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Current status of mobile learning technologies in universities

The need to re-blend!

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TR C08/03 17th November 2008

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Abstract

The use of mobile technologies in education impacts learner motivation, collaboration information sharing, mobility and interactivity which provide opportunities for learners, teachers and the university. This survey investigates the use of mobile learning technologies in higher education with a focus on the potential of mobile learning at universities. The reports of a number of current mobile learning projects are discussed, from which the perceived advantages of using mobile technologies in education, and potential barriers to their use are derived. Areas to be examined include new technological innovations, mobile devices, learning issues, learner’s interactions and collaboration. Certain guidelines are investigated to ensure proper integration of mobile technologies, taking into consideration the learners, teachers, faculty and administrators. A blended mobile learning model is proposed which has the ability to serve the learning process.

1 Introduction

Previous studies have shown that blended learning has proved to be an effective model in higher education, as it can merge with new innovative technologies. Technological innovation constantly and rapidly changes, and this is affecting the way we perform tasks. Therefore constant updating is required to catch up with the fast changing technology. So far blending face-to-face learning with web-based learning cannot fully provide efficient solutions for today’s learner. We believe by re-blending again to add
mobile technologies into the mix will improve learning accessibility, collaboration and flexibility. A proposed theoretical blended mobile learning model for universities will be designed which emphasizes the importance of taking a systems view of all the elements that need to be in place in a mobile learning environment, starting with the communication infrastructure, mobile devices, learners and teachers, in order to ensure the effective adoption of mobile technologies in higher education.

Mobile learning is a big step towards providing flexible education; it has brought about new forum for learning. Higher education institutions are finding themselves grappling with how best to utilize these technologies for learning, while staying within the educational missions and resources of their institution. Higher educational institutions are constantly facing the challenge to experiment with new technological innovations for learning. So far universities are finding mobile learning to be boundless and mobile devices are becoming more common among students. And it seems that the use of mobile technology for learning purpose is becoming the current trend, especially among information technology students at universities. The majority of them are already taking advantages of their mobile devices to help themselves in the learning process. They use their mobile or iPod or any other portable device to record and store information, to download audio lectures via USB into their mobile devices from the university web-site, and to access and share information and data with other students. Deakin University is one good example where mobile technologies are being used among students. Currently DSO (Deakin Studies Online) incorporates ilecture which is an automated lecture capture digital recording and online delivery system. Students can logon to DSO and access the ilecture system and download the recorded lecture to their mobile phone or ipod, and listen to it again anytime they want. Ilecture uses and supports Podcasting technology; Podcasting is based on XML-based technology called RSS, (Really Simple Syndication). The system can store the recording in two format audio or video to suite different network speeds (Deakin website, 2008). Podcasting can be defined also as a series of digital recording audio or video based on the web or on the university server, can be cataloged and automatically downloaded, to be used later by the learner.
The use of Podcasting at universities is emerging rapidly because of its flexibility. The technology involves acts as a thread which is capable of linking web-based learning and mobile learning together. Recently many universities are beginning to use this technology to deliver lectures. Learning content is made easily available to students via iPods, MP3 players, mobile phones and other portable devices.

The rapid developments of MP3 players, iPods and mobile phones have made a significant impact on learning at universities. Currently in Australia most students own a mobile device so access to technology is no barrier. Deakin University is just one example in which learning materials can be downloaded via ilecture to iPods or any portable device. Also Newcastle University along with a number of major Australian Universities are working together on a research project to find out on how ilecture and similar web-based technologies can be further developed to best support learning and teaching (Gosper, et al 2007)

As we can see whether universities are prepared to face the challenge of merging mobile learning into its curriculum or not, students are already integrating this technology into their learning process. Currently the quality and the capability of mobile technology are increasing at a rapid speed. This is due to technological breakthroughs and advancements in wireless bandwidth and data networks (Keegan 2005).

Therefore designing a blended mobile learning model would be beneficial not just towards the university itself, but also towards setting guidelines for proper integration which in terms can create an effective, flexible, blended and collaborative learning environment within the university setting.

2 Current Trends in Mobile Learning Technology

2.1 From Web-based Multimedia to Mobile, the Higher Education Evolution

"Education is the thread that binds us through time to what we have learned and what we have achieved, and provides a system for future learning and development" Hall (2001)
According to Hall, technology is changing the way we live, communicate, share information, collaborate, socialize and the way we interact and learn.

