mobile Portable Computer (UMPC) Q1 (Wikipedia, 2009) was launched by Samsung, followed by the ASUS, Founder (Intel based) and TabletKiosk (VIA based). These devices were earliest tablets with touch capability running Windows tablet edition or Windows XP with touch pack from the Microsoft. Origami was the touch pack and basic touch interface skin from Microsoft on these devices. The competition of tablets among different computer manufacturers became intense. Due to the increasing functions and dropping prices, tablets including the Apple's iPad/iOS devices and various Android-powered tablets (Android, 2012) such as the Samsung

Galaxy Tab (Samsung, 2012) become more and more popular. There are two significant features related to tablets, they are pen/touch based input and Internet accessibility to ubiquitous computing.

As a result, mobile learning becomes a main education method in the future. The following are advantages of using tablets to learn new things including:

- Fully utilizing the pen/touch-based input methods;
- Ensuring all students to have equal access;
- Interactivity and collaboration;
- Instant access to a variety of online resources;
- Enhancing student-centered learning;
- And many others.

Since there are so many advantages to implement mobile learning on tablets (Wikipedia, 2009), in our project, the resulting mobile learning system will focus on one of its most significant feature – pen/touch-based input for learning to write Chinese in the correct stroke sequence, that is particularly challenging and useful for foreign and/or local students.

- Pen/touch based input methods: among the various pen based input methods, Diagramming (Forsberg, 2008) is essentially a study aimed at helping to understand the applicability of pen computing in desktop environments or generally for education. The study applied three mouse-and-keyboard-based and three pen-based interaction techniques to six variations of a diagramming task. There are 18 subjects from Brown University with the average age of 25 to participate in the study. Although the study does not conclusively support that pen-computing has advantages in desktop environments, it does provide sufficient statistically significant evidence to warrant further investigation. Besides, AlgoSketch (Li, 2008) is built in the context of MathPaper, a pen/touch-based mathematical expression

recognition and interactive computation system. AlgoSketch has been proposed to facilitate algorithm design and data analysis or data processing, such as image processing and promoting the quick understanding of new algorithms. AlgoSketch supports flow-of-control constructs. The flow-of-control constructs can either have keyword support or have shorthand notations. For the simplicity of input mechanism, AlgoSketch supports both keywords and shorthand notations for hand written sketches. The variable tracing function provides a better understanding of a sketched algorithm. The values of given variables at some specific algorithm execution points can be displayed at convenient locations. Values of variables or their changes during different iterations can show whether the algorithm is performing as expected. Users can use an arrow to set the trace point and where to display the values. For segmentation and recognition of Mathematical expressions, when a new ink stroke is collected, it is first tested whether it is any of the command gestures. If it is a symbol, it will be passed to the symbol recognizer. The symbol recognizer is rule-based using cusp-related feature points for recognition of allograph. If the rule-based recognizer cannot recognize certain strokes, the Microsoft handwriting recognizer is invoked to recognize the input. AlgoSketch supports image processing with major file type, such as the bitmap, JPEG, TIFF and PNG.

- The Mobilese system: the Mobilese (Mobilese, 2009), namely the Mobile Chinese Learning Application, was initiated as a research project supported by the Teaching Development Grants (TDG) at the University of Hong Kong in 2009. The main aim of the project is to extend the learning of the Chinese language beyond the classroom with both PC version for desktop computers and mobile applications running on mobile devices such as the Symbian-based Nokia mobile

phones. The system was developed with the joint efforts by the Faculty of Education and School of Chinese for foreign students to practise the pronunciation and writing of simple Chinese characters at their own leisure time on Symbian-based mobile phones. Basically, the Mobilese system covers 101 commonly used Chinese characters involving different structures such as the single-part or compound characters. It allows users to practise on the stroke sequence of each individual Chinese character by 'clicking' on strokes or their segments in the correct order. At each step, the user must click on the stroke/segment in the right order before the corresponding stroke/segment is highlighted in red, and proceed to the next step. Otherwise, the Mobilese system will be pending for the user's correct inputs.

● The eStroke system: the eStroke (eStroke, 2009) is a commercially available e-learning system that provides both desktop and mobile versions to learn about Chinese through the display of animated Chinese characters in correct stroke sequences on the desktop computers, Android or iOS based mobile devices. Besides emphasis on the importance of correct stroke sequences in learning to write Chinese characters through high-quality animated images that can be included into a document for clear illustration, the eStroke system also allows the annotation of Chinese phrases with English or German explanation to facilitate the understanding of Chinese paragraphs for foreigners.

Nevertheless, both the eStroke and Mobilese systems do not provide the genuine and practical experience of "writing" the strokes, rather than clicking on the strokes or their segments, in correct sequence on pen/touch-based mobile devices like the iPhone/iPad or Android-powered tablets. In our *iWrite* system (Yeung, 2009; Tam,

2009), we aim to provide such practical experience for local or foreign to actually practise the writing of Chinese strokes firstly on a template, and later on a template-free rectangular box. At the end of the practice, our *iWrite* system will generate a complete and final report to inform the users about which specific structure(s) that the individual user is weak at. And in the subsequent practice, our *iWrite* system will flexibly extract more characters of the concerned structure(s) for the user to practise more.

4.4   System Design and Features

Our system is named *iWrite* (Yeung, 2009; Tam, 2009), which is aim at providing all the 3 essential components as *demonstration, practice and performance statistic* for students to learn how to write Chinese characters correctly. This makes our system design different from most existing e-learning systems (eStrokes, 2009; Tang, 2006) for writing Chinese that mainly focus on 1 or at most 2 out of the 3 essential components. Accordingly, our *iWrite* system is divided into 3 parts including the **demonstration**, **practice** and **evaluation**. Figure 4-1 The System Design of the iWrite System clearly shows the system architecture of our *iWrite* system.
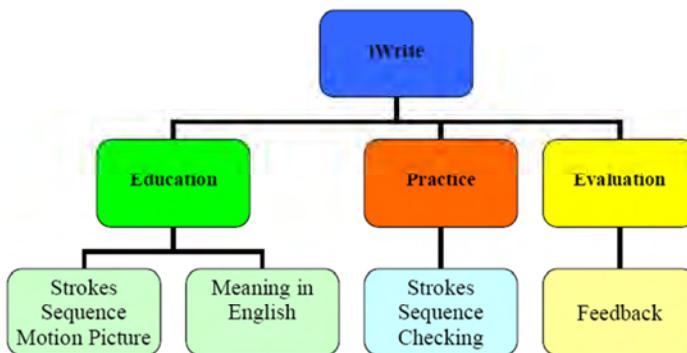

Figure 4-1 The System Design of the iWrite System

For the demonstration part, the system will provide motion pictures of writing Chinese characters with their correct strokes sequence on demand. For the practice part, the system will provide a Chinese character template to student. The system will check the strokes sequence when student writing on the template. The result will pop up to the student when he finishes the input. For the statistic part, the system will provide a statistic result when the student finishes the writing practice. It will provide the analysis of the performance of student and giving suggestion to the student.

The application window of the system will be *1024 × 600* in resolution which suit most of the Tablets in the market. The interface of the system will divide into three parts. The left of the system will be the input area which will provide the template for student to write on it. The right of the system will have two functions. The upper part is the control panel with the demonstration part being under it.
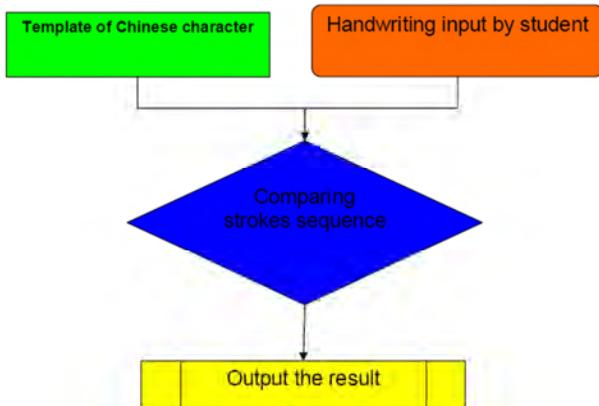

Figure 4-2 The Algorithm of the Stroke Sequence Detection in our iWrite

Fig. 4-2 illustrates the simple yet effective algorithm of the stroke sequence detection mechanism used in the practice part of our *iWrite* system. At the beginning, the system will load a Chinese character template to the handwriting input area for student to practice. Then, the concerned student will write the selected Chinese character by following the template. After the writing of the concerned Chinese character is completed, the system will check whether the strokes sequence is correct or not. And the result of the checking will be displayed with the erroneous stroke(s) being highlighted in red.

Most of the existing method of checking any error in stroke sequence is achieved by image mapping. However, the problems of applying this method are the long computation time and variation of accuracy. Since our *iWrite* system is designated to work on the strokes sequence, a bounding box algorithm is specially designed for checking the strokes sequence. Every stroke is bounding with a rectangle. Once the input stroke was found *well* within the bounding box and the input sequence is correct, it will be counted as 1 positive input. The input strokes must be lied on the template with at least 70% of the total area for the concerned bounding box to score a positive result. Since the stroke sequence checking is done by each individual bounding box, there is no limitation on the number of strokes contained in a Chinese character.

4.5 Prototype Implementation and Evaluation

To demonstrate the feasibility of our proposal, we implemented the earlier prototype of our *iWrite* system using the Microsoft Digital Ink library (MSDN, 2009) and the C# programming language. The current prototype implementation can be installed on any Windows XP already installed with the Windows XP Tablet PC Edition Software Development Kit (SDK) or Vista based desktop or ultra-mobile PCs. It took around 5 man-months for the design and implementation of our *iWrite* system.

For a better evaluation, the Chinese character templates will be built into 1 of the four categories based on the structure of the underlying Chinese characters. The four categories include single structure, up-down compound, left-right compound and bounded structure. Table 1 shows some of the examples for each of the four categories.

Structure	Examples
Single Structure	天, 上, 下, 中, 大, 甘, 日, 早
Up-down Compound	美, 金, 合, 雷, 笑, 哭
Left-right Compound	地, 和, 換, 江, 河, 明, 清, 好
Bounded structure	圓, 周, 同, 國, 回, 風

Table 4-1 Examples of the 4 Categories of Chinese Character Templates Used in our iWrite System

The MS Paint program is used to build the templates of Chinese characters for our *iWrite* system whereas the Ulead GIF Animator (UGA, 2009) is used to generate the motion picture for the demonstration of the correct stroke sequence. The template database was built with Microsoft Office Excel 2003 (MSDN, 2009) that is essentially a spread-sheet application providing calculation, graphing tools, pivot tables and a macro programming language called VBA (Visual Basic for Applications). It can be used to manage data of the template directory, involved bounding boxes and their evaluation. The spreadsheet will then export as a .txt file for the system to access as a database.

Figure 4-3 The User Interface of Our Original iWrite System shows the graphical user interface of our *iWrite* system with a selected template being displayed and ready for the user to practice. After following the

strokes to write, the user can click on the "Evaluation" button to see a detailed analysis of his/her result, and then click on the "Demo" button to view the live animation of stroke sequence in order to learn/revise the correct sequence.
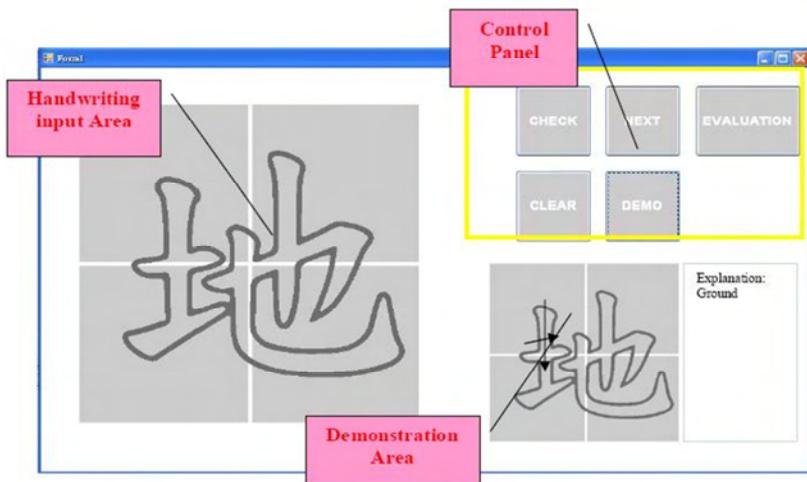

Figure 4-3 The User Interface of Our Original iWrite System

Chinese character	No. of correct results	Chinese character	No. of correct results	Chinese character	No. of correct results	Chinese character	No. of correct results
天	10	美	10	地	10	国	7
上	10	金	10	和	10	周	9
下	10	草	10	海	10	同	9
中	10	安	10	江	10	图	9
雪	10	阜	10	河	10	逛	10
甘	10	電	10	男	10	鼠	10

Table 4-2 Part of the Test Results for Using the Original iWrite to Practise the Writing of Chinese Characters

Table 4-2 shows the number of correct results of the first test. In the first test, the first three types can provide 100% positive result. But the 4th type (Bounded Structure) only achieved 82% in accuracy. It is observed that the problem is worse in some complex characters with more than 12 strokes in total. As you can see in Table 4-2, the □ inside the character 國 is relative small. The bounding box of the strokes in the □ is very small. The error rate will increase due to the input stroke might easily exceed the bounding box. Therefore, the input strokes may easily have less than 70% of its area lied inside the bounding box, thus being counted as a negative result. Lastly, 10 subjects, mostly Year 3 Engineering students, are selected to try out our iWrite system to learn to write Chinese in correct stroke sequence. Their achieved accuracy are reported in Table 3 as follows. It is obvious that most of the subjects can achieve 95% or above of accuracy since most of them are local students using Chinese as their first language.

Test	1	2	3	4	5
Accuracy	90%	95%	97.5%	90%	92.5%
Test	6	7	8	9	10
Accuracy	100%	95%	100%	100%	100%

Table 4-3 Performance of 10 Subjects in using iWrite

Extending from the careful design of the earlier tablet/UMPC version of our *iWrite* system, we successfully developed another mobile version on the Apple's iPad (iPad2, 2012), that has undoubtedly evolved into a very comprehensive e-learning system with pronunciations of both Cantonese and Mandarin for users to practise on the spoken part, i.e. another important skill to be mastered, of the Chinese language. The extended mobile version consists of 4 basic functions, namely the stroke practice, usage, history and similar characters, as shown in Figure 4-4(a). The

"stroke practice" is a simple mini-game in which players will try to connect funny cartoon characters in correct orders through which each player will also learn and practice the writing of individual Chinese characters in correct stroke sequence at the same time. The user interface of this simple mini-game for "stroke practice" is illustrated in Figure 4-4(b). The player can choose to write a Chinese character with or without the background template. Besides, on successful completion, the player can upload his/her completed characters onto the Facebook platform to share with his/her friends. Furthermore, a simple thesaurus is provided to associate each Chinese character to commonly used Chinese phrases aided by clear explanations and audio pronunciations to expand the users' vocabulary. Lastly, animated GIF are provided to demonstrate about the evolution of each individual Chinese character from its pictorial form into the complex form adopted nowadays so as to facilitate the individual user's understanding of the specific meaning/concept associated with each Chinese character.
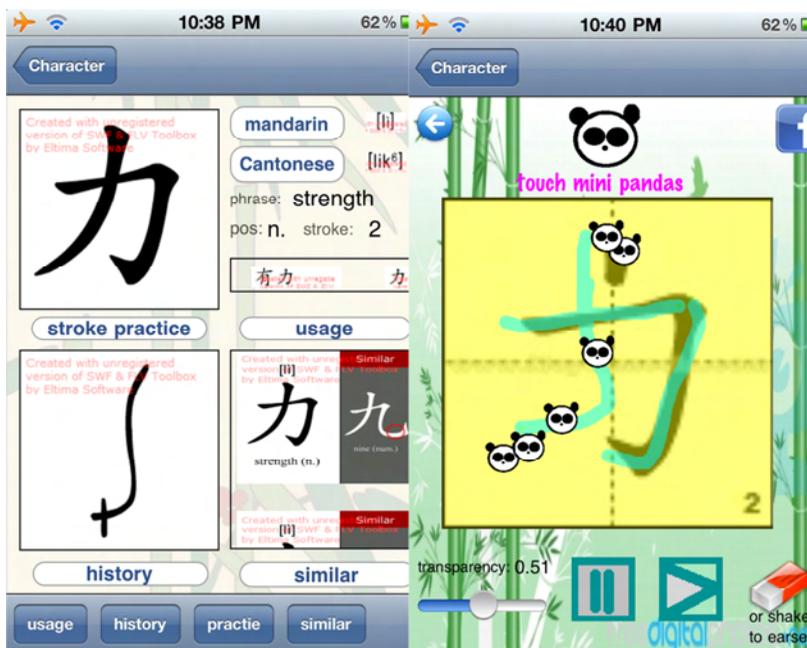
(a) The 4 Basic Functions of Our Extended *iWrite* System on the iPad/iOS devices

(b) The User Interface of the "Stroke Practice" Mini-Game for Our Extended *iWrite* System on the iPad/iOS devices

Figure 4-4 The User Interfaces of Our Extended iWrie System on the iPad/iOS Devices

Around the end of this year, we would plan to conduct a more thorough evaluation of our system by the foreign exchange students taking the Chinese for Foreign Students in the School of Chinese, the University of Hong Kong. After some careful analysis, a detailed report about the evaluation results will be published under our project website by the early part of 2012.

