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Wi-Learn: An Innovative Learning Paradigm for the University of Mauritius

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Abstract

A new teaching and learning paradigm is emerging from the convergence of mobile and wireless communication and handheld computers. As mobile technologies are becoming more pervasive especially with support for a rich social interaction, mobile-learning (m-learning) emerged at the point where e-learning melts into mobile computing. The innovative aspect of m-learning is that learners and teachers will be untethered with a particular location. In this paper, we present a novel system, Wi-Learn, which will transform the existing methods of learning using wireless and mobile technologies at the University of Mauritius (UoM). Mobile learning through wireless enabled devices within the university campus can greatly enhance

learning at UoM. It is not a replacement for the core learning process, but we are certainly keen to use mobile learning to enhance and supplement it. The proposed system, Wi-Learn, enfolds a set of mobile collaborative applications, such as wireless file transfer, multiuser whiteboard sharing, audio and video conferencing, voting poll, SMS breaking news and revision quiz, using different wireless communication technologies.

Keywords: *M-learning, pervasive, education, WiFi, Bluetooth*

1. Introduction

Mobile technologies have become an integral part of the life of both teachers and students. We take photos, record audio and video which we are able to share, at a click, with our friends or colleagues who are physically far apart. The challenge for educators today is to understand and explore at how these new technologies can support learning. The worldwide trend is towards mobile learning. Educators and students are benefiting from mobile learning by supplementing the traditional classroom and extending it to permeate every field of activity. Students are able to study on the move as and when they have time.

However, students of the University of Mauritius (UoM) are not taking full advantage of this phenomenon. UoM currently uses the following platforms to deliver notes, namely (1) shared folders accessible via a Local Area Network, (2) Moodle website (CSE Moodle, 2007), (3) Manhatan and (4) I-Learn. Despite most students of the UoM uses mobile devices like a laptop, smart phones or PDA, and a wireless network is in place, these facilities are under-utilised. Students access their lecture notes by logging on a personal computer wired to the LAN server. This is becoming increasingly difficult as the number of students is growing every year and further straining the IT resources. Due to this increase in the student population, there is the problem of limited access to the labs. Thus, students are incapable of downloading lecture materials from the LANs on time. As the UoM is committed to the advancement of learning through teaching and research, it strives to provide an environment that fosters the achievement of full potential among its students, faculty and other staff. The existing traditional ways of learning and the wired system prevalent at the university have shortcomings due to its immobility. The traditional classroom learning environments, where all the educational activities are carried out at a

designated time and place, are no longer attractive. Desktop computerised education extends the range of education to places where wired connection is available.

2. Related Projects

With the mindset of the world going mobile, m-learning is an emerging area of research with promising and exciting benefits in the learning arena. Leung C. H. And Chan Y. Y (2003) described m-learning as a new paradigm in e-learning and also proposed a framework for m-learning. A number of m-learning projects and research centres emerged to fulfil the trend in the demand for learning anywhere and anytime; mainly Futurelab (Laura et al. 2004), MOBI (IT School of Innovation 2007) and Synchroneyes (G. Hawkins et al. 2007), to mention a few. Futurelab is a non-profit organisation that incubates new ideas in m-learning by providing the necessary support to take them from lab to classroom. MOBI, launched by the IT School Innovation, allows users to chat, listen to the latest music hits and learn on their phones, i.e. turning mobile phones into edutainment devices. MOBI Maths gives the user access to tutorials in the form of streamed videos.

"Synchroneyes" (G. Hawkins et al. 2007) is a classroom management tool which allows students to connect to the system wirelessly using a PDA. The software allows the teacher to constantly monitor pupils' work and share the work with the rest of the group. Each device is displayed as a thumbnail which can then be broadcasted to all users, observed and annotated by individuals or the group as a whole. In addition files can be transferred to and from the teacher, so a particular document can be wirelessly "copied" to all or some devices worked upon and then "copied" back to the teacher. There is also the option to generate quizzes and voting facility.

3. Proposed System: Wi-Learn

The existing m-learning systems do not provide an all-in-one solution for the all the possibilities of m-learning at a University. The Wi-Learn platform underpins all the mobile learning activities using wireless technologies at UoM. A number of applications have been developed so that students and lecturers can have easy interaction with each other using their wireless devices such as laptops, mobile phones, PDAs and personal computers. These applications use technologies like Bluetooth (IEEE standard 802.15.1, 2004), WiFi (Wireless Fidelity – colloquial for IEEE standard 802.11, 2004) and existing cellular networks. The architecture of Wi-Learn is shown in Figure 1.