E-learning started several decades ago as a deployment of learning technology for the open learning system, it began as a matter of the development, the distribution and the transformation of video/audio materials combined with traditional paper-based materials. Following the dissemination of computers, e-learning materials like floppy disks, CD-ROMs, etc., were introduced and used. Then with the widespread and the rapid development of communication technologies, the internet, the World Wide Web, tools for collaboration and web-based communication, delivery models were then integrated within the learning curriculum at most higher educational institutions. (Jarvis et al., 1998; Kerka, 1996).

According to Augar (2006) when web-based multimedia learning first began it was only a way of electronic replication of text based learning content, and this content were made accessible by learners in an online format. The learner was required to read lots of materials provided on the university website, and then to submit work to assess their understanding of the web-based content.

With the integration of multimedia technology web-based learning system came a long way since it was first introduced. Now web-based learning systems have the power to provide interaction and collaboration between learners themselves and between learners' and teachers, this interaction is an important aspect in supporting their learning. A study by (Stacey, 2001) and another by (Carlsen, 2003) both emphasized on the importance of learners interacting, information sharing and collaborating to construct knowledge and increase learners understanding of the course materials.

This was apparent too in a study done by (Gilroy, 2001), the author stated that the interaction among learners and teachers can decrease learners' isolation and make learning a personalized experience therefore enriching the online learning process.
With the understanding that web-based multimedia learning is a subset of the overall e-Learning, web-based multimedia learning was the fastest growing, and it became the dominant delivery mechanism for e-Learning within higher education. The shift towards web-based multimedia learning was due to the growing demand for learners wanting easy access to learning materials, coupled with time and cost constraints in traditional learning. Institutions were looking for a more convenient and efficient alternative to traditional learning hence web-based multimedia learning has been a viable alternative to tradition learning over the years. Web-based multimedia learning is still rapidly growing due to the rapid pace of technological change; higher educational institutions are faced with the ongoing challenge of retooling and updating their learning models.

Now mobile learning technologies are being introduced to the learning curriculum at some institutions, but how would universities adapt the new technology and make it effective for learning? Gardner (2001) suggested that before the integration of any new learning technology, course designers need to state their educational goals and objectives, by doing so they can demonstrate how a certain technology can assist in achieving those goals. (Gardner, 2001)

Because this type of learning is very new, distinctions between the various types of mobile learning are still forming. And institutions are beginning to recognize the advantages of on-demand, blended mobile learning models. This survey anticipates that mobile learning can be further developed to meet the wider needs of the learners, as it can be effective, more flexible, collaborative, easy to use and more convenient.

2.2 Defining Mobile Learning

2.2.1 Mobile and Mobile learning

Being mobile is being detachable, unfixed or not limited to a location, constantly transferable and freely movable from one place to another. Humans are mobile, they carry hi-tech device with them, so others can reach them and they can reach others.
remotely. The hi-tech device they carry around with them is not attached to any wires; therefore it's wireless, portable, transferable, thus making it a mobile device..

Mobile devices now are starting to be used for learning, it is believed that mobile devices play an important role in creating more collaborative environment for learning than web-based learning, because the mobility, flexibility and portability of these hi-tech devices, will allow their user to learn on the go, therefore making users more mobile, and enabling them to connect, share, collaborate, communicate, reflect and learn while going about their daily activity in their normal ordinary life, instead of being in one location in front of a computer screen and in isolation and away from the real world.

Mobile learning on the other hand can be defined in many ways. It is learning which takes place via wireless devices like mobile phones, PDAs, ipod, palmtop, laptop or even digital cameras and USB keys. In general, however, most students seem to associate mobile learning with the latest wireless and portable device they are using. Mobile learning technology is wireless as the name suggests and it is portable, as the learning tool can be moved with the learner anywhere they want. Learning via mobile is considered to be independent from time and location as it could occur at anytime and in any place. It provides access to an on demand learning content.

Mobile learning can be viewed as a focal point where mobile technologies and web-based learning intersect to offer anywhere anytime instant on-demand educational information. Mobile learning is generally defined as a mean of e-learning which occur through a mobile devices (Trifanova and Ronchetti, 2003). Normally learners have to find a personal computer with internet access to learn something in e-learning. This is cannot be considered as fully anytime anywhere learning (Meisenberger and Nischelwitzer, 2004).