4.6   Concluding Remarks

In this paper, we propose to develop an adaptive e-learning platform (Yeung, 2009; Tam, 2009), namely the *iWrite* system, for foreigners or Chinese students to practise the writing of Chinese characters in correct stroke sequences on tablets. To demonstrate the feasibility of our proposal, we implement a prototype of the *iWrite* system using C# and the Microsoft Digital Ink Library for pen-based mobile computing devices. Our prototype of the *iWrite* system can systematically categorize all the stored Chinese characters in its database according to four basic structures, and include Chinese characters of all the basic structures into each training exercise. In each step of the training exercise, a template of the selected Chinese character will be displayed for the students to follow in the correct stroke sequence using a stylus pen or mouse. After the student finishes writing the character, the *iWrite* system will employ some efficient and intelligent heuristics to check whether the stroke sequence of the inputted Chinese character is correct or not. In case the direction of any stroke or the sequence of strokes is incorrect, an error message will be displayed. At this instant, the student can check on the animation button to display the correct stroke sequence of writing the specific Chinese character through animated GIF files. At the end, the student will receive an evaluation report showing at which specific structure(s) of the Chinese characters that the concerned student is relatively weak. In the subsequent exercises, our *iWrite* system may adaptively provide more such structures for the concerned student to practise. A preliminary evaluation was conducted with some encouraging feedbacks collected. Based on the careful design of the earlier tablet/UMPC version of our *iWrite* system, we successfully developed another mobile version on the Apple's iPad or iOS devices (iOS, 2012; iPad2, 2012), that has undoubtedly evolved into a very comprehensive e-learning system with pronunciations of both Cantonese and Mandarin for users to practise on the spoken Chinese. The practice and evaluation of writing individual

Chinese characters in correct stroke sequences is turned into a simple mini-game of connecting funny cartoon icons in correct orders. Lastly, a simple thesaurus to associate each Chinese character to commonly used phrases and animated GIF's to show the evolution of such Chinese character are provided in the mobile version of our *iWrite* system. A more careful evaluation was planned around the upcoming December in which the *iWrite* system would be available for foreign students for trials in some selected Chinese courses in the University of Hong Kong.

After all, there are many interesting directions for further investigation including the integration of relevant course materials such as e-books or pointers to online databases of other existing mobile learning platform such as the *iClass* system (iClass, 2012), and a thorough study of the pedagogical changes brought by our integrated system for mobile learning.

4.7   References

o   Forsberg, A., Bragdon, A., Joseph, J. LaViola Jr., Raghupathy, S., and Zeleznik, R. (2008). *An Empirical Study in Pen-Centric User Interfaces: Diagramming.* In Proceedings of the Eurographics Workshop on Sketch-Based Interface and Modeling 2008, Annecy, France, pp. 135 – 142, 2008.

o   Li, C.J., Miller, Timothy S., and Zeleznik, R. (2008). *AlgoSketch: Algorithm Sketching and Interactive Computation.* In Proceedings of the Eurographics Workshop on Sketch-Based Interface and Modeling 2008, Annecy, France, pp. 175 - 182, 2008.

o   Tam, V.   and Yeung, K.W. (2009). An Adaptive Learning Platform to Practise the Writing of Chinese Characters on Ultra-Mobile PCs. *Proceedings of the International Conference on ICT in Teaching and Learning (ICT 2009),* Hong Kong, July 6

– 8, 2009.

o   Tang, K.T. and Leung, Howard (2006). *Reconstructing the Correct Writing Sequence from a Set of Chinese Character Strokes.* Y. Matsumoto et al. (Eds): ICCPOL 2006, LNAI 4285, pp. 333 – 344, 2006, Springer-Verlag Berlin Heidelberg 2006.

o   The Android development team. (2012). *The Android website*. Retrieved: February 15, 2012, from http://www.android.com/.

o   The Apple iOS 5 development team. (2012). *The iOS 5 website*. Retrieved: February 15, 2012, from http://www.apple.com/ios/.

o   The Apple iPad2 development team. (2012). *The iPad2 website*. Retrieved: February 15, 2012, from http://www.apple.com/ipad/.

o   The eStrokes development team. (2009). *The eStrokes website*. Retrieved: June 15, 2009, from http://www.eon.com.hk/estroke.

o   The HKU iClass development team. (2012). *The HKU iClass Project Official website*.   Retrieved: February 20, 2012, from http://www.eee.hku.hk/~iclass/.

o   The   Mobilese   team.   (2009).   *The   Mobilese   Project Site*.   Retrieved: February   15,   2012,   from http://mobilese.cite.hku.hk/.

o   The Microsoft Developer Network (MSDN) team. (2009). *The Microsoft Developer Network Official Site*.   Retrieved: June 15, 2009, from http://msdn.microsoft.com.

o   The Samsung Galaxy Tab development team. (2012). *The Samsung Galaxy Tab website*. Retrieved: February 15, 2012, from http://www.samsung.com/global/microsite/galaxytab/10.1/index. html.

o   The Ulead GIF Animator development (UGA) team. (2009). *The GIF Animator 5 Official Site*.   Retrieved: June 15, 2009, from http://www.ulead.com/ga.

o The Wikipedia development team. (2009). *UMPC – Wikipedia, the free encyclopedia*. Retrieved: June 10, 2009, from http://en.wikipedia.org/wiki/UMPC

o Yeung, K.W. (2009). Mobile Learning of Writing Chinese Characters on Tablets. *A Final-Year Project Report 2008-09,* Department of E.E.E., The University of Hong Kong, Revised: March 10, 2009.

4.8 Bibliography

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5 The Era of Interactive Learning

5.1 Importance of Interactive Class in the Curriculum Reform

Interactive teaching is of great importance in the curriculum reform. In the Student Evaluation of Teaching and Learning for the University of Hong Kong, questions related to interactive teaching are included: "The teacher incorporated elements of interactive teaching" and "The teacher encouraged interaction/collaboration among students in learning"[2]. It is important for a good teacher to plan lectures to actively engage students in their learning, encourage them to get involved in classroom discussions and work together to complete informal or formal assessment tasks.

As the number of students increases, it will be difficult to conduct interactive classes in big lectures. Some students are reluctant to raise their hands in front of big classes. A system which can capture and analyse students' opinions in a quick and convenient way will be important for interactive teaching and learning during the lecture time.

5.2 Interactive Class Using Gaming Devices

In 2007, teachers and researchers from the Department of Electrical and Electronic Engineering of the University of Hong Kong had developed a mobile learning system. The system allowed students using their mobile devices such as a PSP to make immediate responds to multiple choice questions or

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surveys. The development was technically quite successful and the project won the ICT Bronze Award[3] from the HKSAR Government[4].

However, when the application was deployed in a real situation, many difficulties were encountered in different scenario, which are summarized as follows:

	The school provided the mobile devices	Students prepare the devices by themselves
Pros	1. Criteria of equal opportunity can be met 2. Ensure same devices and standards	1.Simplified administration efforts 2. Minimal initial investment 3. Minimal routine efforts 4. Students own the devices and take care of the security issues by themselves
Cons	1. Significant initial investment 2. Need extra man-power to administrate the loan process e.g. registration and return inspection 3. Need man-power to recharge batteries 4. Lost and damage	1. Equal opportunity issue: poor students are discouraged from class participation 2. Devices and platforms are not standardized 3. Students may forget to bring their devices

In any case, there are logistics and administration problems to implement interactive learning using mobile phone or PDA as it was not convenient

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[3] Ref: http://www.eee.hku.hk/achievements/achievements/
EEE_Teachers_ICT_Award.htm
[4] Ref: http://mlearning.eee.hku.hk/mobilequiz/news.html

enough.

The details of this project can be referred to Appendix A of this book for the paper titled "A Mobile Quiz Platform to Challenge Players' Knowledge on Mobile Devices" published in the 8th IEEE International Conference on Advanced Learning Technologies in Cantabria, Spain in July 2008.

5.3   Interactive Class Using Clickers

Some faculties may use handheld devices such as i-Clicker which is equipped with a few buttons for collecting interactive responds from the class. However, the same administration problems in logistics, maintenance, security, battery charging and other areas still exist. Teachers are required to loan the system from the Classroom Services, distribute the devices to the students, register their names, and then collect the devices and return to them… Sometimes a technician may be required to provide technical assistance to the teachers to operate the system. These problems discourage teachers from using handheld devices for interactive class implementation.

Figure 5-1 Students using handheld devices to give feedbacks in a class

5.3.1   Scholarship Underlying the Development of "Clicker"

There is a substantial scholarship underlying the development of "clicker"

in the paper titled "Clickers in the Classroom: An Active Learning Approach" published by Margin Martyn (2007). In the paper entitled: *"Clickers in the Large Classroom: Current Research and Best-Practice Tips"* written by Jane E. Caldwell, the **conclusion was stated as follows:** When used during lectures, clickers have either neutral or positive effects and a more strongly positive effect on learning outcomes when combined with peer or cooperative learning. They increase attendance and retention and can be used to promote student accountability. They simulate a one-to-many dialogue and make it easier for both instructors and students to receive prompt feedback. Overall, clickers have the potential to improve classroom learning, especially in large classes. Students and instructors find their use stimulating, revealing, motivating, and—as an added benefit—just plain fun….. interactive and real-time class response system can enhance students' active learning, participation, and enjoyment of classes.[5]

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[5] Ref: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1810212/
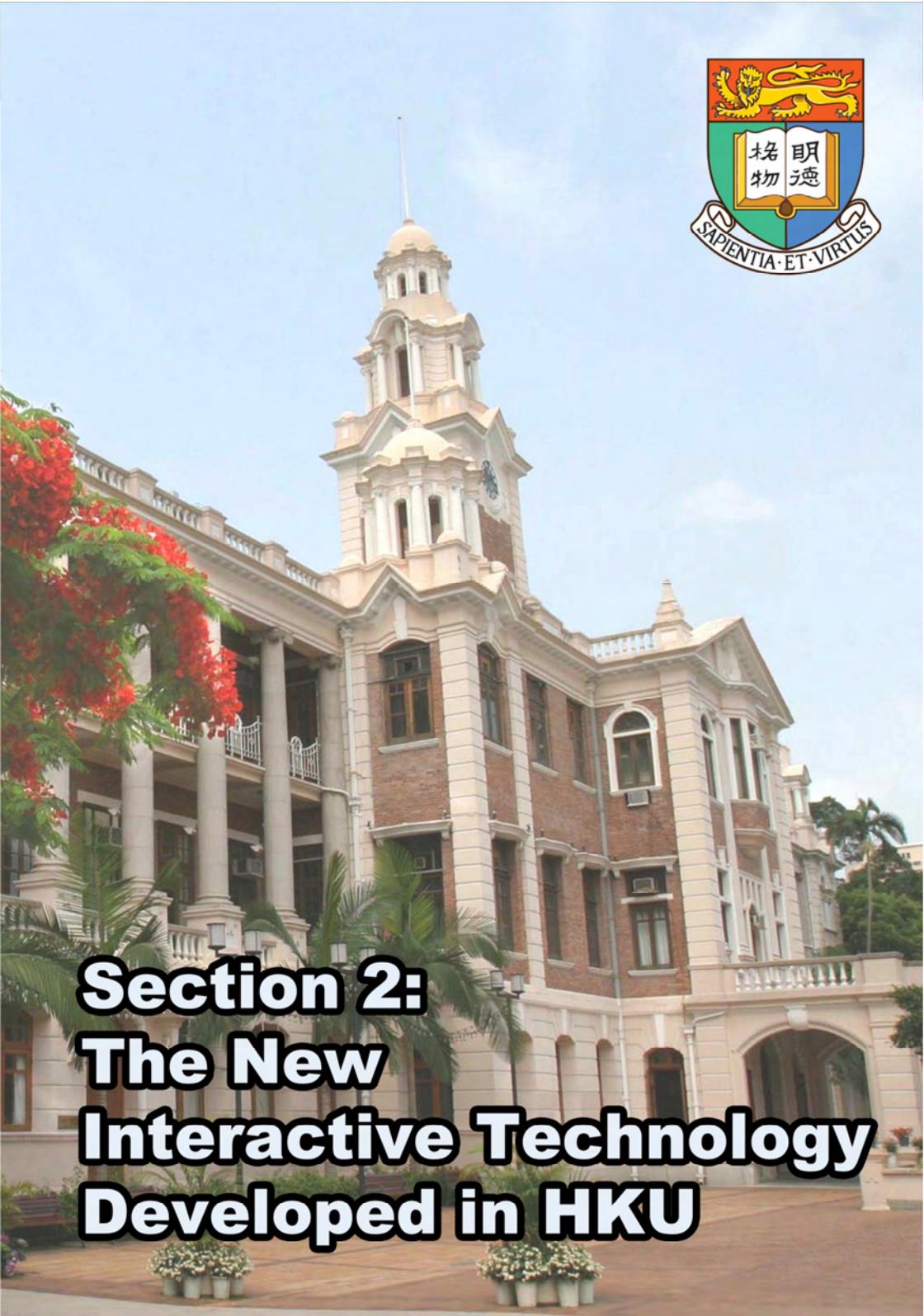
Section 2:
The New
Interactive Technology
Developed in HKU

6 About iClass

6.1   Introduction

The Classroom Response System can provide a convenient, secure, user-friendly, efficient, and effective way to enable interactivity in an ordinary lecture course. Students can use their mobile devices, such as a web-based laptop application, iPhone, iPad, or an Android phone, to access th   e iClass Mobile system and submit their feedback in class. The feedback can be in text or graphic format and will be shared with their classmates immediately through the classroom projector or common social networking applications such as Facebook. This system can makes the classroom setting more interactive and encourage more students to actively participate in lessons. In the past, classroom discussions were conducted through blackboards and paper. In our modern world, interactive classes can be conducted via mobile devices.
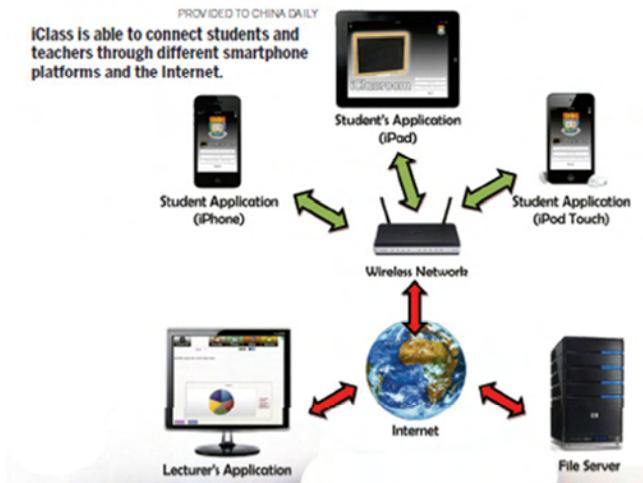
Figure 6-1 System block diagram of iClass

6.2   Components

There are 3 components:

1. Students Apps installed in a mobile device (iPhone, iPad, or an Android phone/ tablet through HTML5 browser)
2. Teacher Apps (Web-base application runs in the existing classroom PC)
3. Apps server/File server

The apps can be accessed from the project website at www.eee.hku.hk/~iclass. The website will provide a link to the Apple App Store, where the iClass app can be downloaded.
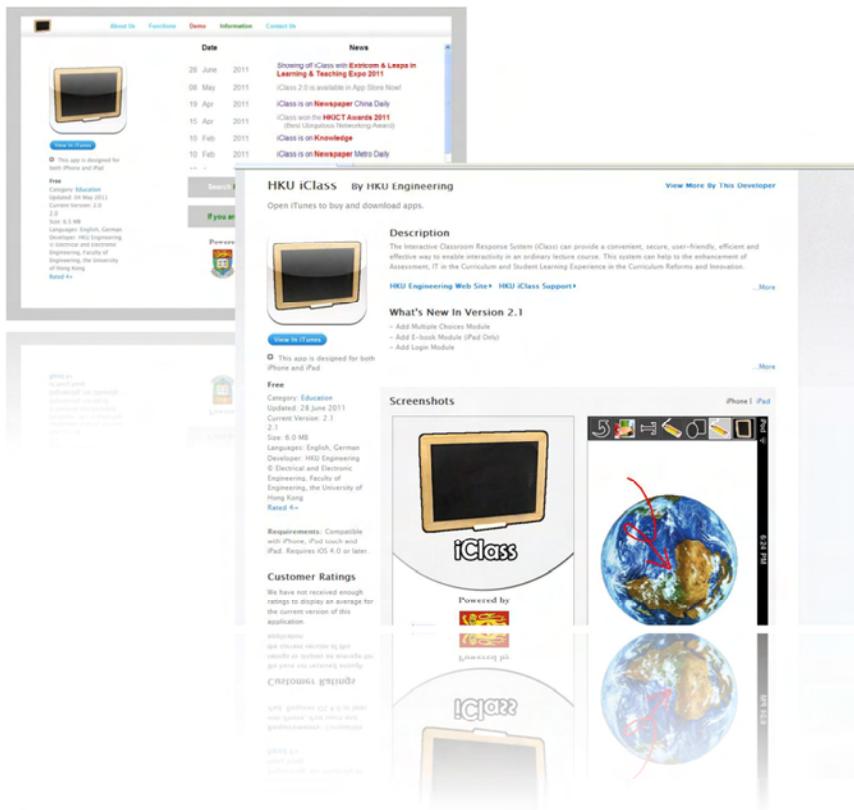
6.3   Video Demonstration of iClass

A video demonstration of iClass can be viewed in the following link in YouTube: http://youtu.be/-t2PnZ3dZzM

7 Operation of the iClass Student Platform

7.1 General System Flow

1. Teachers start the class and open the Teacher Platform.
2. Students can login to the system via Smartphone or tablet PCs.
3. Teachers can ask questions and upload images to the cloud.
4. Students can get questions/images from the cloud via a wireless network.
5. Students can upload their work to the cloud through the wireless network.
6. Teachers can also view the work which is submitted by the students from the Teacher Platform through the cloud.

After the application is installed on the devices, the application can now be run and will enter the main screen as shown above. Notice that the devices must be connected to the Internet, using either a WiFi connection or a 3G connection. If not, the application may not be started successfully.

7.2   Getting Start

In the login screen, there are three text fields, named as "Course Code", "Student ID" and "Nickname". Students are required to enter these fields to login the system.

7.3   Account Settings

 Click the "Settings" button to access the Setting menu. Students can select the display language on the language bar. If this device belongs to a particular owner, owner's information can be entered and saved so that the owner does not need to enter the login information again in the next login. But if this is a shared device (some schools provide and distribute the devices to their students in the class), then the "Account Enabled" switch is recommended to set to "Off".

7.4   Tools for Locating the Right Course Code

7.4.1   Search the Course Code

Students can simply enter the course code on the search bar to access the course directly.

