Mobile Learning System with Notification and Reminder

by

ZHAFARI ISMAIL

Dissertation submitted in partial fulfilment of
the requirements for the
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(Information & Communication Technology)

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CERTIFICATION

CERTIFICATION OF APPROVAL

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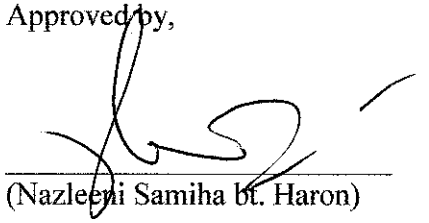
Approved by,

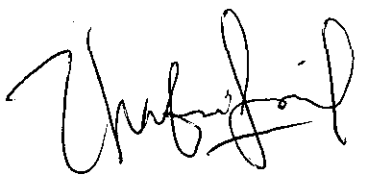


(Nazleeni Samiha bt. Haron)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
December 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



ZHAFARI ISMAIL

ABSTRACT

The purpose of this research project is to make the E-Learning system in Universiti Teknologi PETRONAS become more human-oriented. This can be achieved by transforming the existing E-Learning system into M-Learning system with context-awareness features. The problem of the existing system is lack of accessibility via mobile devices and notification-less framework of learning process. Hence, the scope of study involves in this project is mobile learning technology and context-awareness concepts. This project is developed using Phased Development Methodology. This methodology emphasizes the separation of system component development. At the end of this project, result proves that the idea of mobility and context-awareness does have significant potential to enhance the university's learning process and thus improving students' performance as whole.

ACKNOWLEDGEMENT

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Good luck to us all.

ABBREVIATION AND NOMENCLATURES

E-Learning	Electronic Learning
FYP	Final Year Project
GPRS	General packet radio service
M-Learning	Mobile Learning (interchangeably used with abbreviation)
PDA	Personal Digital Assisstant
UTP	Universiti Teknologi PETRONAS
3G	Third Generation Mobile Telephony

Android	Operating system for mobile devices such as smart phones and tablet computers, developed by the Open Handset Alliance
Context-Aware	(also Context-Awareness, Context-Awared) The ability of a system application to perceive environment contexts and behave accordingly
iOS	Operating system specifically designed for iPhone, developed by Apple Inc.
iPhone	Unique brand name for Apple's smart phone
Learnability	The ability of a system to be learn easily by user
Phased Development Methodology	System development methodology where the system is released in phases
Symbian	Operating system for mobile devices such as smart phones and tablet computers, developed by Symbian Ltd., maintained by Accenture
Usability	The ability of a system to be used easily by user
User Experience	The way a person feels about using a product, system or service
Web 2.0	Technology of web applications that facilitate participatory information sharing, interoperability, user-centered design, and collaboration on the World Wide Web
Windows Mobile	Operating system for mobile devices such as smart phones and tablet computers, developed by Microsoft Corporation

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Learning is a process of continuously acquiring knowledge and skills. A higher set of learning process would be able to make a man to become smarter and skilful. There are two types of learning process – formal learning process and informal learning process. Formal learning process includes the hierarchically structured school system that runs from primary school through the university and organized school-like programs created in business for technical and professional training [1]. Meanwhile, informal learning process describes a lifelong process whereby individuals acquire attitudes, values, skills and knowledge from daily experience and the educational influences and resources in his or her environment [1]. Moreover informal learning process accounts for over 75% of the learning process of a normal person itself.

Nowadays, the learning process has gone through major changes in the human race development. The advent of mobile technologies and and wireless internet connections combined with the concept of informal learning process is the latest technologies used has revolutionize the education which enable the students to learn anytime and anywhere [10][1]. Mobile learning (or M-Learning) is the achievement of E-Learning on mobile computing devices (Personal Digital Assistants (PDAs), Pocket PCs, Android, iPhone and etc) [13]. Mobile learning can be distinguished "by rapid and continual changes of context, as the learner moves between locations and encounters localized resources, services and co-learners" [12].