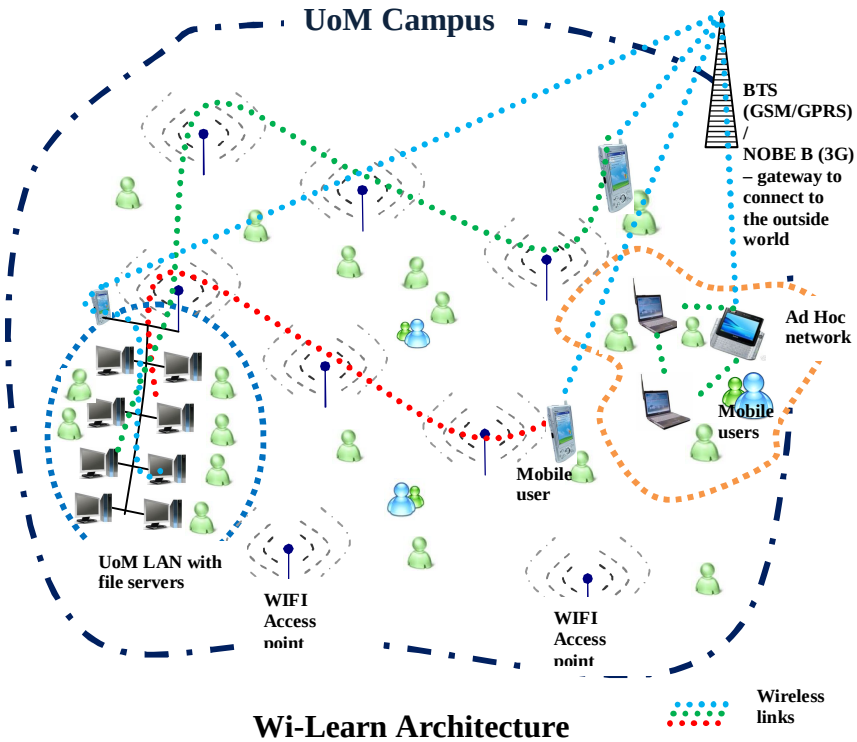

Figure 1: Wi-Learn Architecture

The ultimate goal of Wi-Learn is to improve the learning experience of students through innovative features that will not only support traditional

methods of learning but also raise the interest of users in discovering new subjects. The Wi-Learn System brings a new dimension in the learning process through initiative of knowledge acquisition, interactivity of the learning process, mobility while learning and through the use of state-of-the-art technologies.

With the introduction of Wi-Learn system, the main facilities that comes at the forefront are (1) **wireless file transfer** over Bluetooth, for small file and short distance, and WiFi, for larger file over longer distances, (2) **multiuser whiteboard** for collaborative tasks especially when working out the design part of assignments, (3) **audio and video conferencing** facilities for group discussion on campus, (4) **Voting poll** for conducting surveys and supporting collective and quick decision-making, (5) **SMS breaking news** to disseminate information to students of the University, even when they are not on the campus and (6) **Revision quiz** to instil learning or simply as consolidation exercises. Figure 2 shows the different technologies underpinning the different applications of Wi-Learn.

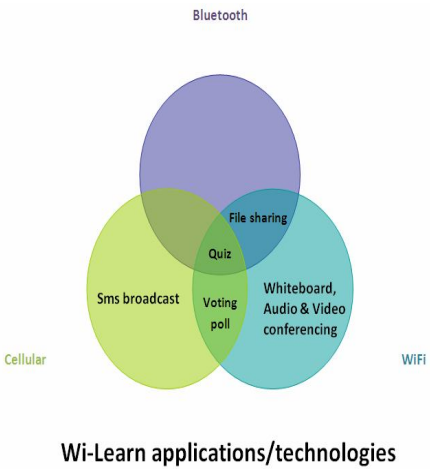

Figure 2: Wi-Learn applications/technologies

Multiple cases (see section 6) were used to illustrate the relevance and usability of the Wi-Learn in the educational system. These mainly included the virtual classroom, the dissemination of breaking news and the assurance of time-on-task.

4. Technological Analysis

In order to assist the process of selecting development tools and planning delivery technologies, a Technology Selection Roadmap was developed. The road mapping process was carried out by identifying, evaluating, selecting technologies and revisiting selection decisions frequently in the light of experience and the emergence of new technologies. The roadmapping process was undertaken to ascertain what technologies were available and how they might serve the project's aims and objectives. Four broad categories of technology were identified, within which specific technologies would need to be selected, these were: transport, platform, delivery and media technologies and are shown in figure below:

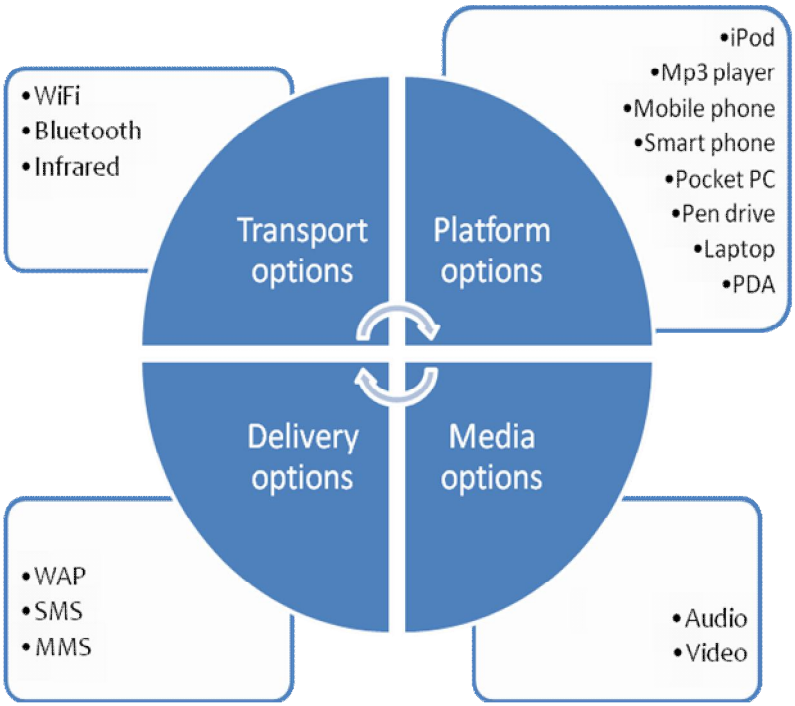

Figure 3: Technological analysis

After analyzing the different wireless technologies, WiFi and Bluetooth technologies have been opted as Wi-Fi covers greater distances and gives higher throughput which will certainly cover the scope of the mobile learning system. Moreover, the University of Mauritius has recently started

to offer a free Wi-Fi network in collaboration with the Enterprise Data Services Ltd.

Audio media will help students listen to lectures whilst they are on the move while video would extend to them an additional facility of visualising a lecture or a demonstration. Teleconferencing would greatly facilitate mobile learning as students and tutors can log in at any time for an interactive class in the comfort of their homes.

The following table shows an evaluation of the different available platform in the digital domain:

Device	Supports	Pros	Cons
iPod	Download podcast, audio and video Lectures Mic Input	Portable Handy Multimedia Support	Small Screen Size Not Interactive Expensive
MP3 Players	Podcasts Audio Lectures, Books Audio Recording FM Radio	Light Handy Upgradeable Affordable	Not interactive Data transfer and encoding is time consuming
PDA	Audio Video Communication	Relatively large Screen 2- way communication Multimedia	Expensive Not suitable to carrying casually as it is does not fit in a pocket
Pen Drive	Mass storage of audio, video and data files	Small and Handy Not Battery USB allows fast data transfer	Only a storage device
Smart phones	Features of PDA Camera Video Recording Mass Storage Internet Access	Powerful communication device	Expensive Small screen size Small keys
Pocket Pcs	Communication Audio Video Email Surfing Web	Support Windows OS Handy	Expensive No full length keyboard
Laptop	Communication Multimedia Surfing Networking	As powerful as a PC Prices are declining	Cumbersome to carry Cannot be used while walking
Mobile Phones	Communication, Multimedia	Widespread Use Easy to carry	Small screen Small keypad

Table 1: Platform options

In order to better understand the current use of technologies among University of Mauritius students, a survey was conducted and 110 students responded to the survey. Mobile phones are among the most popular device among students, 108 out of 110 students have mobile phone and it was found that the 2 respondent who do not possess a mobile phone actually possessed a smart phone instead. PDA and Pocket PC both have a very low penetration rate among the students as shown in figure 4.

Figure 5 shows that a large majority of students preferred the SMS technology (99.1%) as compared to MMS (19.1%) and WAP (19.1%).Thus, for the dissemination of information SMS medium would be a more appropriate option.