7.4.2   Location-based Service

Since over hundred of courses are conducting in the campus at the same time, students can tap the location-based button to access the location-based service. The location of the device will be detected and only the near-by courses will be displayed. This function can reduce the list length so that it will be easier for students to locate the right course.
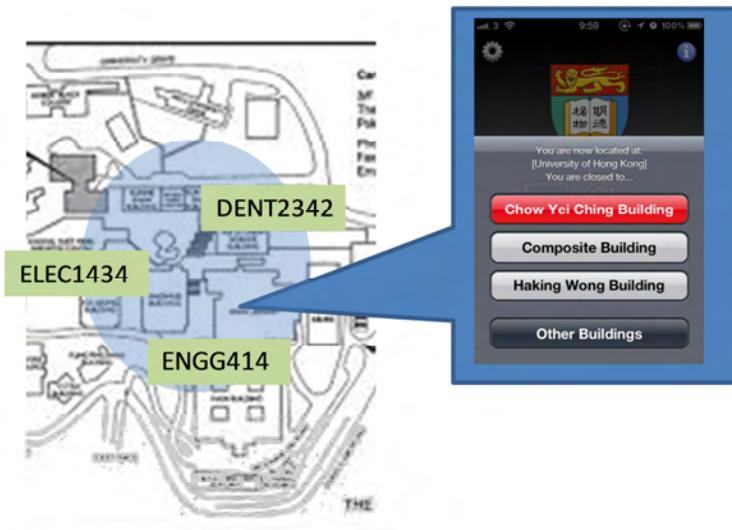
7.5   The Main Menu

Figure 7-1 Main Menu User Interface

In Version 2.0, there are seven modules:

Module	Functions
Drawings	To sketch anything related to the lecture topic.
Keywords	To write keywords for sharing on the teacher screen.
MC Questions	To view and answer MC questions.
E-Book	To read the interactive e-book.
Peer Review	To view, rate and comment other students' work.
QR Code	To decode QR code printed on books or notes.
Web Browser	To access the lecture recommended websites.

7.6 "Drawings" Module

7.6.1 Major Functions

This module allows students to draw a diagram with free-hand or use some drawing tools provided. The drawing can then be submitted to the teacher's screen for real-time sharing. The "Drawings" module has 12 buttons on the left menu. Students can use the draw, shape, text, and eraser tools to create pictures and share them with their classmates.

Icon	Tag	Functions
	Menu	To return to the main menu.
	Submit to Cloud	To submit the drawing to the cloud for showing on the teacher's screen.
	Share	To share the drawing in the user's facebook wall.
	Save	To save the drawing in the local album.
	Load	To load a photo from the local album.
	Draw	To draw straight or freehand lines with different colors and thickness.
	Shape	To draw rectangles and ellipses with different colors and thickness.
	Text	To add text with various colors and font sizes.
	Download Image	To download images provided by teacher from the cloud.
	Easer	To erase part of the drawing.
	Undo	To undo the most recent change to their drawing.
	Clear	To delete the drawing.

For Smartphone users, since the screen size is much smaller, there are only 7 functions buttons on the left menu. Students can tap the "Main Menu" button on the top left hand corner to access a sub-menu page and access other functions such as "Save", "Load", "Clear", "Share" and "Submit". Students can also access this sub-menu by shaking the phone.
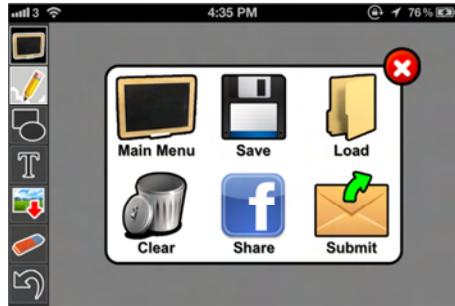
7.6.2   Drawing with Free-hand and Shapes

Teachers may ask students to draw something (for example, a mind-map) on a blank paper. Students can finish the mind-map by using the tools provided in "Drawings".
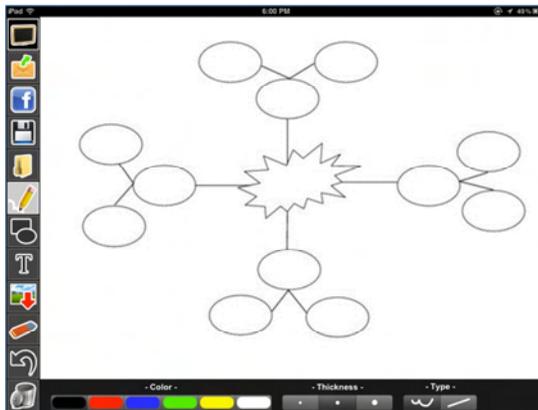
When students finish their work, they may save it to their photo album for future use. They may also share their work by submitting them to the lecturer or via Facebook for sharing and discussion.

7.6.3   Download Image from Cloud

Teacher may upload a worksheet or image to the cloud through the Teacher Platform. Students may tap the "Download Image" button to download the image posted by the teacher.
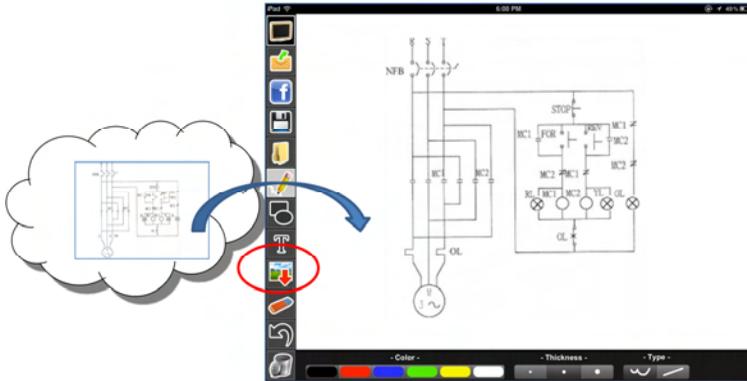
After the image is downloaded, students may draw and edit the image as requested. When they have finished editing the image, they may save, submit, or share their work using the buttons on the left.
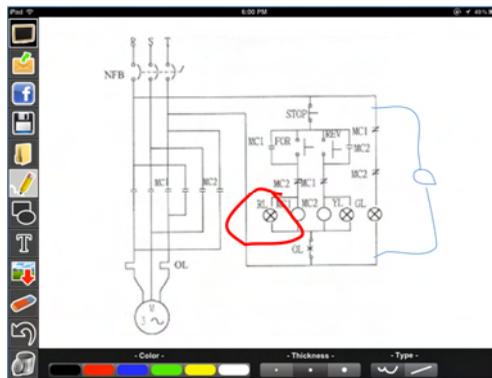
Figure 7-2 Student Works on Worksheet Prepared by Teacher

7.6.4 Adding Text to the Drawing
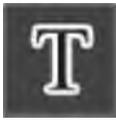
Students can also add text to the drawing by tapping the "Text" icon. When finish entering the text, drag the text box to the desire position on the drawing. Students can repeat this step to add more text labels.

Figure 7-3 Enter Text at the Bottom Right Corner

7.6.5 Sharing Drawings on Facebook

Students can also share their work via Facebook in order to continue their discussion on subject material after class. By tapping the "Share" button, it will automatically share their work via their Facebook account. For Smartphone users, you may find the "Share" button in the sub-menu.
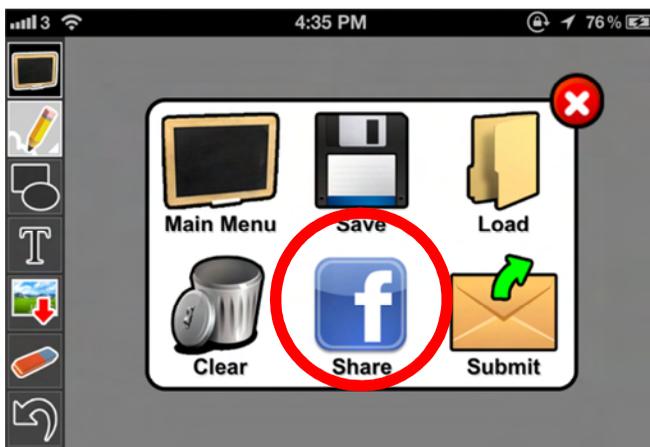
7.7 "Keywords" Module

7.7.1 Major Functions

This module allows students to answer questions posted by teachers and then submit their answers by using keywords. There are six buttons in the menu:

Icon	Tag	Functions
	Menu	To return to the main menu.
	Refresh	To refresh the screen and view any updated questions posted by the lecturer.
	Modify	To modify or delete keywords.
	Save	To save keywords to local memory.
	Load	To load the saved keywords in the local memory.
	Submit to Cloud	To submit keywords to the teacher's screen.

7.7.2　Get New Question

If there is no question available, the keyword answer box is disabled. Students are required to tap the "Reload" button to get question from teacher.
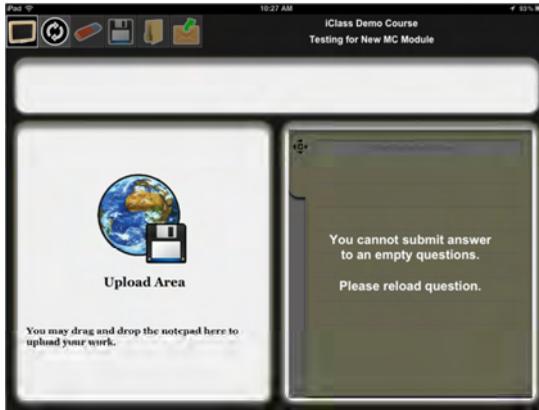
7.7.3　Enter Keywords

After the question is loaded, multiple keywords can be entered as answer. You can enter 1 keyword at a time, and tap the return button for next input. If you want to delete a keyword, swipe the keyword and a delete button will be appeared on the right.

7.7.4   Submit and Share Keywords

Students can tap the "Submit" button to send their work to the cloud and share it with the class. Instance statistic will be generated on the Teacher Platform.

7.7.5   Drag-and-Drop Submission

Students with the iPad may drag and drop the notepad paper from the "Edit Area" to the "Upload Area." Once the user drags the paper to the "Upload Area," their answers will be submitted to the cloud. This action adds interactivity to the application, simulating the action of a student submitting a physical sheet of notepaper to the white board, which can enhance the user experience.

7.7.6   Shake-to-Share

Using the accelerometer in the students' devices, further enhancement of user experience can be achieved. Students may shake their devices to submit their work.

7.8 "MC Questions" Module

Students can answer a set of multiple choice questions from the question bank. The selected choices will be shown on the left column. Tap the "Submit" button to submit to cloud when finish.

Icon	Tag	Functions
	Menu	To return to the main menu.
	Refresh	To updated questions posted by teacher.
	Submit to Cloud	To submit answers to the cloud.
	Back	To go back to the previous question.
	Next	To advance to the next question.

7.9 "E-book" Module

"E-book" module allows students to download e-books from their teachers. They can read and edit the e-book so that they can work on the worksheets in the book and submit their answers and ideas in the class in an interactive way. There are three main buttons in this module.

Icon	Tag	Functions
	Menu	To return to the main menu.
	List of E-books	To select and load an e-book of this course.
	Edit	To enable editing on this page.

Figure 7-4 Download an e-Book from the Course e-Book Library

7.9.1 Load and Read the e-Book

Students can select and download the e-book from the cloud and read the book. Wipe the screen to turn to the next or previous page.

7.9.2 Work on a Selected Page

 Flip to the page you want, for example the page with a pre-printed answer box, and tap the "Edit" button to edit the page. An editing tool bar will appear on the left column and students can use these tools, such as drawing pen, highlight pen and eraser, to edit the page. The functions of the editing tool bar are listed in next page.

Icon	Tag	Functions
	Submit to cloud	To submit the edited page to the cloud for showing on the teacher's screen.
	Save	To save the edited page in the local album.
	Draw	To draw either straight or freehand lines with different colors and thickness levels.
	Highlight pen	To highlight the some keywords or important sentences on this page.
	Text	To add text into their current drawing in various colors and font sizes.
	Eraser	To erase part of the drawing.
	Undo	To undo the most recent change in the drawing.
	Clear	To delete the drawing.
	Finish & Exit	Finish editing the page and return to the reading mode.

7.10 "QR Code" Module

Students can use this module to decode a printed quick-response (QR) code. Teachers can encode textual information, such as the suggested answers of a question, or an URL of a video, in a QR code and print it on a worksheet. Students can easily access the required information with the help of this module. No more CD / DVD are needed!

Figure 7-5 Try this! Use this QR Code to Watch the iClass Video Demonstration

 You can tap the "Cancel Scan" button to cancel the QR code function and return to the main menu.

7.11 "Peer Review" Module

In this module, students can view the drawings which are submitted by their peers to learn from one another. They can also grade and comment others' works and so as to facilitate peer learning.

Icon	Tag	Functions
	Menu	To return to the main menu.
	Assignment	To select the assignment for peer review.
	View Comments	To view the comments of the selected image.
	Post Comment	To post new comment to the selected image.
	Rate	To give the score to the selected image (1 - 5 marks).
	Back	To go back to the previous image.
	Next	To advance to the next image.

7.11.1 Grade the Image

You can tap the "Rate" button to give score to a particular image, ranged from 1 to 5 (represents the highest score).

7.11.2 Post Comments

You can tap the "Post Comment" button to write comments for a particular image. The comments can be viewed by other peers in the same learning group. Students can tap on the "Next" and "Back" buttons to view the next or previous images which were submitted by others. Students can also give score to a particular image.

7.11.3 View Comments

Students can view comments of the image by tapping this button. They can also post their own comment by tapping the "Post" button. The number displayed in the button indicates the number of comments received.

7.12 "Web Browser" Module

"Web Browser" allow students to access a list of website which is provided by the teacher via the Teacher Platform. After you tap the "List" button (the second button) on the top left corner, a list of recommended website will be shown. Students can then access those recommended website in a very convenient way.
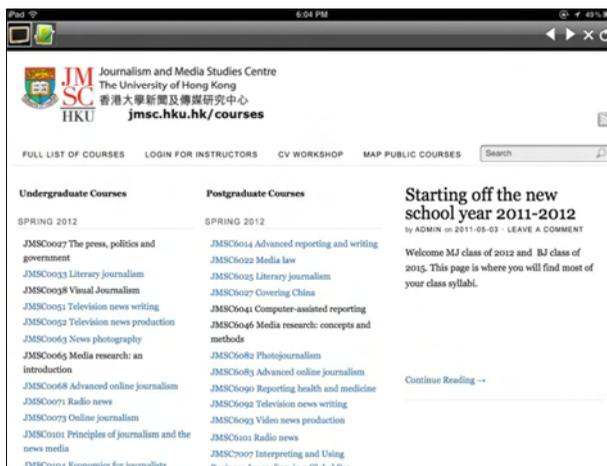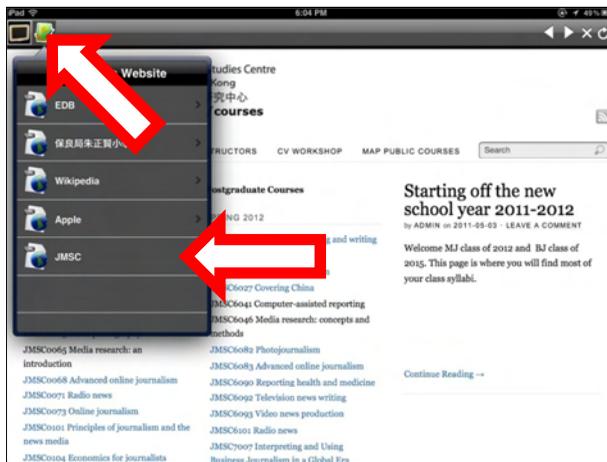
8 Operation of the iClass Teacher Platform

8.1 Introduction

The Teacher Platform is required in order to post assignments and receive student submissions. It is actually a web-base application, which you don't need to install anything in order to use it. What you need is a device which can access to the Internet with a web browser.

8.2 Login
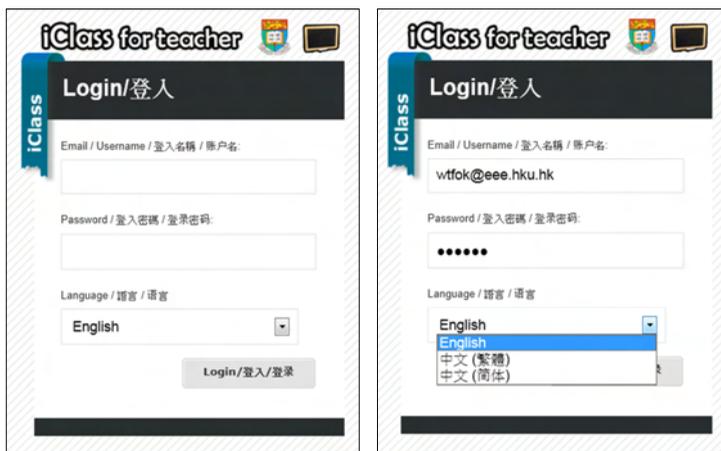
The screens above show the login page of the Teacher Platform. Teacher can use the designated username and password to access the Teacher Platform. Our platform supports multi-languages - English, Traditional Chinese and Simplified Chinese, which you can also select your language here.

After you have successfully login to our system, you can either create a new course or select a course from your course list.

8.2.1 Create a New Course

Teacher can create a new course on the left side of the screen above. Teacher should enter "Course Code" and "Course Name", which the "Course Code" is the field to be displayed on Student Platform for students to select a course.
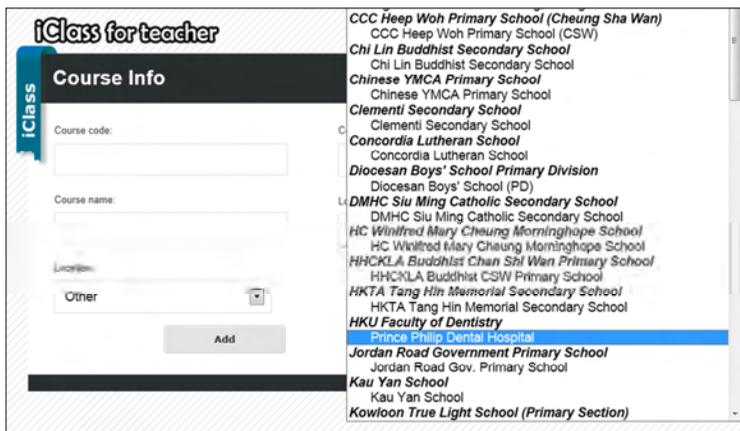
8.2.2 Select an Existing Course

Teachers may also select course which was created by them from the

101

right side of the screen above.