Context is a key in the design of more adaptive mobile learning systems [14]. Meanwhile context-awareness is an element that must be integrated within the systems in order for it to be truly effective [15]. Context-awareness allows users to receive contextually relevant information from the mobile devices in varying contexts, locations and surrounding environments. It also provides better support for variety of learners and give them different sets of skills and motivations to learn in varying contexts.

Therefore, this project is mainly about the integration of mobile learning techonolgies and context awareness to the existing E-Learning system in Universiti Teknologi PETRONAS as an effort to provide a better medium for the students to enjoy learning process. This project will help the students to understand more effective and allow them to build a personalized learning experience that fits thier constraints in terms of preferences, speed of learning, consumed time, and background information [13].

In this project, student's contexts to be considered are student's awareness of new tasks in the mobile learning system. Whenever a new task is posted, student will be notified. Besides notifications, student will also be reminded for any pending tasks that have not yet been performed. Android will be used as the development platform for implementing this project.

1.2 Problem Statement

1.2.1 Immobility of Existing E-Learning System

One of mobile applications that are useful for students is M-learning. M-learning is software that acts like an assistant for students in their learning in academics. However, this application was not used widely by the students because of lack of immediate learning assistance, limitation of the screen interface and incovenient operation which make the learner is unable to receive learning resources in a timely manner [16].

A survey has been conducted to 114 UTP students on E-Learning usage. Results have shown that the most UTP students only login to E-Learning from their hostel rooms via laptop and desktop computers even though they do have Internet-enabled mobile phones. The detail of this survey is described in Chapter 4.

1.2.2 E-Learning's Unawareness of Students Context

With the expansion of mobile devices, the usage of context-aware mobile applications is becoming very popular. Context-awareness have made computing become more human-oriented rather than machine-oriented. Human-oriented here means the system is reaching users while machine-oriented is otherwise. However, the current E-Learning system in UTP is still considered as machine-oriented. For example, if a new quiz is posted in E-Learning, lecturer still need to informed the students in class. Other than that, sometimes students forget deadlines of assignments and miss out new notes posted in E-Learning. In these examples, the contexts include student's unawareness of new tasks and deadlines.

Survey has proved that students still need to login and check manually for new materials and announcement. Students will have troubles if they miss out anything important posted in the E-Learning.

1.3 Objectives

The general objective of this project is to develop an M-Learning system more human-oriented from the existing E-Learning system by adding mobility and context-awareness features.

1.3.1 E-Learning to M-Learning

The existing E-Learning system in UTP is web-based and conventionally accessed via web browsers. Although mobile phones is equipped with web-browsers, the display of E-Learning site is not optimized for mobile views. In addition, some functionalities involving extensive interactivity do not work properly in mobile web browser.

The objective of this project is to develop an M-Learning system which is accessible via mobile phones as an application rather than web page. With proper mobile accessibility, students can access the system anywhere given Internet connectivity is available.

1.3.2 Integration of Context-Awareness to M-Learning

The main objective of this research is to develop mobile application software that will implement context-awareness in mobile learning process using mobile devices to assist the students to understand more in their study within a short time of period [14].

In this project, user's contexts include student's awareness of new learning materials, new and pending quizzes, and assignments.

1.4 Scope of Study

This project is aimed to research on mobile learning process, the context-aware concept that will improve the students understanding in learning process, and finally come out with a prototype that will implement the integration of context-awareness and mobile learning process.

1.4.1 Importance of mobile learning and its revolution

Mobile learning is different from E-Learning in many aspects including terminologies, technology used, and implementation. Good understanding on the revolution of mobile learning technologies is essential for developing this project.

1.4.2 Context-awareness concept and its implications

The concept of context-awareness involves identifying user's context of which useful for an application to decide the correct functionalities. Users' context is dynamic which can change over time and be changed by the application itself.

In this project, the proposed context-awareness feature is purposed to improve students' context and thus improving students' learning performance generally.

1.4.3 Models and architecture

The models and architecture of context-aware application involves the technical profile of the application itself. These models describe objects and actors involved in context-aware environment.