According to Brown (2003) “Mobile technologies have the power to make learning even more widely available and accessible than we are used to in existing web-based learning environments” .He proposes (Figure 1) as a diagram of flexible learning:
Figure 1: The subsets of flexible learning (Source: Brown, 2003)

This diagram shows that mobile learning is a subset of e-learning and e-learning is a subset of distance learning. Even though this assumption is generally true, learning modes have superior characteristics with respect to others. For example, mobile learning provides location awareness applications to learners (Trifanova and Ronchetti, 2003) but sometimes it is very hard to distribute course content to mobile devices. But new technologies are being developed and produced constantly and rapidly.

2.2.2 Mobile Devices

In general mobile devices covers all handheld technology, this may include the followings: PDA (personal digital assistance), Mobile phone, iPod, palmtop, pocket Pc and any device that is compact, autonomous and small enough to be carried around with the learner during their normal everyday activities, and can also be used for acquiring education and knowledge (Trifanova et. al. 2003). (Figure 2) is an illustration of different mobile devices which can be used for learning.
Now with the advancement of new technologies, one mobile device is capable of performing many tasks. For example, the new 3G iPhone or any smart phone contains functionalities to help the users perform many tasks and allow them access to information as required, anytime and from anywhere. This is normally achieved in an interactive way where users felt in control of handling accessibility, management and sharing of resources and information.

Only few years ago one device was able to perform only a task or two, with limited functionality and interactivity.

While the current iPhone (Figure 3) is a revolutionary phone, it is a fusion mobile devices that provide a combination of functionalities, a widescreen iPod, and a breakthrough internet device with rich HTML email and full web browsing, this iPhone 3G redefines what a mobile phone can do, as it can do anything a normal computer with internet connection, and a mobile phone combined together can do.

It is like the internet in the user’s pocket some of its features includes:

- Push email technology
- Photo geotagging
Therefore universities must take advantage of these technological innovations, and use it in cooperation of their current setting to improve accessibility, collaboration, flexibility thus improving the overall learning process among students.

2.2.3 Main Features of Mobile Devices
The recent development of the smart phones like the iphone which was mentioned above has provided an added opportunity and added value for learning. The iPhone was produced by merging PDA’s, iPods, the web, mobile phones and some other technologies to make use and improve mobile devices for education.

The iphone is already popular among learners and it is already making its way to the university’s lab. As today’s students are pushing those devices into their learning process to help them learn faster and in a flexible manner.

Learning via a mobile device is said to improve further, as mobile devices have special features which make them unique and make them stand out, these features are listed below:

- **Portability and mobility**: because of the small size and lightweight of wireless devices, students find them convenient to use and carry with them.
- **Flexibility**: students and educators can access the server from almost anywhere, this includes while traveling or waiting in a queue.
- **Convenience**: Whenever students need to contact teachers or urgently need information from the Internet, remote access is available to them. In particular, accessing the server through WAP (Wireless Application Protocol)
- **Remote Accessibility**: Students can add or update information remotely.
- **Ease of use**: Using an iPhone provides a larger screen than an ordinary mobile phone and it is convenient for user input.
- **Utility**: most of the smart phones provide almost all of the capabilities of a standard computer, such as processing and storing data (Jo et. al., 2002).

Studies done by Meiserberger and Nischelwitzer (2004) showed that mobile phones had some restrictions to be used in education. They summarized and defined these restrictions as follow:

- limited processing power and resources
- variety of screen sizes and the general low resolution of the display
- variety of different input possibilities
- variety of different operating systems(Meiserberger and Nischelwitzer 2004)
But since then technology has come a long way, now mobile devices are capable of processing information as much as a PC does. Now an iPod is more than just a music player, it has functionalities that can be used in many different ways for learning.

These functionalities are listed below:

- Lesson plans
- Audio recording
- Video
- Podcasting
- Notes taking
- Reference
- Quizzes
- Photo capturing
- Calendar
- Interactive content
- RSS feeds

Keeping in mind though that this will always depend on the mobile device in use by the learner. Until now universities don’t have a standardized device to be used by all students; therefore mobile devices may vary among students. Some devices may not have the hi-tech functionality, capacity, and capability as others. Also accessibility to information and the World Wide Web (www) is normally set by the network carrier; this will depend on the plan or deal the user has selected and they have agreed on. This in turn may limit the use of mobile device for learning and for accessing the internet. This is because charges are still being applied, and it is very high comparing to the cost of a normal internet access via a computer.

Therefore selecting the appropriate mobile devices for educational purposes will determine the way students can access learning resources and material, and certain factors must be considered when using mobile devices for learning. According to Singh (2003) these factors can be summarized to cover the followings:

- Cost
• Security
• Battery life
• Display size
• Data input
• Form factor
• Storage capacity
• Processing power
• Communications options
• Application development tools

2.3 Research Issues and Challenges

The introduction of mobile technology alone would not be enough to improve learning; how to design it and how to use it is more important; also the most effective media combinations should be used to convey learning content knowledge and information.