8.2.3 Select the Location of the Class

Teacher may also select the location of your class in the Teacher Platform. Once you have selected the location, students can find your course by using the location-based function in the Student Platform. If you don't want to use the location-based function, simply select "Others" on the list.
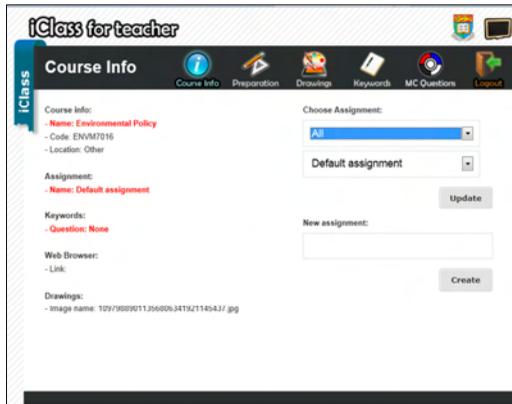
8.3 Main Menu

There are six buttons in the main menu bar: "Course Info", "Preparation", "Drawings", "Keywords", "MC Questions" and "Logout".
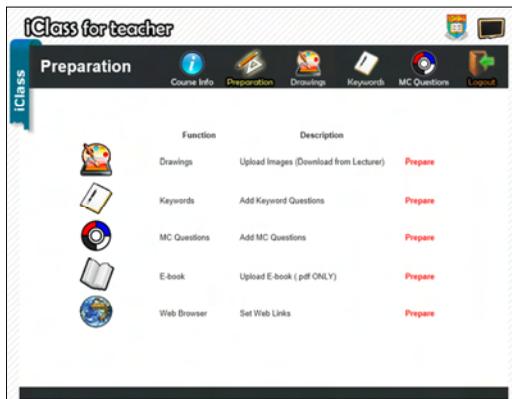
8.4 Course Information

This page is to display the information of the course, such as "Course Code", "Course Name", "Current Assignment", etc. Teacher may change or add an assignment here.

8.5 Course Preparation

Teachers can prepare materials here. The following materials can be prepared: "Drawings", "Keywords", "MC Questions", "E-book" and "Web Browser".
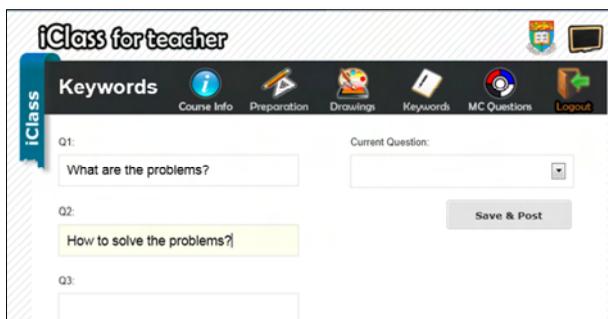
8.5.1 Prepare for "Drawings"

Teacher can upload images to the Teacher Platform for students to download and edit. The file size and format are restricted. If its size is too large, an error prompt will appear.

8.5.2 Prepare for "Keywords"

Teachers can post questions and publish them to their students. In order to post questions, go to the text field and then enter a question. After that, simply choose the corresponding question number and click "Save & Post."

8.5.3   Prepare for "MC Questions"
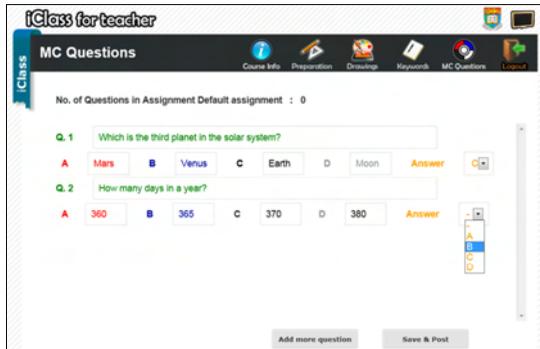
Teachers can post multiple choice questions in this page. Simply enter the question, the four choices and the correct answer. If it is an open-end question, select "-" from the "Answer" list. Click "Add more question" if you want to post more questions. Remember to click "Save & Post" after you have prepared the question bank.

8.5.4   Prepare for "E-book"

Teacher can upload e-books in this page, and it should be in pdf format. Teacher should also enter the name of this e-book. After you have successfully added the e-book, you can view the list on the right.

8.5.5 Prepare for "Web Browser"

Teachers should enter the URL and the name for the website, and click the "Update" button to submit the list. Teacher may also click "Add more links" to add more than 1 website. We currently support up to 5 suggested websites per course. The list can be displayed on the Student Platform under the "Web Browser" module.

This part will be useful for teachers to restrict students from browsing inappropriate contents.

8.6 Display Submission from "Drawings"

Submitted images from students will be shown in thumbnail. Teacher can click on the thumbnails to view the full-sized image.

Information such as author and score will be shown once the image is enlarged. Teacher may sort the order of display by submission time, score or student name. By clicking the "Play Slideshow" button, images can be displayed automatically.

8.7   Display Submission from "Keywords"

This is the page for displaying result from the "Keywords" module of the Student Platform. Real-time result and statistic will be generated, in the forms of pie chart, tag cloud, bar chart and list view.

In a pie chart, more frequently occurring answers will be represented with a larger piece of a circle. In a tag cloud, a larger word represents more frequently submitted keywords while a smaller word represents less frequently submitted keywords.
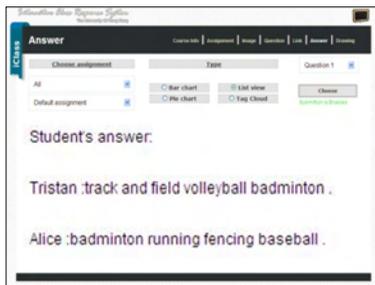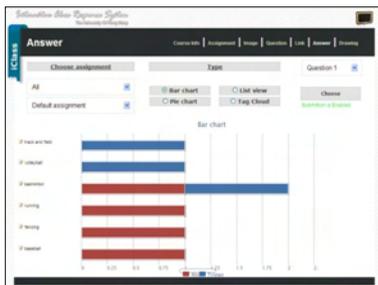
In a bar chart, more frequently occurring answers will be represented with longer bars, while different color represents different students. In a list view, answers are simply arranged in a list by user for easy user logging.

Sometimes, keywords from students may be redundant. Teacher can

combine answers to avoid those redundancies. Teacher can simply drag and drop one answer to another in order to group those keywords.

8.8 Display Submission from "MC Questions"

This page is to display a real-time response from the Student Platform. By default, a table of answers will be displayed according to different students. Red box stands for incorrect answer while green box represents correct answer. If it is an open-end question, a white box will be displayed. Teacher may also click the question number to show a pie chart, which displays the distribution of answers for a single question.

8.9 Logout

This button is to logout the Teacher Platform. It is always a good habit to logout once you finish your lesson.

Section 3: From Technology to Pedagogy
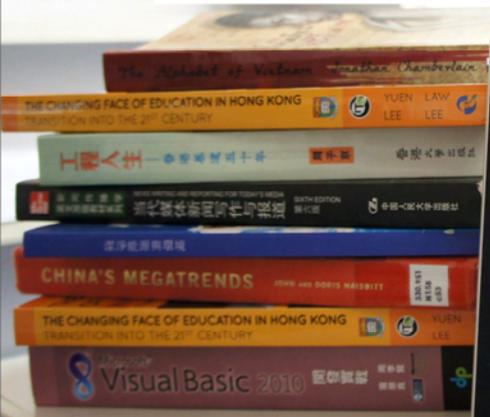
9 Pedagogy Applications

9.1   Introduction

iClass has seven modules: "Drawings", "Keywords", "MC Questions", "E-book", "QR Code", "Web Browser", and "Peer Review", each of which contains interactive functions to help students create freely, express opinions, submit works and share achievements. Lecturers can use one or more functions to develop a wide variety of interactive in-class activities according to the discipline feature, specific topic, learning effect, teaching goal and so on.

In this chapter, we collect some cases and scenarios of applying iClass system to interactivity in six general disciplines. Some are real cases from the current users of the system, the others are simulative teaching plans designed by us. On one hand, we would like to demonstrate the flexibility and feasibility of iClass system, while on the other hand, hopefully these cases and scenarios can initiate more and more educators to try out the system and create their own interactive classes by exploring the potential of iClass.

9.2   Languages Teaching

In Hong Kong, Chinese and foreign languages are the two general categories of this discipline. English is the most prevalent foreign language while learners of other foreign languages have also been increasing. Listening, speaking, reading and writing are the four main aspects of language learning. In this session, we will have a Chinese class and an English class as examples, to demonstrate how iClass encourages student to learn language in interaction, overcoming their shyness and single-mindedness. It should be noticed that these scenarios are not limited to these two languages. Lecturers can have their own modifications according to different subjects and levels of students.

9.2.1   Chinese: Creative Writing and Presentation

Topic	Creative writing: re-write the story of Three Pigs
Targets	Students will finish the composition in class and present their stories to the whole class by group presentation/story-telling. Capabilities of imagination, thinking, organization, cooperation and expression are to be trained.
iClass Functions in Use	Drawing, Peer Review

Lecture Plan:

1. Lecturer uploads the serial pictures of the story via the lecturer's Apps and divides the students into groups in class.
2. Students log in the system with their mobile devices (e.g. laptop, iPhone, iPad and Android smartphones) and enter the Drawing module.
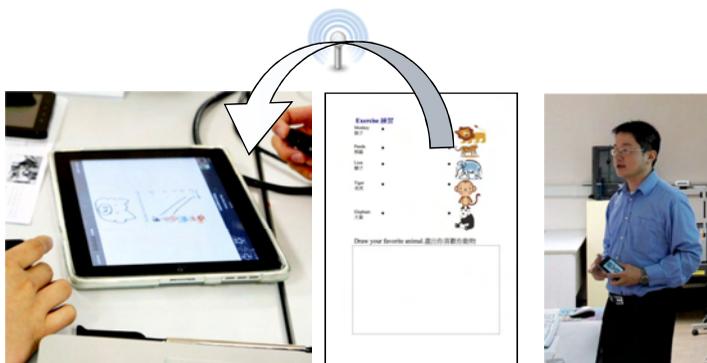
3. Students download the serial pictures from "Drawings" module.
4. Group discussions begin. Students may use "Text" to add new descriptions or lines to the pictures according to the plots re-written.
5. Students may also use "Draw" and "Shape" to edit the pictures.

6. After they finish the stories, students can "Submit" or shake the devices to share with the whole class.
7. Lecturer can view students' assignments via lecturer's App as soon as they are submitted. The new pictures can be shown to the whole class via the projector. Lecturer can invite group representatives to tell their stories.
8. While listening to the story, students can rate it in Peer Review. Lecturer can award to outstanding pieces.
9. If all the tasks cannot be finished in one class, images can be saved for the next class or after-class discussion and rating among students.

9.2.2   English: Synonyms Learning in Compare and Contrast

Topic	Learn synonyms of "happy" through compare and contrast
Targets	Students are asked to raise as many words meaning "happy" as they can, and try to master the accurate use of these words with a comparative approach. Students will have larger vocabulary and use the synonyms more accurately.
iClass Functions in Use	Keywords

Lecture Plan:

1. Lecturer and students log in the system with their own mobile devices.
2. Lecturer uploads the questions to the Keywords module, asking students to come up with at least three different words which mean "happy".
3. Students enter Keywords module, write down their answers and submit.
4. Lecturer can use Bar Chart, Pie Chart, List View or Tag Cloud to show the frequency of each word.

5. Lecturer can, take one step further and ask the students to categorize the words into two groups: "describing human feeling" and "describing nature of an object or an event". Words of the former one are written in the left column and the rest are in the right column on the notebook page in "Edit Area". (This session can be repeated according to different criteria of categorization, e.g. using the multi-column page, emotional degree of the words is from the lowest to the highest from left to right.)
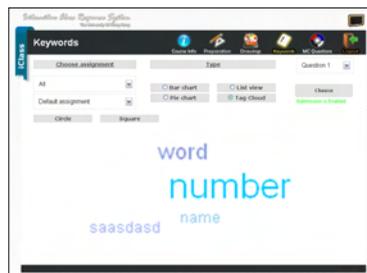
6. Students can drag the notebook page from "Edit Area" and drop it on the "Upload Area" to submit their answers.
7. Lecturer can learn about students' progress according to the statistical results and have tailor-made complements.
8. Lecturer can point out words entailing particular differentiation, e.g. pleased, pleasant, pleasure, and then ask students to make sentences.
9. Students submit their answers. Lecturer can have the sentences on List View and make corrections.

9.3   Fine Arts

Visual art, music, dancing etc. are included within this discipline. Basic knowledge, creation and appreciation are major parts in teaching and learning, which emphasizes communication and interaction between lecturers and students. iClass can provide various facilitations for this. In this session, we will have a creation-oriented class as an example to show how iClass works with such a setting.

9.3.1   Creation-Oriented Visual Art

Topic	How to draw trees
Targets	Through observation and learning the basic drawing methods, students will be able to create their own drawing of trees by the end of the class.
iClass Functions in Use	Drawing, Peer Review

Lecture Plan:

1. Lecturer uploads the e-book pages introducing the drawing of trees in "E-book" module.
2. Students download the pages and practice with "Draw" function.

3. Students can use "Editing" function module to create their own picture freely, with lines or shapes in different colors and sizes. For example, trees in spring are green while trees in autumn are yellow.

4. Students can submit their works to the lecturer and share with their peers.
5. Students can view other students' works via "Peer Review" and rate.

9.4   General Sciences

This discipline includes math, physics, chemistry, biology etc. Traditionally, lecturers often use graphics and images to help students understand abstract concepts, and train themselves to express their concepts with graphics and images. iClass can synchronize these two processes and shorten the time for the lecturers to learn about the student's levels. Moreover, it can make the subject more interesting in interaction. We will have examples of a mathematics class, a physics class and a biology class in this section.

9.4.1   Mathematics: Geometry

Topic	Angle and degree
Targets	Introduce the concepts of "angle" and "degree" to students. They will learn different types of angles, drawing methods of angles and measurement of their degrees.
iClass Functions in Use	Drawing, MC Questions, Web Browser

Lecture Plan:

1. Lecturer uploads images needed, such as horizontal line, right angle, straight angle etc.
2. Lecturer uses "Drawings" module and projector to introduce the concepts of angle and degree by showing the sample images.
3. Lecturer introduces the categorization of angles and tests the students with MC Questions.
4. Students use "Drawings" module to draw different angles according to lecturer's instruction. Lecturer can view their works and do correction as soon as they submit.
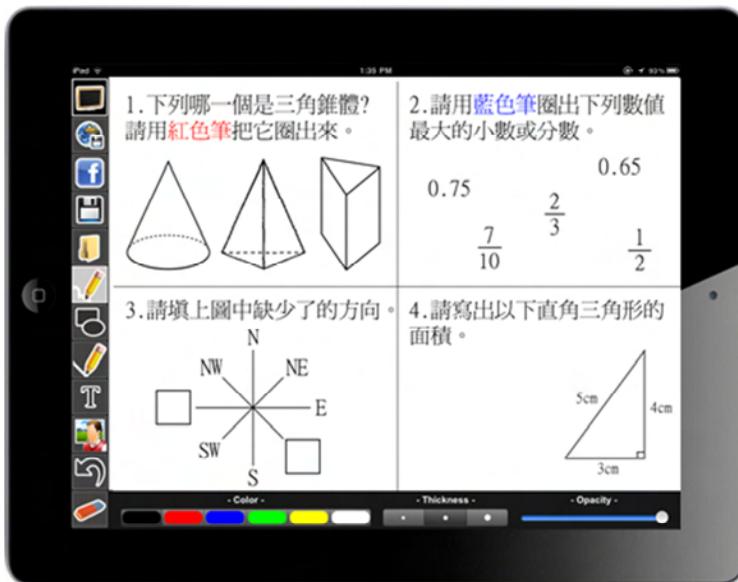
5. Lecturer demonstrates measurement of angles with sample images
6. Lecturer tests the students about measurement with "MC Questions", and can learn about the accuracy rate immediately.
7. Lecturer can award "Stickers" to outstanding pieces of work.
8. In Web Browser module, lecturer can provide links to education websites containing after-class exercises for students

9.4.2   Physics: Circuit Diagram

Topic	Basic Circuit Diagram
Targets	Students will learn to draw basic circuit diagram and practice according to the lecturer's instruction. They will also learn about the calculative relationship among current, voltage and resistivity.
iClass Functions in Use	Drawing, Keywords

Lecture Plan:

1. Lecturer uploads the symbols of electric parts needed for the diagram as "Stickers" and sample circuit diagrams as "Images".
2. Students download the same diagrams and learn about the drawing methods.
3. Lecturer gives instructions and students use the parts in "Stickers" to draw their diagrams. For examples, a circuit that has two light bulbs on together, or a circuit that can never has two light bulbs on together.
4. Students can "Submit" and "Share" their finished assignments. Lecturer can correct them immediately and award "Stickers" to outstanding pieces.
5. Lecturer can demonstrate the calculative relationship among current, voltage and resistivity with sample diagrams.
6. Students can do their calculation in Keywords module and share with their classmates.
7. Lecturer can learn about the correct rate and students' progress immediately, based on which lecturer can give complements.

9.4.3   Biology: Cell Structure

Topic	Structure of animals' and plants' cells
Targets	Students will learn about the different structures and components of animals' and plants' cells. They will compare and better understand the differences of structures and functions.
iClass Functions in Use	Drawing, Keywords

Lecture Plan:

1. Lecturer uploads the structure diagram of two cells as "Image" and name tags of different components as "Stickers".
2. Students download the images and put the name tags next to the corresponding components on the images.
3. Students can submit their answers when they finish and share with their classmates. Lecturer can view their answers immediately and award "stickers" to outstanding pieces.
4. Lecturer can continue with the "Drawings" module, with components in one column and functions in the other and ask students to match them.

5. Lecturer can ask students to have a group discussion to compare the structures of the cells and then explain the differences of functions in correlation to the needs of survival of animals and plants. The results of discussion can be submitted in forms of keywords.
6. Lecturer can use List View or Tag Cloud to show the discussion results and ask group representatives to give presentations.

9.5 Liberal Studies

With the further development of knowledge-and-information society, liberal studies have become more important in today's world. Since 2009, liberal studies have become a compulsory subject in the New Academic Structure. Curriculum Reform in tertiary institutes also puts more emphasis on "core course" similar to liberal studies. With six units, liberal studies require students to remember large amount of information, and meanwhile to think independently and critically and express their personal opinions upon certain topic. Obviously, this discipline is supposed to be inspiring, interactive and interesting. iClass is a very good choice of facilitator. This session will take a class in the unit of "Modern China" as an example.