CHAPTER 2

LITERATURE REVIEW

2.1 Mobile Phone Is Not Just a Phone

In the past decades, many have interpreted the term mobile as a synonym to mobile phone because when we talk about mobile devices; only phones had come up with mobility [2]. However, in the past few years, we can see that mobility of phone have outgrown the traditional purpose of mobile phone as a "phone". Nowadays, mobile computing has become ubiquitous that mobile communications is enhanced every day. Mobile phone is turning into the single unique instrument of mediating communication not just between people, but also between people and institutions or more generally between people and the world of inanimate objects [2].

According to Bruns [5], mobile phone provides such features as:

- **Flexibility and Portability**

  mobile phones are characterised by their relatively small size which makes them readily portable and, therefore usable anywhere anytime. Increasingly they offer connectivity and networking. Being digital they allow resources to be easily modified, presented and re-presented according to changing needs and user groups.

- **Multifunctionality and Technical Convergence**

  Mobile devices now normally bring together more than one function. Whereas only recently separate devices were needed to listen to music, look at images and watch video, maintain a calendar and contact list, view computer files created by different software packages, read e-mails, view webpages etc, these functions are now readily available at affordable prices as single small devices. This characteristic includes availability on demand as well as the creation of content 'on the fly', i.e. in real time.

- **Multimodality**

  Digital technologies allow content to be presented using a diverse range of systems of representation and a combination of different semiotic means of meaning-making. Digital video, for example, allows learners to create representations of themselves and the way they see and interact with the world, for example in the form of narratives or documentaries that are not based on traditional notions of textuality.

- **Nonlinearity**

  Hyperlinking, i.e. the ability to break up sequential ordering of information / pages / screens and allow lateral connections intra- and intertextually, between related as well as unrelated documents / artefacts, allows for unprecedented levels of interconnectedness and possible synergies.

Thus, with the multifunctionality of today's mobile phone, people can perform tasks seemlessly including reading newsfeed, checking e-mails, sharing information, subscribe to forums and even shopping.

The main reason mobile phone is choose is because of its capability to provide a medium for learning process which been called as mobile learning.

2.2 From E-Learning to M-Learning

E-learning system involves the use of a computer in some way to provide training, educational or learning material [3]. Meanwhile mobile learning is more of an advanced system to the e-learning system that using a cellular network as a medium to conduct the learning process.

Mobile Learning technologies are becoming even more complex and interesting with new capabilities such as integrating with social network, sharing information through email, navigating through places and etc. This advancement in mobile computing technologies has great potential to make the users feel more comfortable to learn anywhere and anytime. To make M-Learning effective, we have to discover ways to transform the mobile learning process to a state where it is displayed as part of users life rather recognised as responsibility of learning at all [4].

E-learning	**M-learning**
Computer	Mobile
Bandwith	GPRS, 3G, Bluetooth
Multimedia	Objects
Interactive	Spontaneous
Hyperlinked	Connected
Collaborative	Networked
Media-rich	Lightweight
More formal	Informal
More text- and graphics-based instructions	More voice, graphics and animation based instructions
Lecture in classroom or in internet labs	Learning occurring anywhere and anytime

Table 1: E-Learning and M-Learning Terminologies Comparison

Revolution of M-Learning system from the conventional learning is not only changes in mobility, but also learning environment terminology [3]. In the conventional E-Learning system, its learning environment model is described with such terminologies as multimedia, interactive, hyperlink, and media-rich environment. These terminologies are often associated with Web 2.0 technology which had become very commonly used in the past decade. On the other hand, M-Learning system, the learning behaviour is more spontaneous, intimate, situated, informal, lightweight, private and personal.

The comparison of terminologies between E-Learning and M-Learning is summarized in Table 1 [3].