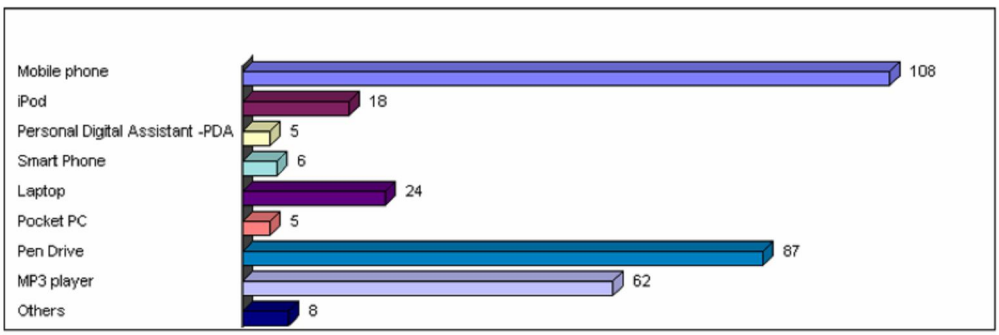

Figure 4: Mobile devices

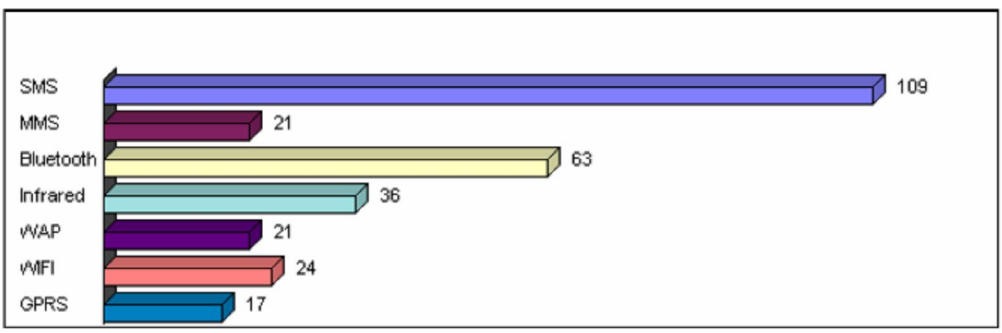

Figure 5: Communication technologies

5. DEVELOPMENT PLATFORM

The components of the development environment are Java JDK 5.0, J2SE Running Environment, Java Swing, Java RMI, Java AWT, Java Media framework 2.1.1, Avetana Bluetooth libraries and Bluecove Libraries. The Eclipse IDE was used.

The database and OS on the server are MySQL and Ubuntu Server respectively. The wireless access points used supported the IEEE 802.11b/g. The devices used for the clients were mainly laptops and mobile phones. The OS installed on these mobile devices varied but they required the installation of the Java Virtual Machine. Most of the laptops were equipped with Wi-Fi and Bluetooth while most of the mobile phones had Bluetooth only.

6. TESTED LEARNING SCENARIOS WITH WI-LEARN

The ultimate goal of developing this system is to improve the learning experience of students through features that are not available in traditional methods of learning. The Wi-Learn System will support a new dimension in the learning process through initiative of knowledge acquisition, interactivity of the learning process, mobility of learning setting and through the use of state-of-the-art technologies. Figure 6 shows the main interface along with the available implemented features. After having successfully logged on the system, members can choose which subsystem they want to access. The case study methodology was used to show the significance of the proposed system in the learning arena. The experimentation was carried out using multiple cases with students of the Computer Science and Engineering department of the University of Mauritius and several usage scenarios of the different features are presented in the following subsections.

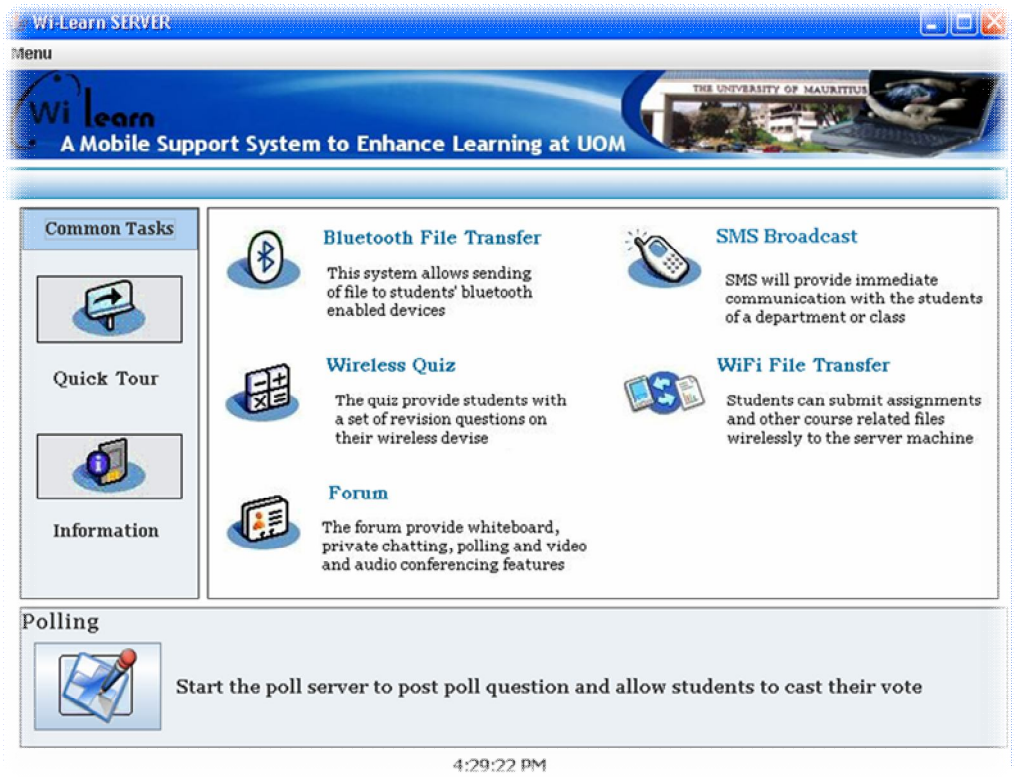

Figure 6: Wi-Learn interface with main features

7. EASY FILE SHARING

Lecturers and students of the CSE department were able to communicate in ad hoc fashion. Students submitted assignments wirelessly while lecturers posted lecture notes and other important documents to student using this file transfer system. Large files sharing and transmission are done using WiFi and smaller files like a picture or short additional notes are successful over Bluetooth transmission.