Mobile learning at universities could make an important ingredient for increasing collaboration and information sharing among students. But universities have been adapting the new method without fully understanding its process.

Mobile learning at universities should adapt to the learners, not the other way around. Because new technologies is better used to shape the learning environment to fit the learner’s lifestyle, rather than forcing the learners to adapt to the new learning environment.

We believe a re-blending the learning environment at universities is needed. This may help in successful integration of mobile learning technologies. Mobile learning has the potential to shift the higher education landscape, by enabling flexible collaborative learning, and by providing access to different learning resources from anywhere and at anytime. The contexts in which mobile learning technologies can best illustrate concepts and make the largest contribution have yet to be identified.
The different methods of learning need to be examined. Many studies have focused on learning in general, but collaboration and transfer of knowledge via mobile devices should also be analyzed. Mobile learning technologies is a breakthrough in education. It is important to ensure that it works effectively in terms of transferring knowledge and learning material to the learners. This is especially true if mobile learning is to integrate within existing forms of learning models. Rapid development of mobile technology exposes some opportunities for higher education. Most people use mobile phones in daily life. These mobile devices are being used in education and they are changing situations and environments. Requirements of mobile communication tools for different educational environments, the type of usage for teachers and students, hardware and software standards of mobile communication tools and advantages and disadvantages of these devices are still uncertain. We do not know much about whether these devices can be used to support collaborative mobile learning environment within higher education.

Universities must experiment with the design of mobile learning models to see the advantages and disadvantages of mobile devices in higher education. There is a need to determine how students think about using mobile technology as a supportive learning material and information services.

Many research studies have suggested that mobile devices like palmtop, personal digital assistants PDA, mobile phones, iPods is going to be the next revolution in technology to affect higher education. (Lockitt, 2005).

(Stead 2005) stated that mobile learning is starting to invade the education system in most universities, and the concern is no longer whether mobile learning works affectively but rather how best universities would fit it and integrate it into their current blend of learning methods. (Stead, 2005).

While there appears to be many research studies focused on the potential of mobile technologies, research on affective collaboration and blending methods on how universities can use and adapt to mobile technologies is sparse.
So far the integration of mobile technologies in higher education, in their design, reflects their theoretical approaches. The current practice of pod-casting lectures which mentioned above is growing rapidly, and the attraction for teachers and students is evident.

There have been few projects conducted on the application of mobile learning technology; it is still in its infancy with regard to university applications. The majority of research has been conducted in an informal setting and not within a formal tertiary education setting. (Attewell, 2005), (Sharples, Corlett & Westmancott, 2002; Silander, Sutinen & Tarhio, 2004). In Australia a project was held in 2005 to describe mobile innovations in four TAFEs. The mobile devices were integrated to deliver learning material to learners at their workplace and to deliver creative learning initiatives (Ragus, Meredith, Dacey, Richter, Paterson & Hayes, 2005).

The findings of the project were positive. And evidence shows that these used methods have been ongoing for a period of time and have been evaluated and then changed. According to (Becta,2004), mobile devices are useful where learners need to record information during a lesson, inputting data, extended writing shared information, and working on individual pieces of work thus making mobile technologies easy to integrate into existing curriculum within the university.

An important pedagogical aspect concerning mobile technologies is that they extend the learning environment beyond the university setting, as they are portable, flexible, independent, learner controlled and provide efficient methods of communication (Juniu 2002).

Roschelle (2003) stated that mobile devices may become an appealing choice of technology for learning, because they enable a transition from the occasional, supplemental use associated with normal pc, to frequent and integral use of hi-tech mobile device.
Currently web-based learning technologies are used to meet learners' needs, and have supported flexible learning methods within universities. Although it is said that learners can access information via the computer just in time, it cannot be considered completely accurate because in universities computers are normally in the computer room unless a student has his or her own laptop to carry around. Therefore if the student wants to go online, he or she has to go to a computer room to access the internet. While on the other hand, mobile devices are portable and can be carried around in the learner's pocket, thus making access to information and learning material fast, in time, on demand, and learner controlled. Mobile learning seems to be the unavoidable and imminent reality and it is going to develop further in the near future. Institutions should try to implement mobile technologies to support learning within the university and to support distance courses, because the real anytime, anywhere, on demand and just on time learning can occur only by mobile technologies.