2.3 Concepts of Mobile Learning

There are few steps to describe the theory of the development and technologies that support the design for mobile learning [6]:

1. **The specialty about mobile learning compared to other learning process or activity**

   The mobile learning process have it's own speciality based on the assumptions that learners are continually on the move. Everyday and everytime a student will learn a new things from different chapters to different topics. Each time the learning process been done, they learn and practice from a new angle of learning process. Thus, by introducing the mobile learning process in thier life might give a new design and pattern of learning process which can increasingly help them to improve and managed accross life transitions. Moreover, through this research, it might help to understand how new technologies can help and support a society through learning process.

2. **The theory of the learning process must be based on contemporary accounts of practices that enable successful learning.**

   A study [7] has produced a synthesis of research into educational effectiveness across ages and subject areas which emphasize four effective learning:

   a. *Learner centred*

      This is built based on the skills and knowledge of the students that enable them to reason from thier experiences.

   b. *Knowledge centred*

      This is built based on the curriculum activities which is taken from the foundation of validated knowledge, efficiency teaching and the intensive used of concepts and methods.

   c. *Assessment centred*

      This is buid based on the ability of the learners itself which offering a diagnosis and formative guidance that builds on success.

d. *Community centred*

This is build based on the successful learners form a mutually promotive community, sharing knowledge and supporting less able students

3. **The theory of mobile learning must take account the ubiquitous use of personal and shared technology.**

The trend usage of the technology that is owned by individual must be taken into consideration. A survey [8] has shown that, in the UK, over 75% of the general population and 90% of young adults own at least one mobile phone and only 43% of students own a laptop computers in University of Birmingham. This shows that, the usage of mobile phone is double higher than that of laptop computers. This proves that mobile phone is a suitable device for mobile learning.

2.4 Context-Awareness Theory

There are many definitions for context described articles and dictionaries. As for Merriam-Webster's Collegiate Dictionary, the word "context" is defined as the interrelated conditions in which something exists or occurs. Actually the use of the word "context" tends to be vague because everything in the world happens in a certain context [17]. As for Guanling Chen et al [17], the term has been used in many ways in different areas of computer science, such as:

- Context sensitive help
- Contextual search
- Multitasking context switch
- Psychological contextual perception

According to Bill Schilit [22], context is divided into five categories:

1. ***Computing context***

   Includes network connectivity, communication costs, and communication bandwidth, and nearby resources such as printers, displays, and workstations.

2. ***User context***

   Includes the user's profile, location, people nearby, even the current social situation.

3. ***Physical context***

   Includes lighting, noise levels, traffic conditions, and temperature. Time is also an important and natural context for many applications. Since it is hard to fit into any of the above three kinds of context, we propose to add a fourth context category as:

4. ***Time context***

   Includes time of a day, week, month, and season of the year.

5. ***History context***

   Includes history received when the computing, user and physical contexts are recorded accross a time span.

According to Anind et al [18], combining several context values may generate a more powerful understanding of the current situation. "Primary" contexts, including location, entity, activity and time, act as indices into other sources of contextual information. For example, knowing whether a user has performed a specific task or not, the application can decide whether to notify the user or not.

Guanling Chen et al [17] believe that the context in mobile computing has two different aspects. One aspect of context includes the characteristics of the surrounding environment that determine the behavior of the mobile applications. The other aspect is user's behavior. Thus, context is the set of environmental and actor states that either determines an application's behavior which makes an application event occurs interesting to the user [17].

2.5 Context-Awareness in M-Learning

Context-awareness for mobile learning represents a relatively new area of research. According to Wood et al [9], context-aware means gathering information from the environment to provide a measure of what is currently going on around the user and the device.

Besides, context-aware mobile learning has become highly important due to the dynamic and continuous change in learning contexts [10]. A new sets of learning applications is needed to adapt the dynamic learning situations accordingly as the environment changed. According to Chan T. et al [12], sensing the mobile environment and adapt to the changing context during the students learning process were the task of a context-aware for mobile learning.

In mobile learning context, it is helpful to consider context-awareness and adaptivity as key features [19]. The purpose of the adaptivity and context-awareness is to provide better support for variety of learners, given that they may have different skills and motivations to learn in varying contexts. Adaptivity can be one form of adaptation; or as a quality of a system to automatically and autonomically regulate and organize its functioning, the appearance of its User Interface and the order of information it offers [20].