9.5.1 "Modern China"

Topic	Chinese geography
Targets	Students will have basic knowledge of Chinese geography, be able to remember some names of mountains, rivers, plains, and basins etc., as well as locations of provinces and cities. Cultural features of ethnic minority areas will also be mentioned and discussed.
iClass Functions in Use	MC Questions, Keywords

Lecture Plan:

1. Lecturer can design MC Questions according to the course content, for example: which is the biggest basin of China?

2. Lecturer can integrate some photos of ethnic minorities into MC Questions, asking students to choose the right people.
3. Lecturer can provide the map of a landscape and then ask students to write down the relevant geographical structures or names of provinces/cities or the climate features of the area.
4. Students can drag their answer sheet from "Edit Area" to "Upload Area" and submit their answers.
5. With the two modules, lecturer can have the correct rate immediately so as to decide the teaching speed.
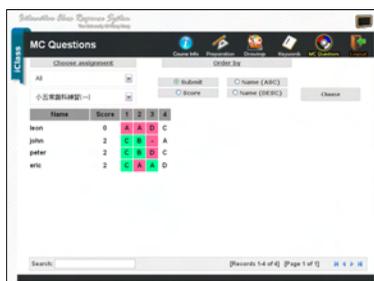
9.6   Tests and Assessment

Besides facilitating interactive in-class teaching, iClass can also help in routine tests and performance assessments. With this system, tests no longer rely on paper and pen but enter a multimedia world where they can

examine the progress of students from various angles with text, sounds and images. Mutual assessments between lecturers and students can also be done more frequently with less time and man-power, which is convenient for the lecturers to adjust the teaching methods. In this session, we will have examples for both to illustrate.

9.6.1   Chinese Unit Test

Targets	Testing how much the students remember and are able to use the words taught in this unit appropriately. Testing how well the students master the correlatives. Testing the capabilities of reading and writing according to pictures.
iClass Functions in Use	MC Questions, Drawing, Keywords

Test Design:

1. Have dictation with "Keywords" module.
2. Ask students to choose the right word to fill in the blanks in "Keywords".
3. Ask students to choose the right correlatives to fill in the blanks in "Keywords".

4. According to text given, ask students to draw out the scene described in "Drawings" module.
5. According to the text given, ask students to capture specific

information and finish MC Questions. Also, asks students to answer questions about their understanding of the text in "Keywords".
6. Use "Drawings" and "Keywords" to compose an article according to the picture given.
7. Students may use "Save" and "Modify" to check their answers. They can decide when to submit the paper before the end of the test.

9.6.2   Mid-Term Mutual Assessment

Targets	Lecturers will assess the learning performance, extra-curriculum performance and conducts of students. Students will assess the teaching methods and effect of lecturers.
iClass Functions in Use	MC Questions, Keywords

Assessment Design:

1. In "MC Questions", choices can be made into credits e.g. A for 1 credit and D for 4 credits. Both lecturers and students can rate an item by making a single choice.
2. Items of assessment are designed by the school. Lecturers and students can start the assessment as soon as they log in the system.
3. Statistics will be accumulated until the deadline of the assessment. Results can be released right after the deadline. Director of the assessment can modify the setting and decide whether to share the results online or not.
4. Besides assessing by rating, students and lecturers can write down opinions or evaluations for specific people on Keywords and submit directly to these people.

9.7   Out-of-Classroom Activities

Besides routine teaching and learning assessments, all kinds of in- and out-of-classroom activities are organized to make campus life more interesting and inspiring, which is consistent with the concept of edutainment. These activities have strong emphasis on interactivity in the hope of getting rid of rigid lecture mode so as to enlarge students'
126

knowledge, expand their horizon, and cultivate healthy hobbies. In this aspect, iClass has its real application in Pui Ching Middle School in Hong Kong. We will also raise some scenarios for reference.

9.7.1   "Eye on the World" Mobile Quiz Game

Ma Hoi-hung, Head of Information Technology Department, Pui Ching Middle School introduced how they used iClass system in campus to the reporter of China Daily. The School has a daily activity named "Eye on the World" when news clips broadcasting on campus TV and students are asked to answer related questions on their mobile phones. Students will be scored in their web-based study performance system.

9.7.2   Encyclopedia of Plants in Campus

In science classes, students of Pui Ching sometimes have walking tours around campus, during which they can check out the plants they encounter by taking photos of the QR codes on the tree's name tag and accessing Wikipedia via campus-wide Wi-Fi.

9.7.3   Debate Interest Group

With multi-column page of Keywords module, members of the group can have brainstorm upon certain topic, listing points of both sides for discussion. The free-to-write e-page allows students to note down their mind map without limits of real papers. According to the opinions listed, group members can have mock-debate exercise. They can also read their group-mates' opinions through Peer Review to maximize the coverage of their thinking.

9.8   Summary

This Chapter introduces iClass applications in six general disciplines

including real cases and scenarios designed by system developers. This aims to demonstrate how to implement iClass into routine classroom teaching to create inspiring and interesting interactive class by using one or more functions. It's our sincere hope that educators can contribute to the adaptation and innovation of the system by exploring its potential in everyday use which will improve iClass to better cater the practical needs of education.

Section 4: Case Studies

10 Case Studies in the HKU

Dr. Wilton Fok,
Department of Electrical and Electronic Engineering
Dr. Kenneth Wong,
Department of Electrical and Electronic Engineering
Dr. Jacqueline Lam,
Kadoorie Institute
Dr. James K.H. Tsoi,
Faculty of Dentistry

iClass was first developed for the enhancement of teaching and learning in the university of Hong Kong as a Teaching Development Grant project. A few departments and faculties in the University started using iClass in the first semester in 2010/11. These departments included the Department of Electrical and Electronic Engineering, Department of Statistics and Actuarial Science and the Faculty of Dentistry. The performance of the system was good and many positive feedbacks were received from teacher and students.

10.1 Pilot in the Engineering Summer Program

Dr. Wilton Fok, Department of EEE

In the Engineering summer program ENGG1901 Engineering the Climate Change, students are required to design and build a solar water distiller using some simple raw materials such as aluminium fold, plastic board and glass. The objective of this exercise is to train the students' creativity and inspire them how solar energy can be applied. Students form groups and they first design and then build the structure. When their solar water distillers were produced, their products were tested under the sun light and the effectiveness of their designs was measured.

After this practical session, students went back to a classroom and the debrief session began and iClass was used. Each group was required to use the iClass Drawing module to draw their design on an iPad. They were very series and had applied many features in the Drawing module such as line, text and shape and produced some innovative and inspiring drawings.

When these drawings popped up on the screen, the lecturer Dr. Wilton Fok then ask a representative from each group to present their design. With their drawings being posted on the screen in real-time, students could share their ideas and inventions with their classmates in a more effective way. After the presentation, they use the "Peer Review" function to view the designs of other groups, rate and add comments to their works. Students could learn the merits from one another and avoid following the same trap.

In this summer course, there were many overseas students from US, UK, Australia, Italy, Korea and so on joined the course. It was their first time when many of them use iClass for interactive teaching and learning.

Comments from the students were in general very positive.

Mr. Aaron Morellini, third year Italian student from the University of Technology of Sydney: "I am so excited about it. It is such an incredible way to learn... it turns lectures into game shows". Another overseas student from the United Kingdom Mr. Robert Deans commented "The app is more convenient because students can do the work using a mobile device such as an iPhone." Ms. Hayley Lau, a first year HKU student: "It is amazing to see our drawings on the screen right after we click the submit button. Without iClass, lectures can be very boring. We just sit there, look at the slide presentations and listen to the lecturer talk for hours. Now I can stay active with a gadget to express my ideas. Every course should use it."

Now I can stay active with a gadget to express my ideas. Every course should use it

I am so excited about it. It is such an incredible way to learn... it turns lectures into game shows.

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It is amazing to see our drawings on the screen right after we click the submit button. Without iClass, lectures can be very boring. We just sit there, look at the slide presentations and listen to the lecturer talk for hours.

10.2   iClass Button for a Common Engineering Course

Dr. Kenneth Wong

Department of Electrical and Electronic Engineering

The iClass Button system was used in a common core course at the University of Hong Kong. Dr. Kenneth Wong Kin-yip, an Associate Professor of the Department of Electrical and Electronic Engineering in the University of Hong Kong found the MC Question module of iClass especially useful in testing students' understanding of complicated concepts and problem-solving process. In comparison with the Clicker system, iClass system with pre-installed buttons on chair arms is more convenient and user-friendly in class.

"Students always say they do understand after the illustration of a complicated concept in class. How can we know the level of understanding?" said Professor Wong, "the simplest way is to have a test." In the class of ENGG1015 Common Engineering, students are usually more concentrated and interested when it's time for an iClass quiz.

Twice or three times will the MC Question module of iClass be used in one class on average with two to three questions each time. As Professor Wong designs, the first question is to warm up, the second one is to tackle a complex concept while the third one is a follow-up.

An example is the learning of digital logic and logic expressions. If students fully understand and master the logic rules, they can get the briefest expression. Professor Wong said, "I am not giving three random

answers and one correct answer for a MC Question. I usually think about in what ways students often mistake the rules and what answers they will get from these common mistakes. The three incorrect answers will correspond to these mistakes." When each of the answers has similar numbers of supporters, Professor Wong knows it's a well-designed question.

Figure 10-1 Students can pick their answer by pressing the buttons on the armrest

The automatic statistics collected and presented with diagrams by iClass help Professor Wong locate students' common mistakes therefore he has a clear picture of students' progress, namely the concepts that are not well received or certain steps in a problem-solving process that are often misunderstood.

In the other course, CCST9015 Electronic Technology in Daily Life, taught by Professor Wong, the same MC Question test cannot be conducted as well as in ENGG1015. CCST9015 takes place in Chow Yei Ching Lecture Theatre A, facilitated by the Clicker system. To conduct the MC Question test in class, Professor Wong has to borrow the equipment from department office, hand out the devices to students,

install the system in his computer and collect the devices at the end of class. "It's pretty inconvenient and sometimes the system doesn't work well," said Professor Wong, "a technician is needed to be with us from time to time."

Figure 10-2 The iClass button teacher console. The students' answers can be displayed on the teacher console

In contrary, ENGG1015 uses iClass system in Lecture Theatre C, where buttons are pre-installed on the chair arms. As long as Professor Wong and his students log in iClass, students can answer the MC Questions by pressing the buttons while no devices need to be handed out and later collected, which saves time and increases efficiency.

Some feedbacks were collected from students who experienced iClass Button.

I think that the Interactive Classroom Response System can help to improve teaching and learning quality.   This system provides an opportunity for every student to answer the questions. Answering the questions can provide interaction and keep student to be concentrate.

It's a good way to let students and lecturer to know students' learning progress. Although lecturer did try to ask questions in the past without using this Interactive Classroom Response System, students are usually too shy and reluctant to answer them. This system is a good way to encourage students to give response to the lecturers.

The system can count the number of correctness of each student. Students can compare their performance with the others and understand their own weakness.

In the last lecture, we used the system to answer the MC questions from last year exam paper. Facing large amount of questions, lecturer can know exactly the studying progress of students and explain the answers according to students' performance which provide a tailor-made and effective teaching method.

10.3   When Technology Meets the Role of iClass in Collective Learning and Consensus-based Capacity-Building

Dr. Jacqueline CK Lam[*] and Dr. Wilton Fok[#]
[*]Kadoorie Institute, HKU, [#]Department of Electrical and Electronic Engineering,
The University of Hong Kong

Most environmental and sustainability (E/S) challenges, e.g. air pollution and climate change, are highly interdisciplinary, complex, real-life and context-specific (Lam, Walker and Hills, 2011). Because of the multi-faceted nature of environmental/sustainability (E/S) challenges and their underlying complexities and uncertainties, it is highly difficult, if not totally impossible, to develop simple solutions. Solving real-life and context-specific problems such as climate change are highly dependent on the collective inputs of individual stakeholders and their consensus. The essence of environmental/sustainable (E/SB) education is therefore to expose students to the wide range of environmental controversies and solutions, to develop collective learning and consensus-building capacities, and to equip them to become the future leaders in the field of E/S. Given such a background, enabling technologies in the form of an interactive classroom system - the iClass system - that provides a dynamic platform to engage students in real-time, interactive discussion and debates, could make an important contribution to E/SB education. With functions such as drawing, keyword, and rating etc, iClass shortens the feedback loops and facilitates interaction and participation. It builds

up the student's collective learning and consensus-building capacity in tackling highly complex interdisciplinary environmental challenges.

iClass was introduced in a special lecture series titled "Technology, Society and the Environment" in the course "ENVM 7016 Environmental Policy", co-taught by Dr. Jacqueline Lam, the Course Organizer, and Dr. Wilton Fok, the Guest Lecturer. It was offered to part-time students in the Master of Science Programme in Environmental Management. The programme aims at providing students with the basic understanding of the relationship between technology, society and the environment. The first lecture focussed on the key (positive and negative) impacts that technology will bring to the society and the environment, and vice versa; the second one brought forth the idea of transition management and ways to steer the society to transit to low-carbon energy and transport in practice. iClass was used before the delivery of lectures in each class.

In the first lecture, students were asked to share their views, via the iClass system, on how new environmental technologies can solve some highly complex and interrelated environmental challenges in connection with climate change. The visualization and rating features significantly shorten the feedback loops. Collective learning and consensus-building have been enhanced as a result.

The visualization function allows all creative ideas to become visualized in individual iPad screens as well as the central lecture screen, which greatly facilitate the exchange of ideas in and between groups. Four to five students were invited to form a group to discuss how the climate change challenge can be tackled technologically. They were asked to draw pictures to express their ideas. With its visualizing function, students could express their group ideas quickly visually, engage in debates and discussion, and provide instantaneous feedback to other groups' findings, through real-time transfer of all group findings back to the centralized system (see Figure 10-3). A wide range of climate change

technological solutions was put forward by different groups of students, ranging from renewable energy technologies to carbon capture and sequestration; from individual innovation such as generation of biofuels to systemic and integrated innovation, to facilitate further discussions.

The rating feature enables students to easily vote for the solutions that they think are the best. One group that won the highest rating suggested that an integrated green energy and transport system, in combination with more sustainable living, will offer the needed strategy to combat the climate change problem. On the one hand, green energy technologies such as solar and wind technologies can generate electricity and reduce carbon emissions; on the other hand, replacing car-driving with biking will significantly reduce emissions and promote more sustainable and healthy living. The rating ensures that the most or least supported options can be easily identified. Further investigation into why one option is preferred over the others can be followed up subsequently.

To combat climate change problem, it is vital to look at non-technological policy solutions. The acceptance of policy options is context-specific and case-dependent. For instance, what has been considered an effective climate change strategy in some countries, such as carbon tax, can be taken as highly unacceptable by societal stakeholders in some other places. Stakeholder engagement and consensus-building are needed to build trust and derive the most commonly agreeable solutions to enhance policy effectiveness and legitimacy. Equipping students with the capacity to discuss and build consensus constitutes an essential part of E/SB education. The process can be accelerated by the iClass interactive system that provides a common platform to achieve the purpose. The keyword function is designed to invite input keywords to summarize a wide range of management and policy options generated by the groups. After capturing the keywords, the iClass system can re-group keywords systematically, facilitating the consensus building process. During the first lecture, students were asked to input their non-technical solutions to

climate change in the form of keywords. A wide range of policy options ranging from laws and regulations including emission targets, caps and charges, to incentive-based policies such as subsidies, and economic policies such as carbon taxation were provided subsequently (see Figure 10-6). The rating feature displayed what most of the groups considered the most effective (economic - tax and subsidies) and the least effective (voluntary – education or planning) policy options. The preferences were presented in bar chart, pie chart, tag cloud, or list view displays (see Figure 10-5). The lecturer then further adjusted the keyword grouping (see Figure 10-7). The generalization of individual, diverse opinions, and the identification of mainstream opinions (economic and regulatory policy options) to facilitate consensus-building, can be made possible.