(Wagner 2005) stated that mobile learning is here to stay, whatever we like it or not and whatever universities are ready and prepared for it or not. Therefore we must find an effective and efficient method to include it. Before universities embrace these new technologies, research needs to be conducted in this area. As we discussed before few universities are beginning to introduce mobile learning technologies into their curriculum without fully considering an effective measure, which take into consideration a blended collaborative learning environment, and how this could be achieved via a mobile learning environment. The penetration of mobile technologies into universities cannot be ignored, as it forms part of the e-learning blend, and their importance will continue to grow over the coming years.

We've already seen how blended collaborative learning showed effectiveness in learning outcome at universities, but how could this be applied when learning is being acquired via a mobile device? How could universities integrate and blend mobile technologies within their current system to provide student with an effective mobile collaborative learning environment
2.4 Mobile Learning Model

The introduction of mobile technology alone would not be enough to improve learning; how to design it and how to use it is more important; also the most effective media combinations should be used to convey learning content knowledge and information.

We believe a re-blending of the learning environment at universities is needed. This may help in a successful integration of mobile learning technologies. Mobile learning has the potential to shift the higher education landscape, by enabling flexible collaborative learning, and by providing access to different learning resources from anywhere and at anytime. Research in mobile learning technologies is still in the early stages for determining the optimum display modalities to aid learning and help collaboration among learners in higher education.

It is important to ensure that mobile learning technologies work effectively in terms of transferring knowledge and learning material to the learners. This is especially true if mobile learning is to integrate within existing forms of learning models. Rapid development of mobile technology exposes some opportunities for higher education.

Most people use mobile phones in daily life. These mobile devices are being used in education and they are changing situations and environments. Requirements of mobile communication tools for different educational setting, the type of usage for teachers and students, hardware and software standards of mobile communication tools and advantages and disadvantages of these devices are still uncertain. Universities must experiment with the design of mobile learning models to examine the advantages and disadvantages of mobile devices in higher education. There is a need to determine how students think about using mobile technology as a means for learning.

Stead, (2005) stated that mobile learning is starting to invade the education system in most universities, and the concern is no longer whether mobile learning works affectively but rather how best universities would fit it and integrate it into their current blend of learning methods.
While there appears to be many research studies focused on the potential of mobile technologies, research on affective collaboration and blending methods on how universities can use and adapt to mobile technologies is sparse. Before universities embrace mobile learning technologies, research needs to be conducted in this area. As we discussed before few universities are beginning to introduce mobile learning into their curriculum without fully considering an effective measure, which take into consideration a blended collaborative learning environment, and how this could be achieved via a mobile learning environment. The penetration of mobile technologies into universities cannot be ignored, as it forms part of the e-learning blend, and their importance will continue to grow over the coming years.

We’ve already seen how blended collaborative learning showed effectiveness in learning outcome at universities but how could this be applied when learning is being acquired via a mobile device? How could universities integrate and blend mobile technologies within their current system to provide student with an effective mobile collaborative learning environment?

Therefore redesigning the existing model is required to make place for mobile learning. The new model draws on certain aspects mentioned within the current literature in order to provide a strategy for the effective adoption of mobile technologies in education. Our proposed model takes all the factors influencing the successful adoption of mobile learning, which are also applicable in universities. The model requires necessary policies and standards to be in place; these are beyond the scope of this paper.

According to Naismith et, al. (2004) there is no concrete theory of mobile learning. However, there is a direction towards integrating the use of mobile learning technologies with existing methods of learning but with different approaches, thus making the blended learning approach an effective opportunity to integrate the innovative mobile learning technologies.
Naismith et al. (2004) emphasize that blended approach facilitates learning with mobile technologies, as the approach engages different activities from a number of different theories and practices. Blended learning via a mobile device brings multimedia effects like pictures, animations, video clips, simulations and instant real live images. These multimedia effects are capable of enhancing the learning process, and making learning a pleasant experience for students.

This is also was apparent in a similar study by Issack et al. (2006), the authors stated that even though mobile learning can’t be used for delivering large amount of reading material, but it is rather very effective in supporting small, concise and informative content, which in term can improve the learning process. The authors also considered mobile learning technologies as a value added feature, which can form an effective blend of the pedagogical approach within the learning environment.

Therefore the re-blend of the learning environment at universities is important to change the delivery mechanisms and instructional approaches and to support mobile learning, so learning can become more individualized, learner’s led and controlled, collaborative, shared and interactive.