Data about users and activities can be managed using Activity Adaptation Module in Context-Based Adaptation architecture so that process of deciding the suitable activities for correct users can be done timely [21]. This module is responsible of deciding the availability of activities and generating the list of available activities to be sent to the alerting module. Alerting module notifies the learner about the incoming activities or tasks depending on the various contextual element values. Set of rules is applied to user's context in order to indicate the appropriate moment to notify users [21].

According to Pilar Rodríguez et al [11], context-awareness adaptation should also supports the inclusion/exclusion of activities in/from the list of recommended activities, depending on the suitability of the type of activity for the particular context of the user. For example, if a user is in classroom with his/her smart phone switched on, it makes no sense to suggest him/her to engage in a collaborative synchronous task, since he should be participating in the class and paying attention

to the teacher and students comments. However, it could make sense for the teacher to ask the students to complete a quiz through their phones during a lecture, so that their answers were immediately sent to the system, and the system were able to evaluate both quiz and attendance.

In this project, student's awareness of new and pending tasks are the contexts context will be applied to the mobile learning process. The values of some contextual element's attributes are updated when an the task is completed, but some conditions must be checked before the update (when activity's goals are achieved) [10]. For example, if quizzes have been completed, assignments have been submitted and notes have been read, the student's will be no longer reminded for pending tasks.

CHAPTER 3

METHODOLOGY

3.1 Development Model

As mentioned, the project delivers an Android application of M-Learning system which consists of several components. These components are to be developed separately and any components may have to be completed before other component can be developed. Thus, phased development methodology is used as illustrated in Figure 1.