In conclusion, the interactive iClass system creates a facilitating learning environment to stimulate idea generation, sharing, refinement and consolidation. First, students are able to explain their ideas and concepts visually through drawings and keywords. Second, the technology allows students to provide real-time, instantaneous feedback to ideas posed by other groups of students. It speeds up the process of knowledge sharing and facilitates debates and discussion among students as well as the lecturers (see Figure 10-4). Third, the interactive, engaging and collective learning process sharpens the students' critical thinking and strengthens their capabilities to understand and appreciate the views of others. Through the process, further refinement of ideas and consensus-building can be made possible. Such process is particularly important for handling highly complex and interdisciplinary environmental issues such as climate change, as many different types of innovative solutions to solving a complex environmental problem can be generated through the collective inputs of different groups of students. After all, E/SB education is about capacity-building – to help future environmental leaders identify critical challenges to E/S, to build consensus among stakeholders in the society, to develop the most effective solutions and to lead the society and its people towards a more sustainable trajectory. Along this direction,

iClass can contribute greatly in E/SB education.
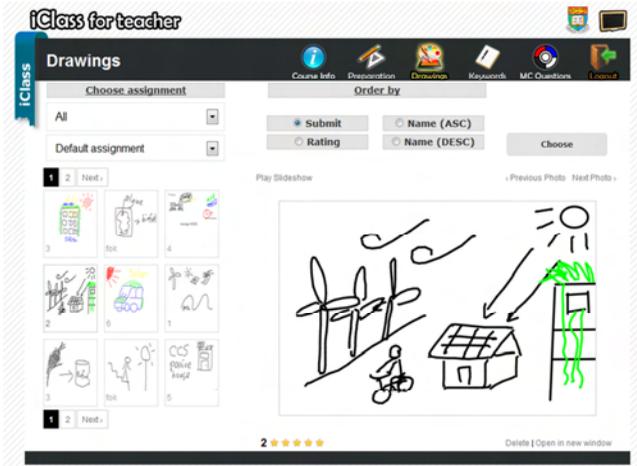
Figure 10-3 A Mushroom of Ideas Generated from iClass Methodology

Figure 10-4 A student explaining their group's idea on how an integrated renewable energy system can offer a good solution to addressing the climate change challenge
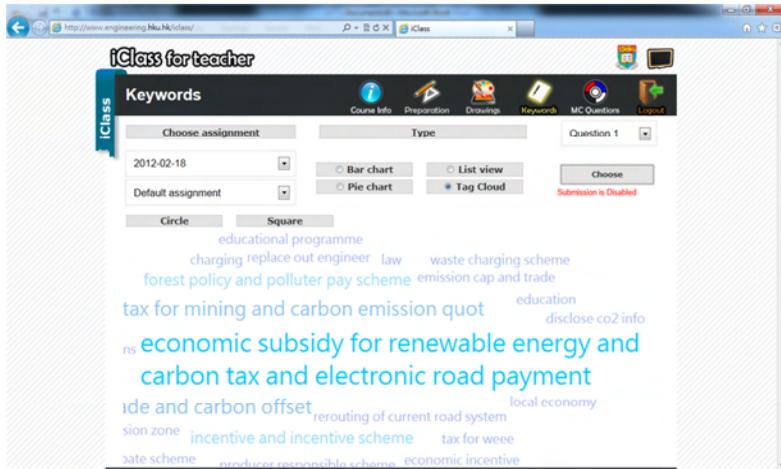
Figure 10-5 Keyword function which allows the display of different policy options to combat climate change in tag cloud, bar chart, pie chart and list view formats
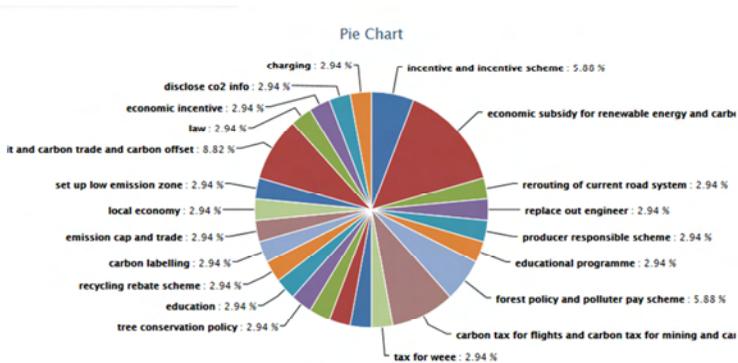
Figure 10-6 The ideas generated by students are highly distributed and diversified before regrouping.

charging : 2.94 %

disclose co2 info : 2.94 %

law : 2.94 %

set up low emission zone : 2.94 %

local economy : 2.94 %

incentive and incentive scheme and economic subsid

...on offset and emission cap and t : 14.71 %

rerouting of current road system : 2.94 %

replace out engineer : 2.94 %

producer responsible scheme : 2.94 %

educational programme and education · in part

...bate scheme and economic incentive : 5.88 %

...bon tax for mining and carbon emission quot : 8.82 %

simple life style · comsumption tax · change our values and forest

Figure 10-7 Regrouping allows the mainstream opinions to stand out to facilitate consensus-building

Reference:

Lam, Jacqueline, Richard M. Walker and Peter Hills (2011) 'Interdisciplinarity in Sustainability Studies: A Review', *Sustainable Development*, DOI: 10.1002/sd.533

10.4 Using iClass as a tool for Journal-based Learning (JBL) in teaching Dental Materials Science at MSc Level

Dr. James K.H. Tsoi, Faculty of Dentistry

Understanding dental materials is crucial to successful clinical dentistry and those who work in biomaterials business. This one year full-time course, MSc in Dental Materials Science, MSc(DMS), is a taught postgraduate course organized by the Faculty of Dentistry and recognized by the Hong Kong Dental Council. This modern cross-disciplinary course was introduced in 2009, directed by Dr Jukka P. Matinlinna, Associate Professor, Faculty of Dentistry, HKU, and coordinated by Dr James K.H. Tsoi, Lecturer, Faculty of Dentistry, HKU.

Journal-based Learning (JBL) is one of the learning modes in the MSc course. The traditional mode of JBL is: Students are expected to read and study some prescribed journal articles on specific topics, and discuss among themselves along with the facilitation provided by knowledgeable and experienced facilitators during the tutorial lessons. Various journal

articles may have various arguments, views and discussion points, that the students may not have enough knowledge to justify which one is correct and vice versa. Thus, the role of facilitator becomes very important to assist in the justification and help to direct a right way for discussion. Hence, two interactive objects are identified that are important in the JBL discussion: student-to-student (SS) and facilitator-to-student (FS). Therefore, to enhance the interactivity in these objects, we have adopted iClass as our learning tool which seem to improve the interactivity, and successful results and constructive comments were obtained.

We run the tutorials at the following setting:

1. Students size: < 10;
2. Journal articles: pre-selected from facilitator and each student is distributed with 2 different journal articles to read before the lessons;
3. All students are equipped with iPhone/iPad with iClass apps.

iClass has a "Keywords" function that can provide a platform letting the students to input and express their views on present questions, which are carefully selected and pinpointed to the topic. After the inputting, the facilitator can group the similar opinion (Figure 10-1 8) and start the discussion. The grouping function is very useful as it gather the journal articles' information together (contributed from the students) and the facilitator is grouping the information. During the grouping, the facilitator keeps the mind-exchanging with the students (FS interaction) to illustrate *e.g.* why the points are being grouped. After that, various grouped keywords are being discussed among the SS group (SS interaction). The 'Keywords' function is simply like a mind- and information-mapping tool, that coined facilitator and students mind, knowledge and information together. With iClass, the FS interaction becomes much more obvious, which makes the facilitation easier. Students are also allowed to explain/defence their 'Keywords', so SS interaction is clearer among students.
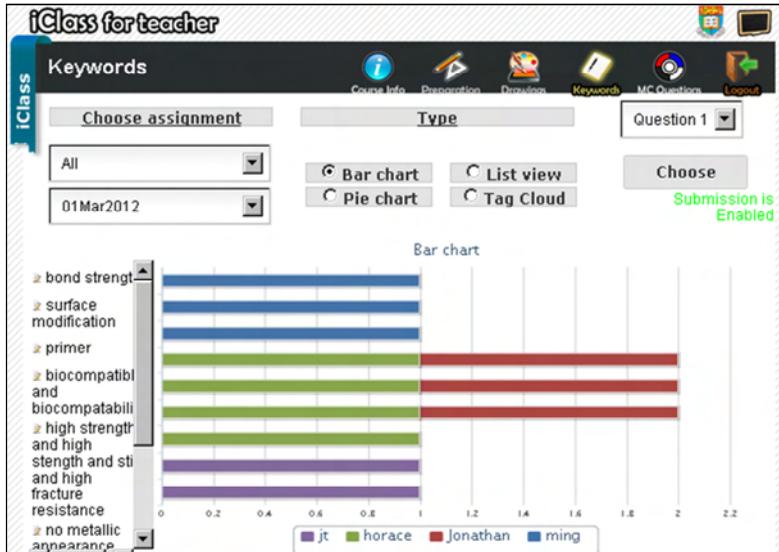
Figure 10-1 Example of 'Keywords' function used in tutorial class

Another feature is 'Drawings'. Facilitator is pre-loaded some pictures, which are erroneous and downloaded from some journal/book articles, and the students are required to identify the 'problems' of the pictures. Students can draw on the pictures (Figure 10-2 9) to point out the problem, and upload it to the server. Then, all students are allowed to review others' pictures according to facilitator's instruction. All students are able to identify the error and problems in the pictures. In the traditional mode of learning, such an error identification exercise is homework, with unidirectional FS interaction (either facilitator-to-student or student-to-facilitator). With the aid of iClass, SS and FS can be done in parallel. FS or SF is synchronic interaction at this case.

Figure 10-2 "Drawings" in iClass during the tutorials

To conclude, iClass is a powerful and useful teaching tool in dental subjects. It might be also useful to utilize other function such as 'MC' and 'eBook' in the future, especially for undergraduate students. Although facilitator may need some extra time to prepare the materials and well-equipped so as to interact with the students, this is worthwhile and beneficial to both parties. More investigation should be stressed not only on the apps functions, but the pedagogy of the apps teaching, the integration to curriculum, and the adaptability to the students and teachers.

11 e-Learning for Problem Based Learning at the Faculty of Dentistry

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Dr. Peter CS Tsang, Prof. Colman McGrath, Prof. Edward Lo,
Prof. Lakshman Samaranayake,
Faculty of Dentistry, The University of Hong Kong

11.1 Introduction

This collection on a new era of e-learning for the new curriculum provides a forum for the exchange of ideas and innovations in the area of educational technology and higher education, specifically in the areas of mobility and interactivity. The purpose of this contribution is to share the development of one project in the Faculty of Dentistry, The University of Hong Kong that has supported a re-thinking of resourcing for problem-based learning (PBL). In what follows, we describe the process of change prompting curriculum development and discuss the intended impact on student learning in the undergraduate curriculum.

Since adopting a student-centred, integrated, problem-based curriculum in 1998, the Faculty of Dentistry has become recognised regionally and internationally as a leader in dental education, particularly in the field of problem-based learning (PBL) (McGrath, 2006; Winning & Townsend, 1998). In preparing for educational reform in the Hong Kong Special Administrative Region (HKSAR), and for the new 2010 and 2012 curricula, the faculty has decided to build on this model of integrated, interdisciplinary inquiry. One way forward has been to critically re-examine the role of technology for problem-based learning.

A challenge for all curriculum designers in higher education has been to examine how best to harness and infuse the technological affordances of educational technologies and Web2.0 developments to enhance educational experiences and support the attainment of student learning outcomes. The distance education and open learning models from Australia and the UK initially created systems to support learning outside the traditional face-to-face models in higher education. For curricula adopting small-group, inquiry-based pedagogies, these Learning Management Systems (LMS) and new forms of digital resources have been readily adapted to support independent learning between tutorials. The challenge is to examine how best to support learning within the face-to-face tutorial. For PBL in Dentistry, the initiative taken was to embed educational technologies across the existing tutorial structure (see Figure 11-1).

Figure 11-1 2010 Problem cycle (Dentistry, HKU)

(For a more comprehensive description of PBL in Dentistry see: http://facdent.hku.hk/docs/PBL_FacDentHKU_2008.pdf)

11.2 A Blended Approach to PBL

While higher education in general is facing a global call for change towards more interactive and student-centred pedagogies, the way that knowledge is perceived is also fundamentally changing. Given that one of the educational rationales for the original introduction of PBL was to support learners in building reasoning skills to handle an ever-growing, dynamic body of knowledge (Hmelo-Silver & Eberbach, 2012), we have argued elsewhere that "the educational rationale for PBL may be even more cogent today than when the approach originated over 40 years ago" (Bridges, Whitehill, & McGrath, 2012, p. 226).

Another area of concern for many higher education curriculum leaders is how to design programmes that engage the current generation of technologically-connected learners, often referred to as the Net Generation (Bonk, Kim, & Zeng, 2008). These students arrive on campus with various skills in networked environments. In particular, the most

recent wave of students are increasingly engaged in real-time technologies from blogs and instant messaging to social networking websites such as MySpace, Facebook, and file sharing programs etc. Blended learning has been suggested as a way forward in engaging these younger, "tech savvy" learners. In its simplest of definitions, blended learning is seen as the principled combination of face-to-face and online learning. The challenge is how these hybrid models can be structured coherently to enhance student learning thereby avoiding the trap of using technology as a novelty "add-on". A review by Vaughan et al (2007) on studies in higher education found that across the broad spectrum of approaches offered, blended learning encouraged new methodological approaches. Importantly in terms of implications for curriculum renewal and development as well as the sustainability of educational innovation, they found that in the process of experimentation with education technology, motivation increased not only amongst students but also amongst academic staff.

In preparing for the new, extended 2012 undergraduate curriculum and the younger student cohort, the Faculty of Dentistry's undergraduate curriculum development team has sought to respond to new ways of thinking about learners, learning and learning spaces whilst consolidating upon our interactive approach to pedagogy (i.e. small group, inquiry-based). One way forward has been to blend virtual and face-to-face learning opportunities while remaining cognizant of the University of Hong Kong's three guiding principles of curriculum design: structure of experience; continuity of experience; and coherence of experience.

11.3   Enhancing Educational Practice

Central to a student-centred approach is the constructivist focus on student engagement and interactivity through collaborative inquiry (Hmelo-Silver, & Barrows, 2008). Initially, "electronic printboards" were installed to support the PBL tutorial process (identifying facts, ideas,

learning issues etc) (Barrows, 1998) and for recordkeeping. The written summary was then printed as a hard copy and distributed amongst the group members.   Since the introduction of a Web-learning Centre (WLC) utilising the university's Learning Management System (LMS) in 2005-06, online learning resources have grown and expanded, including creation of original content and learning activities by Faculty members. This establishment of a web-learning centre was an important first stage in re-designing online resourcing for a PBL curriculum; however, these resources were accessed asynchronously by students using the LMS during independent, self-directed learning sessions between tutorials (see Figure 1). While beneficial as a resource for post-tutorial reflection and research as well as online discussion with tutors, there was an opportunity to further build on this model of asynchronous interaction for problem resourcing. The logical next stage was to not only continue to develop more digital materials and online learning support, but also to capitalise on these resources by enhancing student engagement and learning within the face-to-face tutorials. The ultimate goal, therefore, was to expand the blended approach to e-learning by introducing the *synchronous* integration of educational technologies within face-to-face tutorials through the introduction of Interactive White Boards (IWBs).

In considering spaces of learning, the adoption of a blended approach using Interactive White Boards (IWBs) has introduced innovations to the existing small-group learning in PBL tutorial rooms. While IWBs have been popular in the K-12 years of education, particularly in primary schools, their adoption in higher education has been slower. A recent review (Higgins, Beauchamp, & Miller, 2007) proposed that

"The use of the IWB may be the most significant change in the classroom learning environment in the past decade and the relationship between multi-modal pedagogy, multi-modal technologies and gesture as part of our communications armoury is an emerging and increasingly investigated area of research into teaching and learning."

A critical issue at any level of education is, then, the interface between the pedagogy and the technology in enhancing student learning outcomes.

The intention, therefore, has been to enhance the problem-based aspects of the curriculum with a focus on heightened technological interactivity during face-to-face tutorial interactions. In the 2009-10 academic year, interactive white boards (IWBs) were installed alongside the existing printboards. In this most recent development in PBL at the Faculty of Dentistry, we have, therefore, moved away from the first-stage "digital repository" approach where student engagement with the available online resources

was out-of-step with the face-to-face knowledge co-construction process during tutorials.

Important for health sciences curricula in general, and dentistry, in this particular instance, is the role of visual representations and their interpretation in the learning process. Initial practice within tutorials was for students to share printed photographs and radiographs across a table. As one of the guiding principles is that the problem itself is the starting point for the process, these resources were then made available in the LMS as scanned images released after the first tutorial.

Improved wireless connectivity in ensuing years saw an increase in student usage of personal devices, mainly laptops, in tutorials. Concurrently, new types of problems were being created with different multimedia. In other health sciences curricula, new media in the form of video stimuli or "triggers" were introduced and found to be of additional benefit for case presentations and to stimulate tutorial discussions (Chan et al 2010). However, in observing the tutorial process at this time, a possible limitation of laptop usage was noted with a potential for tutorial discussions to fracture as students variously accessed the online materials via their smaller, individual screens. With the more recent installation of IWBs in each tutorial room, students have been able to interact with large-scale visualisations, increasingly of video and 3-D animations. This ability to not only project but also manipulate and annotate larger images is particularly relevant with scientific and clinical resources that are naturally "micro" in size. Shared viewing, enlargement and manipulation of these digital objects have supported whole group analysis and engagement in the learning process. Evaluation has indicated that the use of IWBs in the dental curriculum has supported a seamless integration of face-to-face teaching and online support (Bridges, Botelho, & Tsang, 2010). Usage reports indicate the highest uptake of IWB technologies to be in the earlier years of the curriculum. This is logical given the higher amount of PBL in the early years of the 5-year curriculum and the dedicated technical support provided for first-year

academic induction.

The introduction of IWBs has provided the necessary infrastructure for real-time, large screen engagement with not only in-house digital resources but also open access resources such as animations, videos and critical thinking software such as concept mapping tools (Novak & Cañas, 2008). Correspondingly, the number of digital materials uploaded to the Learning Management System (LMS) has grown, particularly in terms of video content as academic staff develops an ever-expanding bank of digital learning objects and online resources for a digitally-engaged generation of undergraduates. This blended learning project for undergraduate dentistry engaged with undergraduate curriculum reform by supporting critical intellectual inquiry for a problem-based pedagogy. The Faculty of Dentistry's e-learning strategy aims to facilitate a more interactive approach to resourcing PBL and engaging undergraduate student learners in a new era of e-learning.

References

o   Barrows, H. S. (1988). *The tutorial process*. Springfield IL: Southern Illinois University Press.

o   Bonk, C. J., Kim, K., & Zeng, T. (2008). Future directions of blended learning in higher education and workplace learning settings. In C. J. Bonk & C. R. Graham (Eds.), Handbook of Blended Learning: Global perspectives, Local Designs. San Francisco, CA: Pfeiffer.

o   Bridges, S., Whitehill, T. L., & McGrath, C. (2012). The Next Generation: Research Directions in PBL. In S. Bridges, C. McGrath & T. L. Whitehill (Eds.), Problem-Based Learning in Clinical Education. (pp. 225-231): Springer: Netherlands.

o   Bridges, S. M., Botelho, M. G., & Tsang, P. C. S. (2010). PBL.2.0: Blended learning for an interactive, problem-based pedagogy. *Medical Education, 44*, 1131.

o   Chan, L. K., Patil, N. G., Chen, J. Y., Lam, J. C. M., Lau, C. S., & Ip, M. S. M. (2010). Advantages of Video Trigger in Problem-based Learning. *Medical Teacher, 32*, 760-765.

o   Higgins, S., Beauchamp, G., & Miller, D. (2007). Reviewing the literature on interactive whiteboards. *Learning, Media and Technology, 32*(3), 213 - 225.

o   Hmelo-Silver, C. E., & Barrows, H. S. (2008). Facilitating collaborative knowledge building. *Cognition and Instruction, 26*, 48-94.

o   Hmelo-Silver, C. E., & Eberbach, C. (2012). Learning Theories and Problem-Based Learning. In S. Bridges, C. McGrath & T. L. Whitehill (Eds.), Problem-Based Learning in Clinical Education. (pp. 3-17): Springer Netherlands.

o   McGrath, C., Comfort, M. B., Luo, Y., Samaranayake, L. P., & Clark, C. D. (2006). Application of an Interactive Computer Program to Manage a Problem-Based Dental Curriculum. *Journal of Dental Education, 70*(4), 387-397.

o   Novak, J. D., & Cañas, A. J. (2008). The Theory Underlying Concept Maps and How to Construct Them. Florida: Florida Institute for Human and Machine Cognition.

o   Vaughan, N. (2007). Perspectives on Blended Learning in Higher Education. *International Journal on E-Learning, 6*(1), 81-94.

o   Winning, T. A., & Townsend, G. C. (1998). Problem-based curricula and dental education: facilitating change for teachers and learners. *European Journal of Dental Education, 2*(4), 143-148.