8. SHARED WHITEBOARD

The forum includes an interactive whiteboard, shown in figure 7, for users to share ideas and sketches. Group discussions in classes become more

interesting especially when the expected outcome is graphical, for example drawing of models (Entity-Relationship diagram, flowcharts) prior to implementation. Proulx et al. (1996) pointed out that students are growing with all sort of technological devices with nice user-friendly graphical interfaces. As such, here students' exercises are graphics-rich.

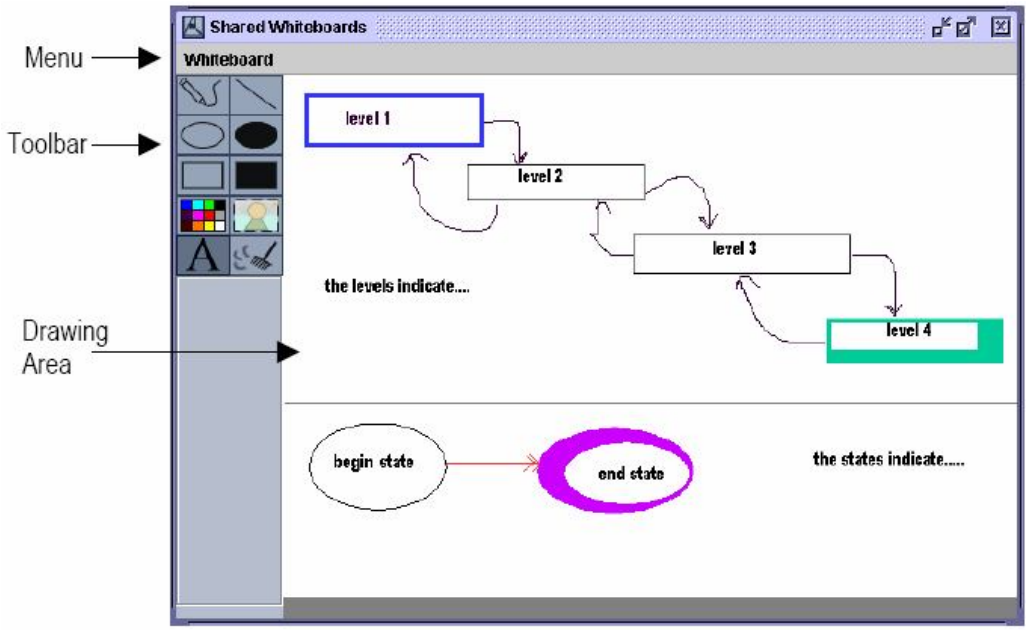

Figure 7: Shared whiteboard

As computers are paving their way in the daily human environment, Ratto M. et al. (2003) and Anderson J. et al. (2003) proposed the use of wireless technologies to the setting up of a classroom feedback system. The voting poll of Wi-Learn has been used to determine the understanding of a topic at the end of a lecture. Students' responses are collectively assessed and presented to the lecturer as shown in figure 8. Using this method, it was now possible for lecturers working with large cohort at the University to gather feedbacks from all students very efficiently and can adjust explanations' depth dynamically, based on the actual understanding of students.