Few researchers implemented models in which mobile learning technologies can be integrated effectively. Barker, Krull, Mallinson, (2005) proposed a model which clearly illustrates that mobile devices can fit seamlessly within existing setting by providing support for learners via web-based assessment, delivering content, and access to the internet via mobile devices. Their model focused on a mobile learning environment, which can be adapted to encourage and improve traditional learning environment. This environment is supported by effective mobile learning policies and instructions. The communications infrastructure contained a mobile access point, which in term can enable communication among the mobile devices. This model focused in general on the infrastructure, polices and guidelines of the learning environment It used mobile devices as an external support for traditional learning and not as a blended model by itself, which have
the strength to offer learning content in a collaborative, blended and flexible learning environment.

The model requires necessary policies and standards to be in place; these will not be looked at now but will be discussed later.

According to (Naismith et al. 2004) there is no concrete theory of mobile learning. However, there is a direction towards integrating the use of mobile learning technologies with existing methods of learning but with different approaches.

The blended learning approach represents the opportunity to integrate the innovative and technological advances offered by web-based learning and mobile learning with the interaction and participation from traditional learning. (Thorne, 2003)

(Naismith et al. 2004) emphasize that blended approach facilitates learning with mobile technologies. Blended learning approach engages different activities from a number of different theories and practices.

Blended learning via a mobile device brings multimedia effects like pictures, animations, video clips, simulations and instant real live images. The learner is in control of the content. A re-blending of the learning environment at universities is needed to change the delivery mechanisms and instructional approaches, to support mobile learning so learning can become more individualized, learner’s led and controlled, collaborative and interactive. Few researchers implemented models in which mobile learning technologies can be integrated effectively. (A. Barker, G. Krull, B. Mallinson, 2005) proposed a model which clearly illustrates that mobile devices can fit seamlessly within existing setting by providing support for learners via web-based assessment, delivering content, and access to the internet via mobile devices. These mobile devices are able to provide communication in two ways: learner-to-learner and learner-to-teacher, as shown in (Figure 5).
This model for mobile learning illustrated a mobile learning environment, which encourage and improve traditional learning environment. This environment is supported by effective mobile learning policies and instructions. The communications infrastructure is represented by a dotted line contains a mobile access point, which in term can enable communication among the mobile devices. This model focused in general on the info-structure, polices and guidelines of the learning environment. It didn’t show an effective structure which could blend web-based learning traditional learning and mobile learning environment. This model used mobile devices as an external support for traditional learning and not as a blended model by itself which have the strength to offer whole university course content in a collaborative, blended and flexible learning environment. (Becta, 2004) suggests that universities need to contemplate whether they will be able to provide the training and technical support that may be necessary for mobile learning implementation. Moreover, it is important that learners, faculty, administration and
teachers should be involved in the development of the mobile learning environment, thus making it a collaborative blended and flexible environment.

(T. Goh and Kinshuk, 2004) spoke about several mobile teaching and learning system implementations which was done before. They came to conclude that, mobile learning is still in its early stage and researches are still exploring every aspect of it. The mobile learning content can be as simple as SMS to a more complex which can contain most aspects of multimedia technology.

Furthermore (Hsu - Yang Kung & Ming- Yao Wu, 2005) also proposed a framework which contains three important technical components: server cluster, real-time video learning, mobile users and learning environment. It also creates two learning environments: infrastructure and Ad Hoc learning environment. This model can be combined into one hybrid environments. (Figure 6) illustrates the design of this model.

![Figure 6: The framework of mobile learning system. (Hsu-Yang Kung & Ming-Yao Wu, 2005)](image-url)
The design of this model focused on the mobile ad-hoc network, where each node is willing to forward data for other nodes, and so the determination of which nodes forward data is made dynamically based on the network connectivity. It represents a framework of a mobile learning system where mobile learning could take place.

Another proposed model by (Attewell, 2005) in which he considered that the implementation of mobile learning requires five important technological aspects should be taken into account. He classified these aspects as: transport, platform, delivery, media technologies, and development languages. This is illustrated in (Figure 7).

![Figure 7: Technology selection (Attewell, 2005)](image)

Attewell (2005) model basically designed to focus on technology selection when integrating any new model for learning, it looked at technologies that can be used for learning and knowledge acquisition and illustrated the practices which can be adopted when selecting these technologies, making the university, faculty and administration, the leader in this process. The university in the above model does appear to have the power in technology selection to be used to deliver learning content.
The proposed blended mobile learning model will take into consideration the procedures and methods used to design the three models but will focus on co-operating a blended learning environment, and its design will concentrate on an efficient and effective way to blend mobile learning within the currently used setting.