12 Case Studies in Primary and Secondary Schools in Hong Kong and China

12.1   Kau Yan Primary School

This section is extracted from a news report written by Kane Wu titled "Wireless Classrooms" published in China Daily on Apr 19, 2011

"Hong Kong has no problem providing the most advanced hardware in classrooms. The problem is software and our rigid curriculum," says Fielie Fung, associate principle of Kau Yan School.

The private primary school on Hong Kong Island is starting a trial program with iClass on iPad in May.

"Most primary schools in Hong Kong are still quite traditional and their mindset is to focus on textbooks and getting good scores. That's why Hong Kong students lag behind their counterparts in Western countries in terms of their creativity," Fung says.

He has travelled to the United States and many countries in Europe and learned how they use high-tech to stimulate students' creative thinking.

The school started a high-tech teaching program three years ago, acquiring 60 laptops, 30 netbooks and 30 iPads, with a specially designed campus-wide Wi-Fi that provides high-speed Internet to dozens of devices at the same time. Students in the school are taught to use computer for homework and research beginning with their first year. Whenever they want to access the Internet, they can rent a device from the e-learning center. Students above Form 4 also have video-editing, computer programming and music composing classes.

The total investment in high-tech exceeds $HK1 million but Fung says the result is quite positive. "First year after the program started, the Form 6 students performed better than ever in their middle school entrance interviews," Fung recalls. "The interviewers said their overall ability improved significantly."

Fung is constantly searching for suitable and free software online. "iClass is the first Hong Kong-developed application I have found so far from the app store," Fung says. "The resources are out there, but it's up to us how to use them to best facilitate the students." Fung hopes that iClass developers will add more modules to the current system, further enhancing the level of interactivity.

12.2 Pui Ching Middle School

This section is extracted from a news report written by Kane Wu titled "Wireless Classrooms" published in China Daily on Apr 19, 2011

A Hong Kong-developed online application for smartphones is taking off in local schools. Developers even hope that iClass will be an asset for helping local students bridge the creativity gap with their Western counterparts. Kane Wu reports.

Normally, students are not encouraged to use mobile phones in classrooms. When they attend Pui Ching Middle School, however, they are required to do so.

"We ask our students from Form 1 up to equip themselves with an Android-based smartphone," says Ma Hoi-hung, the Kowloon school's Information Technology Department head. Students in the school have started doing quizzes or Internet research using Android applications Ma has chosen from thousands of educational applications from the Android store.

"We have a daily session called 'Eye on the world' when we broadcast news clips on the campus TV and ask students to answer related questions on their mobile phones," Ma explains. "And we score them in our web-based study performance system." In science classes, students sometimes have walking tours around campus, during which they access the Internet via campus-wide Wi-Fi to check out the plants they see on the way.

"There is a tag attached to each plant with the name and basic features on it. There is also a QR (Quick Response) code for us to get connected to the Internet," Form 1 student Natalie Hui says. She uses HTC Desire with a mobile contract that costs her a little less than HK$200 a month. "You just take a picture of the QR code, and the phone automatically links it to the Wikipedia web page that tells you everything about the plant, very simple," she adds.

Natalie is 13 years old. Five years ago, a student of her age wouldn't even

know what a QR code is (according to Wikipedia, QR code, short for quick response, is a specific matrix barcode or two-dimensional code, readable by dedicated QR barcode readers and camera phones. The code consists of black modules arranged in a square pattern on a white background. The information encoded can be text, URL or other data). Five years ago, iPhone was still an idea on paper. Five years ago, students would not be lucky to get Wi-Fi in the classroom.

"Now we have a computer, a projector, a television, Wi-Fi, and a Smart Board in every classroom," Ma says, "plus our unique CCTV system that supports online video conferences. You can also zoom into documents with the system and display them on the electronic Smart Board." The government-subsidized school spends a great proportion of its money on high-tech. "We are actually reducing the number of computers, because the trend is going mobile," Ma said.

However, looking for suitable applications for students in different grades can be hard, since there are so many of them out there. Ma was particularly happy to have found iClass, an interactive class response system developed by students from the University of Hong Kong (HKU) in March.

The application supports most popular mobile devices such as Android phone, iPhone, iPad, iPod Touch and embedded buttons in a lecture room. The modules differ from each platform, but generally, teachers can upload images or text to the system on its computer- or web-based software. Students can draw or write or modify the images or texts in their own iClass application downloaded from App Store or Android Market, and then submit them to the teacher. The system then automatically generates statistics based on students' answers so the teacher will be able to identify the problem when things go wrong. Students can also find each other's work and make comments via the "peer review" function, or simply share them on Facebook. QR code and

Internet browsers are also embedded in the application.

"We believe iClass is the first app in Hong Kong, even in the world, that has reached such a level of interaction," says Law Kam-yuen, one of the developers of the application. "The current education software is mostly electronic textbooks, which are not that different from paper books in terms of interactivity."

12.3 PLK Chee Jing Yin Primary School

Chee Jing Yin Primary School became a user of iClass system in the academic year 2011-12, ten years after it was qualified as one of the Centers of Excellence by the Education Development Bureau. "We have been great in mobile learning," told Mr. Li Chi-sing, Head of Information Technology Department of the school, "We started to use iClass because it supports IOS system and it's effective."

The school now focuses on iClassroom whose immediate collection and presentation of students' feedback is most favored. In English class for both low and high grades, students can give their answers or votes via iClass system.

Teachers can view the results in different types of charts generated by the system right after the students finish their choice, which allows timely follow-up in class. "Since the system supports IOS, students can have these activities with their iPads and iPhones. It's user-friendly and interesting. We have already developed two teaching plans for students in different grades to learn English with the system," said Mr. Li.

Besides traditional subjects, the school also pioneers in promoting digital arts. Every six days as one cycle, students have one-hour special activity class daily, during which they use iClass system to create digital drawings.

The Drawing module of the system provides lines and shapes in different sizes and colours to students' convenience. "In the past, we had to collect the students' work before share. Now with iClass, students can share their work as soon as they submit it. They can also view others' work via Peer Review and grade them, which adds lots of fun," told Mr. Li.

More than 200 students in the school have been using the system. They show more interest and initiatives in study since it becomes an enjoyment. Teachers are also happy with the immediacy, interactivity and flexibility of the system. With the campus-wide Wi-Fi, they can catch up with students' progress, provide feedback and start tasks anytime anywhere.

Mr. Li said, though they are still at the early stage of applying the system, they will definitely consider to introduce it to more subjects. He is also looking forward to the further development of the system, in a hope that one day the system can support off-line activities so that students can participate in iClass learning events even when they are visiting places out of campus.

12.4   Jordon Road Government Primary School

Case	Shortening the Feedback Loop
Teacher	Mr. Lau Ka Yiu
School	Jordon Road Government Primary School
Students	Local and Non-Chinese Primary 2 Students
Subject	Mathematics

The teacher prepared an e-book with 4 pages of exercises, asking the students to identify different shapes including round, oval, rectangle, trapezoid and so on. The students were all excited about this new mode of learning and were highly involved. The students were more impressed by what they've learnt with a vivid picture in their minds.

Preparation: It took one lesson for the teacher to teach the students how to use iClass. The students learnt very fast and got familiar with the operation very quickly. The next class, all the students were already able to use the tool without problem.

Teaching effectiveness: The class became more engaging and all the students were more attached to the class discussion and concentrated more on what the teacher said. The students were less easily got distracted by other things when holding the iPad and focus on the

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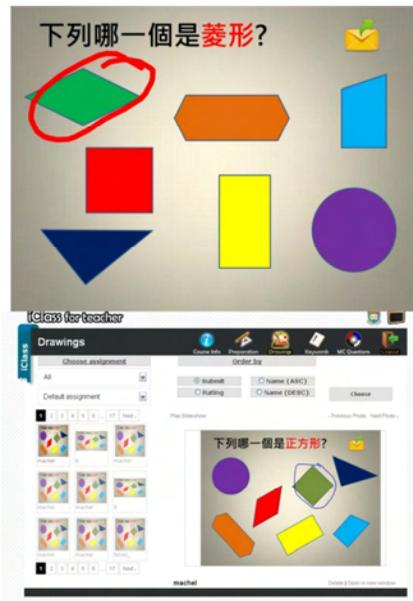
system. Therefore, the recent mid-term examination has witnessed an impressive result of the section taught via iClass. The average result of identifying the shape part is significantly better than other sections, which did not use iClass for teaching and learning.

Problems encountered: Some of the students finished the test too fast. Sometimes the teacher required the students to answer the questions posted one by one. He would like to explain or have a discussion after each problem solved, while some students were going too fast and proceed to the next one. Thus, the teacher needed to have a better control of the flow and pace of the class. The teacher asked the students to flip over the iPad when they finished answering one question so that he could have a better pace control.

12.5 Kwun Tong Government Primary School (Sau Ming Road)

Case	Using Peer Review to Enhance Students' Iinterest
Teacher	Ms. Ms. Ho Kit Man
School	Kwun Tong Government Primary School (Sau Ming Road)
Students	Local Primary 2 Students
Subject	Chinese Language

The teacher made a good use of the e-book function which made the Chinese class more diverse to the students. It's kind of a breakthrough to use iClass for Chinese teaching, which required a more complex content preparation and how to proceed the class with more interactions.

The teacher prepared a worksheet first and students could download the passage from the e-textbook, read the content on the iPad. With the text function in drawing module, the students input the adjectives they chose to express the emotions and submit. Thus, they shared their answers with the rest of the class and at the same time, saw others work via peer review module, learning from each other and discussed together.

The teacher was much impressed by their familiarity with the system and was very happy that that peer learning can be applied to primary two students as well. Although some advanced e-learning tools were used in the class, however, the teacher found fewer students got distracted compared with in a traditional class.
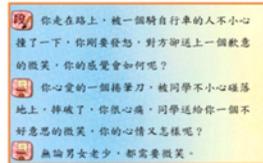
13 Pedagogical Integration of e-Learning in Classroom Teaching - From Theory Into Practice

A joint school pilot project of Kwun Tong(Sau Ming Road) Government Primary School and Jordan Road Government Primary School

Ms. TSE Lai Man,Edith
School Principal,
Kwun Tong(Sau Ming Road) Government Primary School

Since 1998, HK Government has started the promotion of IT in Education. The three strategies on Information Technology in Education have been launched. It is the growing popularity of web and gadgets that the concept of e-learning was raised up in education at the beginning of 20th century, while over ten years we are still exploring the method for a further development and an effective way of using it. Since the web and computer technologies are being developed rapidly with increased efficiency and effectiveness, in particular the innovation of tablets, high-speed internet and improved design of learning platform. Resulting from these users friendly and speedy transmission approaches in development, less time and effort would be put in the manipulation of devices. According to the third strategy on Information Technology in Education, e-Learning should be efficient, effective and enjoyable. It will help students develop the habit of life-long learning and in turn, facilitates whole-person development. Therefore, e-Learning should not merely mean the use of e-textbooks, but should also include the effective and integrated use of e-Learning resources and e-Learning platforms in a diversified manner. In line with the third strategy on IT education focusing on the human factor and learning effectiveness, this is the right

time for the educators to explore in-depth on the pedagogical integration of IT focusing in classroom teaching and learning process, in particular at the primary education.

13.1   The Aims and Concepts of e-Learning Project

13.1.1   Broadening Educational Experiences to Keep in Track with Future Cyber World

In the education reform, the concept of learning has gone through a series of paradigm shifts. Life-long education has become a trend with a shift from teacher-centered to learner-centered and from knowledge and skill oriented learning to contextualized multiple intelligence. With the rise of IT technology and its impact on our daily life, teachers should make use of the new technology to explore more learning opportunities for students with a focus on skill based performance in knowledge management. Therefore, taking IT technology for teaching and learning has become an important part of education reform to prepare our students to keep in track with the future cyber world. It is also of great importance in the globalization of education that we set up a proper learning network and IT environment to foster learners to manage knowledge and skills to cope with expansive knowledge in the dynamic cyber age.

13.1.2 Cyber Ethics

Nowadays, cyber world has been closely connected to teenagers' life and is becoming indivisible. They have already got used to surfing the internet on a daily basis and it is time for teachers to make use of this trend, making teaching and learning more effective related to their daily life experiences. It is of great importance for the teachers go into the cyber world and explore together with students and make better use of advanced technology. The teachers should let the students begin to recognize that those digital devices are an integral part of their learning process rather than playing toys. However, meanwhile, it is also critical that the teachers could protect youth from dangers on the Internet and for those who might abuse it. Teaching teenagers about the ethical issues on the web and intellectual property could help prevent cybercrime.

13.1.3 Rethink Teaching Strategies and Learning Effectiveness

In order to prepare our students in the 21st century to meet the aims of education reform, the educators should rethink whether the traditional lecture mode of teaching in primary and secondary education is still having prominent effect. This is the time to shift from teacher-centered to student-centered; transforming passive classroom into open-ended learning environment; the lesson planning need to be redefined from memorizing factual knowledge to find and evaluate knowledge; from oral instruction to task based and problem solving approach through multi-media presentation, to which turns the education process from a passive to an active way resulting from the multi-sensory stimulation.

According to Keith Courville (2011). Technology can aid in educational achievement through two primary methods: the removal of physical barriers to learning and the transition of focus from the retention of knowledge to its utilization. For teachers, technology, in accordance with knowledge management principles, can be used to develop databases that will alter professional development. Teacher should rethink the design of

lesson based on the change of format and ways to access information and knowledge.

13.2 Promote Self-Regulated Learning (SRL) in Digital Classroom

According to the theory of self-regulated learning and academic achievement (Zimmerman 1998) and in the research by Barnard-Brak, Lan. and Osland Paton (2010), individual who are self-regulating in the learning appear to achieve more positive academic outcomes than individual who do not exhibit self-regulating behavior.

In theorizing about the development of self –regulated learning skills and strategies, Zimmerman(1998) proposed a three-phase model. The first phase, forethought, refers to the skilled and strategic processes that precede and set the stage for performance in learning. These processes would include but are not limited to goal-setting, attribution, self-efficacy of eminent tasks, and the intrinsic motivation to perform the learning task. Self-regulated learning skills and strategies such as environment structuring and goal setting may be associated with the forethought phase.

The second phase, the performance control or volitional phase, consists of the skilled and strategic processes that occur during the learning process. These skilled and strategic processes include but are not limited to attention, affect, and monitoring of action. Self-regulated learning skills and strategies, such as time management, task strategies and help seeking are associated with the performance control phase. In the third and final phase, the self-reflection phase, individuals react and respond to their self-regulated efforts in the learning process by evaluating the outcomes of their performance. During the final self-reflection phase, the individual will self-evaluate based upon social comparisons and adjust the implementation of skills and strategies in the forethought and performance control phases for the next learning task.

13.2.1   Implication of IT Devices in SRL

Using tablets and e-learning platforms as a means to facilitate self-regulated learning skills, in which the prominent functions of multisensory stimulation and interactive transmission of data could facilitate the goal setting, time control, task attribution phase. The networking and sharing platform in the digital devices could shorten the feedback loop, as such, to enhance the effect of evaluating outcomes of performance based on peer comparison and interaction between teacher and students. The devices could also have effect on self control of learning pacing and build strong intrinsic motivation through personalize in learning experience. In addition, teacher could cater for diversity in different pacing and tasks assigned through the support of electronic databases and the powerful IT devices.

13.2.2   Trial on Using Tablets and E-Learning Platform

The growing popularity of tablets and other gadgets has witnessed the great impact they exerted on the e-learning process. iClass, developed by HKU, as an effective platform to facilitate e-learning and interactive class process, are deployed for trial to enhance teaching and learning process in classroom .

With various functions provided by iClass like drawing, peer review and e-book and MC questions, we are now trying to develop a task-based approach for teaching and learning. iClass, with various modules can facilitate the task-based approach and help students finish multiple tasks individually or pairs under the teacher's instruction and offers encouragement. Teachers are able to generate pie chart or bar chart to show the result immediately after the students submitted their answers via key words or MC functions of iClass, so as to give simultaneous feedback to the whole class. Meanwhile, with peer review function, students can view and rate the works of others so that they can get inspirations from others and refer to their own work. These functions help with shortening

the feedback loop thus the students could have an immediate response and feedback from teachers and other classmates, and triggering self-learning and evaluation awareness of students. With such tools, the students can personalize their independent learning opportunities and study pace, so as to get the motivation for review, self-evaluation and improvement.

The "moodle" system is setup as the electronic databases of lesson plans and teaching materials, which requires teachers to have a better course design before the class and how to apply it during the class with better approach, and therefore, facilitate the after-class review. Although at first, it may be more challenging for teachers to design and plan an effective class with e-learning tools than do it in a traditional way, it will actually help greatly with quality control of the class while turn it into a routine pedagogy. Once the standard is set, all the teachers are able to follow the module and apply it in the class in various ways. And thus, the teaching effectiveness can be guaranteed as the framework has been set already. On the other hand, with the overall quality control, teachers still need to find their own ways to achieve better interactions with students with difference approaches aided by advanced e-tools.

The cases of lesson trial in the Jordon Road Government School and Kwun Tong Government School are listed in Section 12.4 and 12.5 respectively.

13.3 Task Based Lesson (TBL) Incorporated with IT Elements

The task-based teaching approach is always referring to the English language learning. However, some of the key elements of this learning approach, could be adapted to other subjects, in particular Chinese language and mathematics, it also could be considered as a hubs in lesson planning with IT elements. In addition, it also calibrate with the development of self-regulated learning skills. According to Jane Willis (1996), the goals and outcomes are the key factors of task-based learning. Any topic can give rise to a wide variety of tasks. One job of the designer and teacher is to select topics and tasks that will motivate learners, engage their attention, present a suitable degree of intellectual and linguistic challenge and promote their language development as efficiently as possible. Tasks have a specified objective that must be achieved, often in a given time. They are 'goal-oriented'. In other words, the emphasis is on understanding and conveying meanings in order to complete the task successfully. While learners are doing tasks, they are using language in a meaningful way. All tasks should have an outcome. The outcome can be further built on at a later stage in the task cycle, it is the challenge of achieving the outcome that makes TBL a motivating procedure in the classroom.