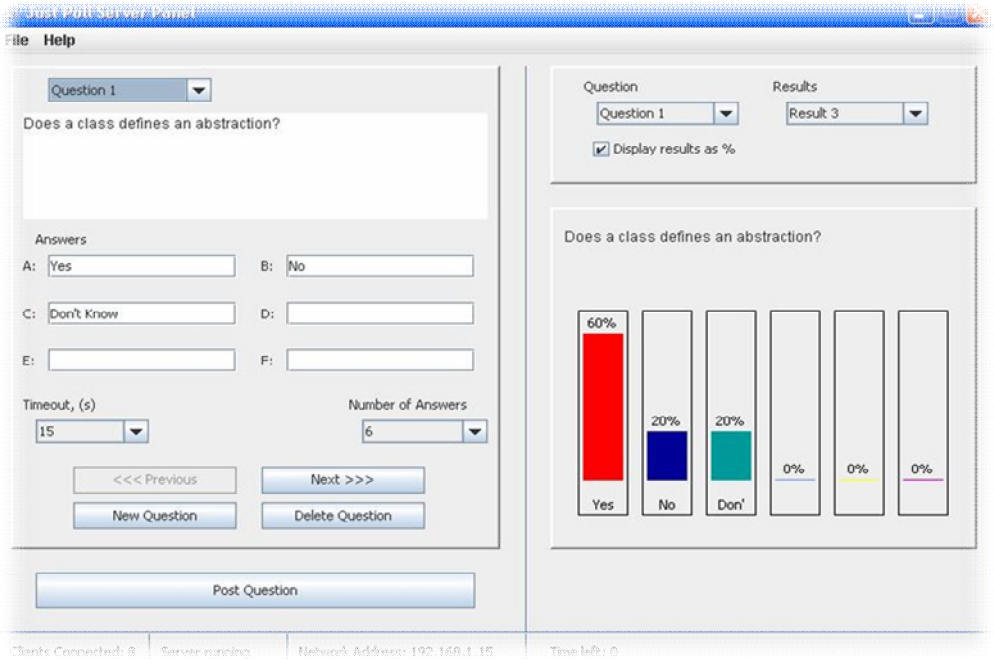

Figure 8: Voting poll

9. VIRTUAL CLASSROOM

When students and lecturers were not in the same classroom, it was still possible to hold a virtual classroom with the audio-video conferencing module combined with the shared whiteboard. At the same time, students were able to send instant messaging to selected recipients using the chat module. As such, at times, the lecturer received comments from one student which is meant as a collective response from the learners. Another advantage of this learning method was that unlike the case in classroom, students were much less intimidated to send a query to their lecturer as they can also initiate a one-to-one chat session and raise an issue at the discretion of their class mates. As a result, lecturers were able to formulate reports on Frequently Asked Questions and also state or clarify common misconceptions in the study guide of their respective modules.

10. DISSEMINATING BREAKING NEWS

The SMS breaking news uses a laptop or personal computer to do an SMS broadcast. The computer is connected to a mobile phone using Wi-Fi, infrared or Bluetooth wireless technology. It can also have a wired connection using a serial cable or a USB cable.

The performance of the SMS breaking news depends on the transmission technology being used. The breaking news can employ any one of the following technologies - GSM, GPRS, UMTS or HSDPA. However, using GSM, no significant latency issues was reported by students receiving the breaking news although GSM is the slowest mode. The different technologies are listed in ascending order of transmission speed in the following table.

Technology	*Required Hardware*	*Transmission Speed*
GSM	2G Mobile phone	Low maximum 14.4 kbps
GPRS	2.5G Mobile phone	Low maximum 85.6 kbps
UMTS	3.0G Mobile phone	High maximum 384 kbps
HSDPA	3.5G Mobile phone	High maximum 1.8 mbps

Table 2: Technology vs Transmission speed

11. TIME-ON-TASK

It is a very common issue in the educational system in keeping students actively engaged in the learning of a subject after the regular class session. The revision quiz game helps students on their time-on-task.

Students, who are usually more than punctual for lecture, had the opportunity of spending some time taking a revision quiz as a short personal recapitulation session, shown in figure 9. This game has two milestones, one at 45 and another one at 75 marks. If a student passes the first milestone and could not answer to a particular question before reaching the second milestone, the student obtains the mark of the milestone else he/she obtains no marks. During the game however, the student may ask for help, either from a friend or from the public (a random poll generated to state the possible correct answer) or otherwise opting for the 50:50, which eliminates two wrong answers out of the four options.

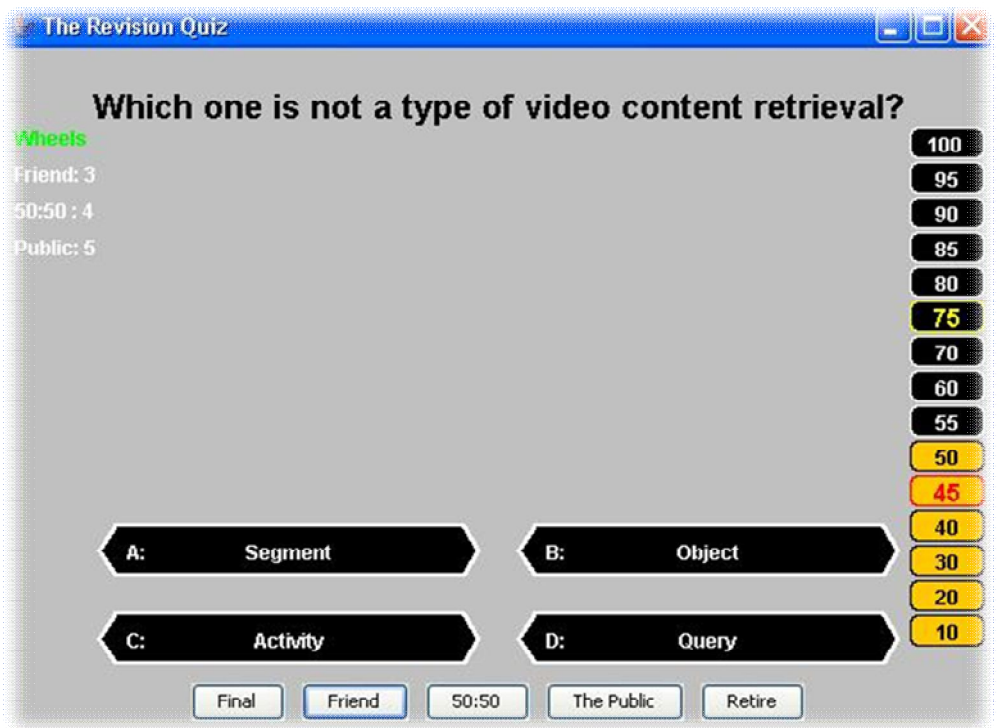

Figure 9: Revision quiz interface

12. EVALUATION OF WI-LEARN SYSTEM

In this section, we present the performance evaluation of Wi-Learn. We have also checked how far all the requirements have been met. Then the pedagogical benefits of the system are discussed.