It is will be based on the blended learning model which was implemented by (Lanham 2007), in which it merges online learning and traditional learning to form an affective, efficient blended learning model. Tests, trails and evaluation for the blended model were successful (Lanham, 2007).

It has clearly been shown one approach to learning or the adoption of one environment to learn does not suit every learner, this is even more apparent in today's society than even before. However, before we present the new model for implementation, we shall first review the blended learning model to which our extension of mobile learning will be added.

Blended learning is defined as the combination of characteristics from both traditional learning and e-learning environments (Valiathan, 2002) (Chesterman, 2002) (Cisco Systems, 2001). It is seen a merging aspects of e-learning such as: web-based instruction, streaming video, audio, synchronous and asynchronous communication, etc; with traditional “face-to-face” learning. Blended learning provides educators with the opportunity to combine learning resources and technology from face-to-face and online environment to create flexible learning options for students.

Blended learning can be seen as a mix of the e-learning elements and technologies with traditional forms of classroom training and one-to-one instruction. It is through this mix which we hope to include aspects and technologies of Mobile Learning. The potential of blended learning is almost limitless and represents a naturally evolution from the traditional forms of learning, to a more personalized and focused development path. And the next almost natural progression is to incorporate the mobile technologies into the current learning environments.
The original Blended learning model, as extracted from (Lanham, 2007) and presented below in (Figure 8), incorporates various aspects and methods from the two prominent learning styles of the time, face-to-face and online learning, to create a blended environment in which to conduct learning. The blended learning model focused on providing the platform to allow the creation of a more flexible learning environment. We hope to take this model one step further with the inclusion of mobile learning and technology.

2.4.1 The Blended Learning Model

Before we present the new model for implementation, we shall first review the blended learning model to which our extension of mobile learning will be added.

Blended learning is defined as the combination of characteristics from both traditional learning and e-learning environments (Valiathan, 2002) (Chesterman, 2002) (Cisco Systems, 2001). It is seen a merging aspects of e-learning such as: web-based instruction, streaming video, audio, synchronous and asynchronous communication, etc; with traditional face-to-face learning. Blended learning provides educators with the opportunity to combine learning resources and technology from face-to-face and online environment to create flexible learning options for students.

Blended learning can be seen as a mix of the e-learning elements and technologies with traditional forms of classroom training and one-to-one instruction. It is through this mix which we hope to include aspects and technologies of mobile learning. The potential of blended learning is almost limitless and represents a naturally evolution from the traditional forms of learning, to a more personalized and focused development path. And the next almost natural progression is to incorporate the mobile technologies into the current learning environments.

The original blended learning model, as extracted from (Lanham, 2007) and presented below in (Figure 8), incorporates various aspects and methods from the two prominent
learning methods of the time, face-to-face and online learning, to create a blended environment in which to conduct learning.

The blended learning model focused on providing the platform to allow the creation of a more flexible learning environment. We hope to take this model one step further with the inclusion of mobile learning and technology.

The main function of blended learning is to use the strengths of one learning environment to improve the weaknesses of another learning environment, therefore creating a stronger basis for students. So blended learning is a means of bridging the gaps of traditional classroom learning and contemporary online learning, as shown in (Figure 4).

<table>
<thead>
<tr>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• can be repeated as many times as possible</td>
</tr>
<tr>
<td>• suitable for review, etc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• lack of collaboration / easy to feel isolated</td>
</tr>
<tr>
<td>• do not know your peers in person, etc</td>
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<p>| |</p>
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<tbody>
<tr>
<td>• easy to collaborate</td>
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<tr>
<td>• know your peers in person, etc</td>
</tr>
</tbody>
</table>

**Figure 8:** The Blended Learning Model (Lanham 2007).

From the above figure we can see that blended learning provides a bridge between the two extreme learning styles. It suits a broader range of student types as it is not specifically designed for any one group of students.

Blended learning sits between classroom learning and online learning, taking elements of each environment to produce a blended approach in order to create a more comprehensive learning environment in which to engage students.

Therefore with the importance on creating flexible learning environments for all students blended learning has been regarded as an appropriate approach.
It is our intention through to take the existing blended learning model and adapt it to include the new frontier of Mobile Learning.