The six types of task suggested are: Listing, Ordering and Sorting, Comparing, Problem solving, Sharing personal experience and Creative tasks. All these tasks are mostly used in an interactive and student-centered lesson. With the application of IT devices and learning platform such as "IPAD", "iClass", "Moodle", they could be served as a powerful means for the students finishing their tasks efficiently and

effectively. A construct of a lesson framework with teaching steps and IT elements through task based teaching in Moodle system are illustrated below:

Figure 13-1 Main page for Moodle keywords

Figure 13-2 JRGPS Learning Platform for Chinese

科目:六年級 中國語文　第（2 / 5）教節 教學流程

本教節目的：

1. 學生能從詩歌中找出情感的詞語，且能歸納出作者的思想感情。

2. 認識及運用情感詞語

學生已有知識:初步了課文內容及新字深詞

教學步驟	iClass	電子工具	其他	完成/呈交 (時限)
1.引入課題：觀賞影片				2分鐘
2.限時寫出不同情感詞語表達對影片的感受				2分鐘
3.默讀圈出情感的詞語				5分鐘
4a.老師講解：依課文中四種情感將詞語把學生提供的歸類　4b.學生將詞語先行歸類，老師再行講解				5分鐘
5.二人一組：在課文圈出描述情感的句子/段落				3分鐘
6.講解：根據句子歸納詩歌主旨及思想感情				3分鐘
7.總結:學生依課文資料歸納主旨及思想感情				

Figure 13-3 Lesson Framework for Chinese

13.4 A Way Forward and Limitation

It is a long and winding road to get into the target. The pilot project is only on the preparatory stage of phase one (Table 13-1). The readiness of students and the performance outcome observed in a preliminary lesson trail are very rewarding. It is no doubt for the young generation to get in touch with the digital world. However, it is crucial that teacher is the significant factor in this new concept of teaching and learning process. Teachers served as the hubs to synthesis education theory and application of IT element to enhance learning effectiveness. Both teachers and students are learners if technology is directly applied in the classroom

teaching and learning process. Thus, it is important to generalize a structure and pedagogy for teacher development in this new area. According to National Education Technology Standards for Teachers (NETS-T) in USA, the expectation for teacher in IT development are Facilitate & Inspire Student Learning & Creativity, Design & Develop Digital-Age Learning Experiences & Assessments, Model Digital-Age Work & Learning, Promote & Model Digital Citizenship & Responsibility, Engage in Professional Growth & Leadership. The expectations extend beyond the classroom in that teachers are encourage to use technology as a tool for professional growth and leadership. Teacher can no longer remain the "sole provider" of knowledge and skills needed by our students, but rather need to actively participate in global communities connected by an interest in the education of our youth. In order to equip the young generation with the 21st Century knowledge and skill to prepare for the future cyber world. (Gary R. Morrison and Deborah L. Lowther ,1999)

In contrast, the evolution of technology is far beyond the development of education, with its continued and dynamic changes in a speedy way, we should think of the future development of education compatible with modern technology.

A	Stage 1: Preparation
1	Set up working group
	- Technical and support team
	- Teaching and learning team
2	Exploration of the feasibility in using application of "Moodle" . "iClass" and hardware of "IPAD"and Digital white board.
3	Synthesis and merging the technology into Teaching and Learning process.
4	Study of the lesson frame work with IT element based on task-based

learning and self-regulated learning approach.

B	**Stage 2: Teacher Development and Databases**
1	Teacher training in lesson planning focus in subjects of language and Mathematics.
2	Set up "Moodle" as the electronic databases for lesson plans and teaching materials.
3	Teacher training on manipulation of IT devices.
4	Searching for electronic and digital teaching materials.

C	**Stage 3: Student preparation and lesson trail**
1	Prepare students in manipulating the "IPAD" and "iClass"
2	Trail on lesson using the lesson framework synthesized with IT elements with task-based teaching.

D	**Stage 4: Evaluation on the newly approach lesson framework and technical problems**

E	**Stage 5: Distance online learning and revision**
1	Revised the lesson framework in the "Moodle" as an online revision material.
2	Students log in the "Moodle" system to revise the lesson and finish the task materials taught in the class
3	Review on the effectiveness of self regulates learning performance.

Table 13-2 Stages of implementation of 5 years plan (Phase 1)

13.5 References

o Barnard-Brak, Lan. and Osland Paton (2010). Profiles in Self-Regulated Learning in the Online Learning Environment

o Gary R. Morrison and Deborah L. Lowther (1999). Integrating computer technology into the classroom. Skill for the 21st Century. Pearson.

o Meg Ormiston (2011). Creating a digital-rich classroom, teaching and learning in a web 2.0 world. Solution Tree.
o Jane Willis (1996). A framework for task-based learning, Longman.
o James E. Herring (2011). Improving students' web use and information literacy. A guide for teachers and teacher libarians.
o Keith Courville (2011). Technology and its use in Education: Presemt Roles and Future Prospects, Paper Presented at the 2011 Recovery School District Technology Summit(June 6th – 8th, Baton Rouge, Louisiana) Session name: Current Trends and Recommendations in Technology
o Kevin Larkin and Glenn Finger (2011). Informing one-to-one computing in primary schools: Student use of netbooks, Australasian Journal of Educational Technology.
o Panayiota metallidou and Anastasia Vlachou (2010). Children's self-regulated learning profile in language and mathematics: The role of task value beliefs. Psychology in the school. Vol. 47(8), 2010
o Izabela Soric and Marko Palekcic (2001). The role of students' interests in self-regulated learning: The relationship between students' interests, learning strategies and causal attributions. European Journal of Psychology of Education 2009.
o Rod Ellis (2003). Task-Based Language Learning and Teaching, Oxford.
o 莫慕貞、鄭燕祥(2006)，網絡化環境下的自我學習，教育研究月刊 2006.5

14 Appendix A - A Mobile Quiz Platform to Challenge Players' Knowledge on Mobile Devices

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14.1 Abstract

In the past few years, many new mobile technologies including the 3G, WiFi or mobileTV have created unprecedented learning opportunities on mobile devices. Furthermore, such technologies continuously fuel the rapid growth of new fields of research like the edutainment for educational entertainment. In a recent project awarded by the Hong Kong Wireless Development Center, we have 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. After all, our work shed light on many interesting directions for future exploration.

14.2 Introduction

Undoubtedly, new telecommunication technologies or services including the High-Speed Downlink Packet Access (HSDPA), namely the 3.5G, the

IEEE 802.11, namely the WiFi for Wireless Fidelity, based products, or lately the mobileTV, have been continuously reshaping our modern living. With the availability of powerful mobile devices connected to a high-speed wireless network, with the maximum data rate as several to tens of mega-bits per seconds nowadays, many attractive mobile learning applications realizing the concept of learning anytime and anywhere have been developed 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 which users can send and receive encyclopedia-type inquiries between specific, pre-defined groups of users through text messaging on mobile phones. In Europe, there are many exciting mobile learning projects including the MOBIlearn [3], the Mobile Learning Framework 5 project and the Kaleidoscope mobile learning initiative [2]. Essentially, the Mobile Learning Special Interest Group (SIG) provides a forum for researchers to share new findings and technology in mobile, contextual and ambient learning across and beyond Europe. In Hong Kong, there was a mobile learning project conducted in a primary school in which around 40 GPS-enabled 3G PDA phones were used for data acquisition, conducting live interviews or surveys in the Hong Kong International Airport with the aid of GPS and video-recording functions, and also the uploading of captured data via the Internet to the back-end server for real-time analysis to support learning activities outside their classroom. In addition to the uses of mobile devices for learning or assessment, new technologies continue to fuel the blending and rapid development of new fields of research such as the edutainment for educational entertainment. An example is the digital game based learning (DGBL) approach advocated by M. Prensky, that combines serious learning and interactive entertainment in a fun, engaging and highly exciting medium.

In response to a call for applications on the China's 3G network, namely the TD-SCDMA, by the Hong Kong Wireless Development Center in the last May, 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.

Our system design is reliant against any possible system or network failure. Besides, 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. Here, 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 reviews some previous work relevant to our proposal including the use of mobile devices for mobile learning. Section 3 details the system architecture design of our mobile quiz system to enhance learners' experience on 3G mobile phones. We consider various evaluation strategies on our developed quiz system based on different criteria in Section 4. Lastly, we summarize our work and shed lights on future directions in Section 5.

14.3   Related Work

14.3.1   Mobile Learning

Due to the advance in mobile devices and communication technologies, mobile and contextual learning is a fast developing research field all over the world. Europe has led the way through the MOBIlearn [3] and Mobile Learning Framework 5 projects and the Kaleidoscope mobile learning initiative [2]. The MOBIlearn project explores new ways including a new m-learning architecture to use mobile environments so as to meet the needs of learners who are working by themselves with others. Besides, the Kaleidoscope Mobile Learning Special Interest Group (SIG) provides a forum for researchers with interests in mobile, contextual and ambient learning to exchange new findings and technology, and develop joint methods and initiatives across Europe and beyond. Furthermore, there are many interesting mobile learning projects including the POSIT by the MIT and the SENSE project conducted in the Universities of Nottingham and Sussex.

14.3.2   Mobile Social Encyclopedia

Cellphedia [1] is the first ubiquitous social encyclopedia or Mobile Social Software (MoSoSo) that promotes the sharing of knowledge. It allows users to send and receive encyclopedia-type questions between specific, pre-defined groups of users, through Text messaging. Users can register on a specific website and then start building quick reference entries, or ask questions or answer ones wherever cell phones is available. Similarly, our mobile quiz system also aims to facilitate the sharing of knowledge through quiz challenges posted on 3G mobile phones of pre-registered users in a specific community, for instance the registered audience of a specific Olympic event or a selected course in tertiary institution. However, due to the higher communication bandwidth available on 3G networks, our mobile quiz system is not restricted to text messaging. The

quiz questions stored in our mobile system may contain image, sound, text or video.

14.4   An Adaptive Mobile Learning System

Goh et al. [5] proposed an architecture and prototype quiz system based on XML/XSLT, Document Object Model (DOM) and Active Server Pages (ASP) technologies to work on both PC and mobile platform. Their system performed adaptation based on the device and user profiles and then chose the appropriate content for display to suit the specific client's need.   XML files are used to store the content (questions), directions for multimedia presentation of revision material, and the user model. For example, when the user is using a mobile phone, the system adapts to display a text based context. On the other hand, when the user is using a PDA, the system adapts to a video clip to flexibly provide the context. In a similar fashion, our mobile quiz system also adapts to different device profiles, and flexibly adjusts the image sizes, resolutions and frame rates for the best display of the image, text or video under different screen sizes.

14.5   System Architecture and Services

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

a) the Mobile Quiz Game Portal;
b) 3G based Mobile Quiz Game Platform Server;
c) Administration Console Portal;
d) SMS Gateway (a hardware gateway for sending SMS).

After registration, each user logs in our Quiz Game Platform Server via the 3G network through the client interface already loaded onto their

mobile phone. During the schedule time, the Quiz Game Server will push some relevant questions, possibly embedded with some video clips, for the user to answer. Each user will be given with 3 options, namely "Skipping 1 question", "50:50" – that is to remove 50% of the options that are incorrect, and "Prolonging the Time Limit" – that will instantly double the amount of time (10 sec.) allowed for the current question. In each round, those users who had given the incorrect answers for 3 times would be required to exit from the current game session. 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. Thus, our 3G based mobile quiz game platform is essentially a round-based game that requires data synchronization on the server side.
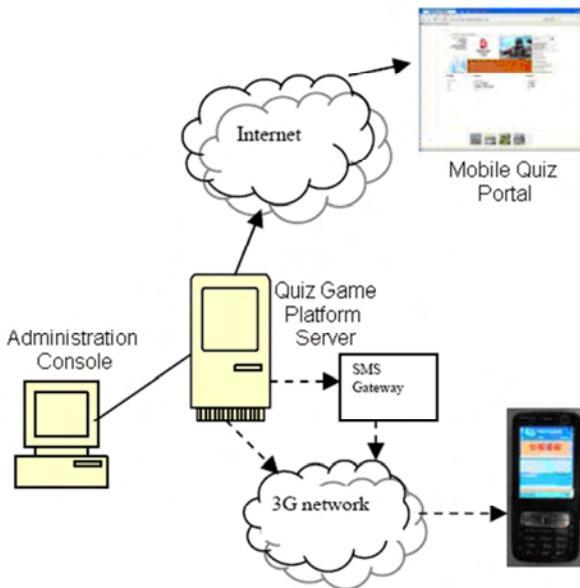

Figure 14-1 The System Architecture of our Mobile Quiz System

As the small-sized data packet for the client's returned answers, our game server can be easily extended to handle hundreds or thousands of

pre-registered users' requests in an efficient manner without suffering as the performance bottleneck. This can help to demonstrate the timely performance of the 3G network to transfer a large number of clients' data requests for any demanding mobile applications including our mobile quiz game system.

14.6 Prototype Implementation & Evaluation Strategies

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 [4] was set up to allow the downloading of a client program (.jar) for installation on any mobile phones to access our mobile quiz system as shown in the picture below.

As our mobile quiz system is generally applicable to any selected event or course, a detailed evaluation will be conducted in 2008/09 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.

14.7 Concluding Remarks

In this paper, we reported an on-going project in which we have successfully developed a 3G 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 share the relevant experience in system development have been considered. After all, our work shed light on many interesting directions for future exploration.

14.8 References

[1] The Cellphedia development team, The Cellphedia website, maintained by L. Garcia, Retrieved: November 12, 2007, from http://www.cellphedia.com.

[2] The Kaleidoscope development team, The Mobile Learning website, maintained by M. Sharples, Retrieved: January 12, 2008, from http://mlearning.noe-kaleidoscope.org/.

[3] The MOBIlearn development team, The MOBIlearn website, Retrieved: January 21, 2008, from http://www.mobilearn.org/.

[4] The Mobile Quiz System development team, The Mobile Quiz website, maintained by Jade Wong, Retrieved: November 12, 2007, from http://olympic.eee.hku.hk/.

[5] T.T. Goh, Kinshuk & Taiyu Lin. "Developing an adaptive mobile learning system" In K.T. Lee & K. Mitchell (Eds.) Proc. of the International Conference on Computers in Education 2003, Hong Kong, December 2-5, 2003, p. 1062-1065.

15 References

1. Margin Martyn, "Clickers in the Classroom: An Active Learning Approach", 2007

2. "Clickers in the Large Classroom: Current Research and Best-Practice Tips", Jane E. Caldwell.

3. V.W.L. Tam, W.W.T. Fok, K.S. Lui, "Turning Mobile Phones into A Mobile Quiz Platform to Challenge Players' Knowledge: An Experience Report" published in the 8th IEEE International Conference on Advanced Learning Technologies 2008.

4. The Cellphedia development team, The Cellphedia website, maintained by L. Garcia, Retrieved: November 12, 2007, from http://www.cellphedia.com.

5. The Kaleidoscope development team, The Mobile Learning website, maintained by M. Sharples, Retrieved: January 12, 2008, from http://mlearning.noe-kaleidoscope.org/.

6. The MOBIlearn development team, The MOBIlearn website, Retrieved: January 21, 2008, from http://www.mobilearn.org/.

7. The Mobile Quiz System development team, The Mobile Quiz website, maintained by Jade Wong, Retrieved: November 12, 2007, from http://olympic.eee.hku.hk/.

8. T.T. Goh, Kinshuk & Taiyu Lin. "Developing an adaptive mobile learning system" In K.T. Lee & K. Mitchell (Eds.) Proc. of the International Conference on Computers in Education 2003, Hong Kong, December 2-5, 2003, p. 1062-1065.

The way forward

From Chalk
to Click

In the new era of
e-learning, the
development of new
technologies and
and innovative
pedagogies are
progressing together.

Educators and technologists
must work together to
maximize the impacts of
e-learning for our future.

16 Acknowledgement

Special Acknowledgement

I would like to take this opportunity to thank the members of the iClass development team: Eric Au Yeung, Ken Law and Alan Chiang. They were my students in the University. After their graduation, they continue to invest their time and efforts for the development of iClass. Without their passion and persistence, such an award winning technology could not be developed.

The iClass technology had awarded two Silver Awards in the Hong Kong ICT Award 2012
From left: Eric Au Yeung, Ken Law, Dr. Wilton Fok and Alan Chiang in the Hong Kong ICT Award presentation.

" Technology, content and pedagogy are all crucial for the success of e-learning. Among these, it is most important that we develop effective pedagogical practices that draw out the best that new technologies and learning resources have to offer. I congratulate Dr. Wilton Fok and his colleagues for work well done, and I look forward to seeing their continued contribution in the area of e-learning in Hong Kong! "

Kenneth Chen Wei On
Under Secretary of Education, HKSAR

" This book The New Era of e-Learning illustrates many of the above points showing our technological and pedagogical development on e-Learning here at HKU. Some of the developed methods are being applied in the University and some primary and secondary schools in Hong Kong demonstrating the effectiveness of e-Learning for teaching and learning. "

Prof. Roland T Chin
Deputy Vice-Chancellor and Provost
The University of Hong Kong

" The publication of this volume cannot be more timely. In Hong Kong, schools have completed the first cycle of the new senior secondary curriculum and universities are gearing up for the launch of a new academic structure in September 2012. This unprecedented educational reform is motivated by the need to equip students with the skills and capabilities to meet the challenges of a rapidly changing world. "

Prof. Amy B.M. Tsui
Pro-Vice-Chancellor and Vice-President (Teaching and Learning)

" Thanks to the contributions from the teachers and researchers at the University of Hong Kong, as well as the inputs from some principals and teachers from a few primary and secondary schools in Hong Kong and mainland China, this book was published. It is a collection of knowledge and experience of e-learning development, in both technology and pedagogy, in Hong Kong and the region. We would like to take this opportunity to share this knowledge with educators, teachers, students and parents through this Knowledge Exchange project. "

Dr. Wilton Fok
The Editor

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