13. EXECUTION TIME OF WI-LEARN FEATURES

The following features were tested and the time taken was recorded as follows:

Features tested	*Time Taken(seconds)*
SMS breaking news (for 8 mobile phone users)	• 46 (using GSM) • 39 (using GPRS) • 30 (using UMTS) • 22(using HSDPA)
Polling	Almost instantaneous
Send file via Wi-Fi	2
Whiteboard	Almost instantaneous
Video Audio Conferencing	Almost instantaneous

Table 3: Execution time of Wi-Learn features

14. REQUIREMENTS EVALUATION

The table below shows the initial requirements and the corresponding features achieved in the Wi-Learn project.

Initial Requirements	*Functional Feature in-place*
Communication on wireless network using mobile wireless devices-Laptop ,Mobile Phone and PDA	Wi-Fi File Transfer, Bluetooth File Transfer, Audio/Video Streaming, SMS Broadcast, Revision Quiz Game, Chat System
Easy file sharing methods	Wi-Fi File Transfer, Bluetooth File Transfer
Mobile Learning	Wi-Fi file Transfer, Bluetooth File Transfer, Audio/Video Streaming, SMS Broadcast, Revision Quiz Game, Chat System
Instant dissemination of information	SMS broadcast
Interactive Learning and group discussion	Forum, Revision Quiz Game, Chat System, Interactive Whiteboard
Security	Password Protected
Continuous Assessment of students	Polling, Live Revision Quizzes

Table 4: Evaluation of functional requirements

The following table shows the evaluation of the non-functional requirements of the system.

Features	*Evaluation*
Usability	A new user would require an average of 15 minutes training to start using the system effectively.
Efficiency	The system would supplement the existing system at UoM and greatly facilitate learning.
Reliability	The system behaves as expected 95% of the time. It is incompatible with certain types of mobile phones.
Security	The system is password authenticated. Passkeys are used to validate Bluetooth devices.
Performance	The system can handle multiple clients simultaneously and responded in less than 1 second in 98% of cases under test conditions. For bulk SMS the system takes a few seconds.

Table 5: Evaluation of non-functional requirements

15. EFFECTIVENESS AND PEDAGOGICAL BENEFITS OF WI-LEARN

A sample of 50 students who has used the Wi-Learn system was surveyed about the effectiveness of the system to their learning experience. The promising results are summarised in the following charts: (1) the ease of use, figure 10, (2) the most useful feature, figure 11, and (3) the rated effectiveness, figure 12.

The main pedagogical benefit that was noted from the system is an overall increase in interests for students to communicate among themselves and to

discuss module contents. Also, as students are living in an electronic gadgets-rich world, they are more at ease, active and inspired to work in a state-of-the-art learning environment. Unlike in traditional classrooms where the majority of students usually get bored and pray for the end of the class, with Wi-Learn, students impatiently wait for the next interactive learning session. This is mainly because they are given the opportunity to make use of their latest mobile gadgets while learning.