2.4.2 A Layered Architecture

The blended learning model consists of three major levels with the overall umbrella level of blended learning itself rounding off the model at the top level. The levels of the model as presented in (Figure 9) and are described as follows:

- Policy level
- Mechanisms level
- Implementation level (Lanham, 2007).

Each of these levels within the model holds a specific role and purpose, however they all share a common goal and that this to ensure the successful implementation of the model.

![Figure 9: Blended Learning Model Architecture (Lanham 2007)](image)

The policy level of the model outlines the key components that need to be included within the Blended Learning Model. These components are the elements that need to be
taken into consideration when designing any blended learning environment. At policy level we can expect that the individual policy would have to be approved by a governing body, i.e. the University, before the items could be included within the model (Lanham 2007).

Once the key components have been identified and included within the model, the next stage is to support those components. This support of the policy level is provided in the mechanism level. Within this level methods of addressing and including the key components are discussed and created. At this stage of the model we should ask the question "What mechanisms do we need to support the policy level?" Different policy decisions may result in a different set of mechanisms to be used. However, the same mechanism may be able to support (or partially support) a number of policies. In the case of this thesis we have two main themes that we are perusing and they are:

- Promoting collaboration amongst online students.
- Providing a means for students who learn through repetition or rote learning

The final stage of the model is to provide support for the mechanisms through implementation using various technologies. Due to the nature of the mechanisms in place, the support chosen is as follows:

- To support the online collaboration, an online editable web site was selected to promote students working together to produce a final outcome using principle used in the classroom environment.
- To support the repetitive learning style of some students, an online repository where students can go repeatedly and access the store unit resources (Lanham 2007).

3 The Proposed Blended Mobile Learning Model

We take the existing blended learning model and adapt it to include the new frontier of mobile learning. Previous researches have shown that mobile learning is more effective when it is used as part of an existing blend (Stead, Sharpe, Anderson, Cych, & Philpott, 2006). So mobile learning can be blended in as an additional method, which combines
web-based and traditional learning environment, to form an effective, flexible, collaborative and efficient learning atmosphere.

Therefore the proposed blended mobile learning model is to integrate seamlessly with the current learning environment. It provides learners with anywhere, anytime, and in real-time learning. The model makes students able to customize their ways of receiving their learning material, based on when and where they are. The model also supports multimedia and short text-messaging and instant polls. Through these venues, students can ask questions and make suggestions, download material, reuse these material and share and collaborate with other students and with the teacher in real time,(Figure 10) illustrates the blended mobile learning model.

Figure 10: The Blended Mobile Learning Model

It is proposed through the above model (Figure 10), that the addition of mobile learning to the original blended learning model will enable us to incorporate the current trend of mobile technology into the innovative learning environments faced by Universities. We also took into consideration the advantages and limitations of each method as listed within the blended mobile learning model in (Figure 10). These advantages and limitations will be carefully examined and considered during the implementation and testing stages.
The blended mobile learning model is to form an effective learning environment; it fits within and form part of the online, the blended and the classroom learning models. Each one of them with its unique advantages and specific limitations are believed to be therefore mobile learning model is most effective when used in conjunction with both online and classroom learning, thus making the learner in control of which method they would choose to learn. This was clearly apparent by (Jarvela and Hakkinen, 2005) as they suggested that by breaking down the learning process into distinct activities, the technology in use can mold the learning process around the learner's lifestyle rather than forcing them to adapt to the learning method itself.

It is through the integration of mobile technologies that we shall test our models effectiveness and efficiency.

The architecture for the model design is presented in (Figure 11) it is a brief illustration of how communication is achieved via a mobile learning environment.

The model can be easily adapted to be used within university environment in conjunction with web-based learning environment and the classroom environment. The proposed model is to help support sharing and collaboration among students and encourage teachers to take the challenge to integrate mobile technology for educational purpose, and start to blend them within their curriculum.
4 Conclusion and future work

Learning is a continuous process, not just a one off knowledge acquisition experience. Therefore with the integration of blending mobile learning into the learning environment, we are extending the learners reach to the learning materials, and improving their accessibility to course content.

A blended mobile learning environment will provide a more natural and flexible way to learn. It will use the major components of each of the learning environments involved to create a comprehensive coverage of all learning methods.

In this survey we have proposed a model which takes into consideration all aspects of learning via technology, and how best to successfully integrate mobile devices into the university sector. It is through further discovery and research that we hope to expand our

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Figure 11: The Architecture of the mobile learning model
model further to provide a layered and complete prototype for implementation into Universities, covering all major level of infrastructure.

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