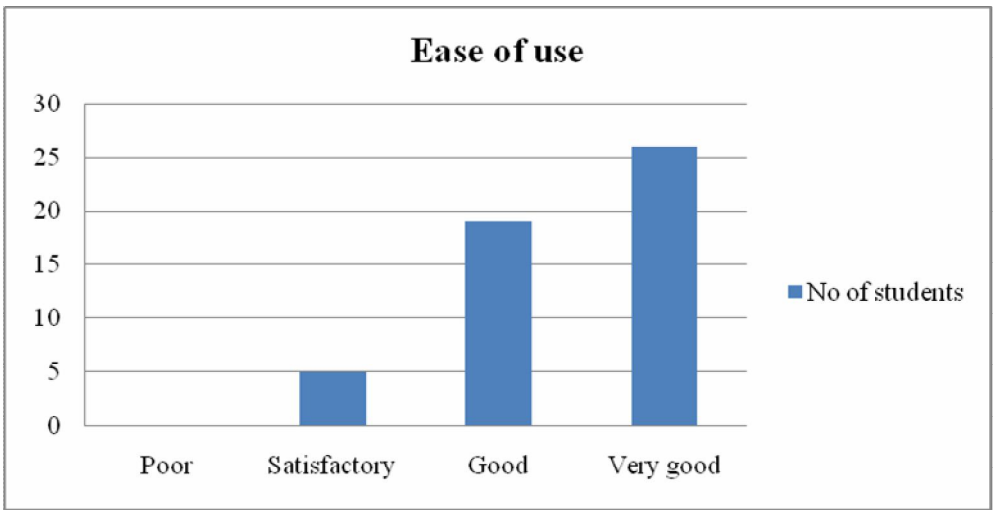

Figure 10: Ease of use of Wi-Learn

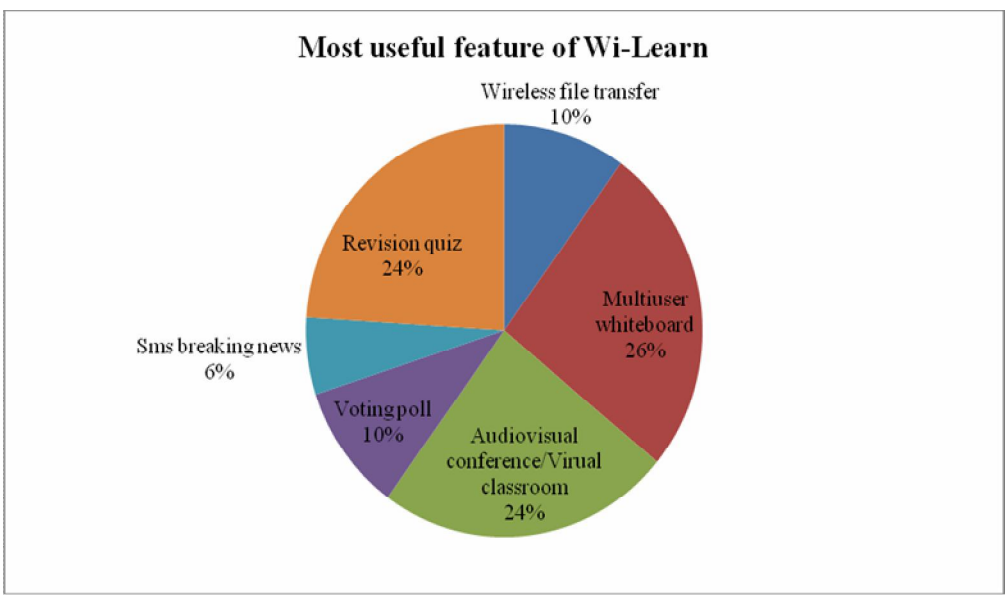

Figure 11: Most useful feature of Wi-Learn

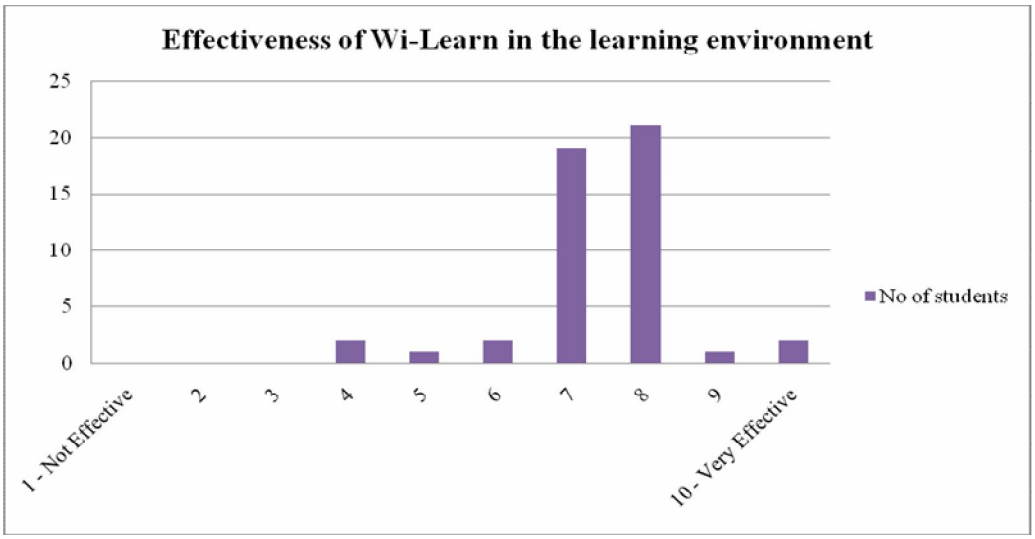

Figure 12: Effectiveness of Wi-Learn in the learning environment

16. CONCLUSION

Unlike other m-learning platform, Wi-Learn, with its wide range of applications, is the all-in-one package for wireless and mobile interactive learning at a University. The Wi-Learn platform offers various facilities including: Chat, Video conferencing, Voting Poll, Wi-Fi file transfer, Bluetooth file transfer, whiteboard, revision quiz and SMS broadcast. The downloading of notes by students do no longer require a seat in the lab. Moreover, the collaborative features of Wi-Learn did not only enhance the coordination of assigned tasks to students, but at the same time, students seemed to be more motivated to collaborate when it comes to using their personal high-tech devices. Wi-Learn is also the 'just-in-time' logistic for the instant dissemination and collection of information cutting across the highly dynamic mobile university students, lecturers and management staff. Wi-Learn did not only enhance the traditional classroom-based learning, but also cut the high cost in getting people to and from their learning venues especially by participating in virtual classroom.

Further enhancements can also be made to Wi-Learn. It can be augmented to include more facilities like SMS quizzes. Other possible improvements that can be brought are (1) live broadcasting of classroom lectures, (2) adding specialised databases to answer student questions, (3) ability to update the knowledge base, and (4) engage more resources like television, radio and internet to reach even more people. Furthermore, this project should extend to all departments of the University of Mauritius so that everyone could benefit from the applications of Wi-Learn platform.

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