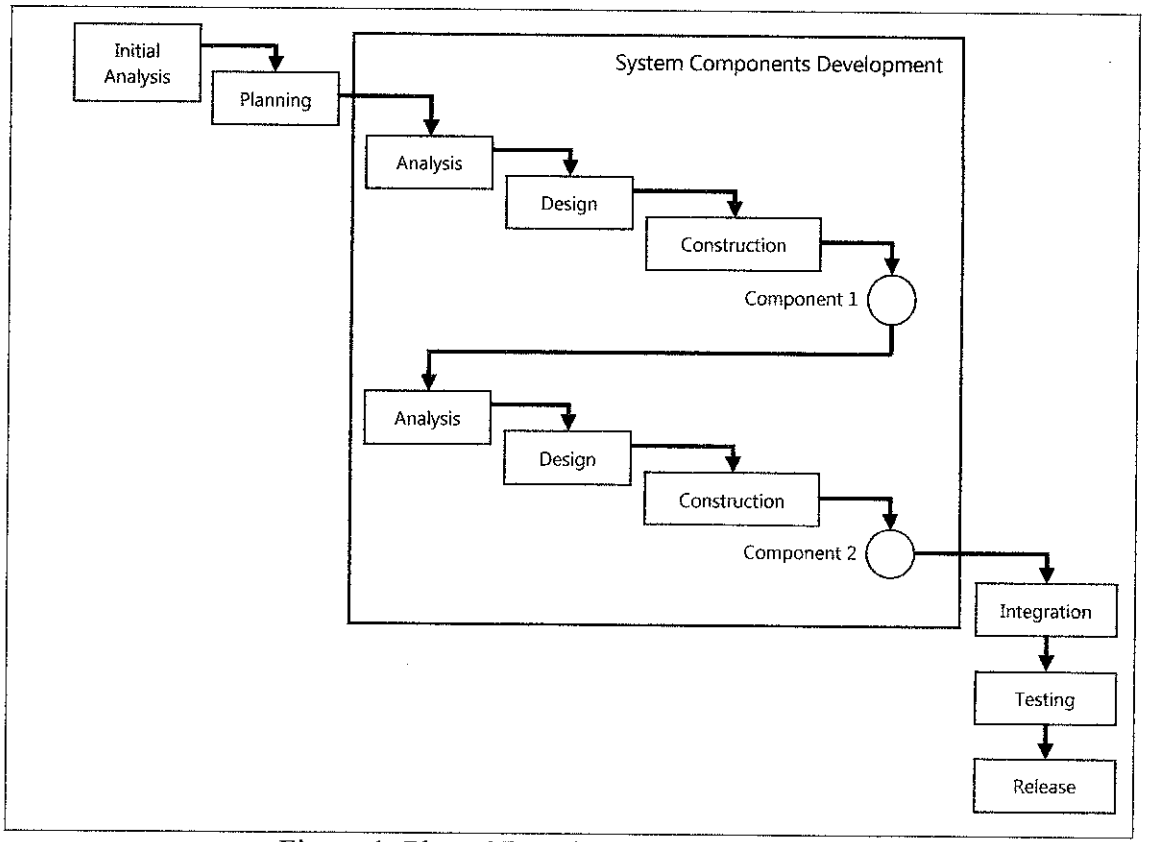

Figure 1: Phased Development Methodology

In this development model, every component is developed throughout three processes which are Analysis, Design, and Construction. The significance of this

development model is that, even though the components undergo similar development processes, each component's processes are not identical (e.g. Analysis of Component and Analysis of Component 2 are undergone separately). In other words, each component development is unique.

The project development is undergone in less than one year throughout Final Year Project I and Final Year Project II as shown in **Appendix 1**.

3.1.1 Initial Analysis

The first step to be performed in this project is Initial Analysis. In this process, the existing E-Learning system is studied and analyzed. This process also includes studying the theories and concepts of mobile learning and context-awareness. Apart from that, data gathering activities are also conducted.

3.1.1.1 Explore existing systems

The Initial Analysis process of the project is started by exploring the existing system. The E-Learning system that is currently used in the university is explored and analyzed to identify flaws and weaknesses that can be overcome in order to achieve the project objectives.

3.1.1.2 Conceptual research

To improve the existing system, the project should understand the theories and concepts of the research areas which are mobile leaning and context-awareness. The project must focus on these scopes for improving the existing system.

3.1.1.3 Data gathering

Users are in fact the most valuable stakeholder of this project. Data gathering is performed in order for the project to identify the problems of the existing system in users' point of view. Information gathered from users is useful for defining the requirements of the project.

Data gathering can be performed via questionnaires and interviews. Questions incorporated in these methods are listed in **Appendix 2** and **Appendix 3**.

3.1.2 Planning

With information gathered during Initial Analysis, the project proceeds to Planning where the system requirements are defined. In this process, the system components are identified and the sequence of their developments is determined.

3.1.2.1 Requirement specification

Before starting to develop the system, the project should define and specify the requirements of the system based on the information gained from Initial Analysis. This is to ensure that the system development is in the correct scope and meets user's expectations.

3.1.2.2 System design

The system is designed based on user's expectations as what have been specified in the requirements earlier. Designing the system includes describing the system behaviour in UML diagrams and flow charts. These diagrams are useful to illustrate the system's object-oriented environment. Actors involved in the system are described as classes of object instantiations.

3.1.2.3 Database

Database is the most effective and flexible way to store and organize information. The database structure should be designed in a way that data storing is efficient (i.e. use minimal amount of space) and effective (i.e. actions such as storing and retrieving can be performed accurately).

3.1.2.4 User interface

The system's user interface is important at the front-end of the system as it gives the impression of usability and learnability. Good user interface can

ensure ease of use of the system. User-friendliness is taken into account in creating good user interface.

3.1.2.5 System components

The system is divided into several components which are developed either in parallel or in sequence. Some components are dependent to other components; thus, the most dependable components are to be developed first.

3.1.3 System Components Developments

Each system component carries out three development steps – Analysis, Design, and Construction.

3.1.3.1 Analysis

In this process, parameters of a component are identified. These include the inputs, outputs, and pre-requisites of the component.

3.1.3.2 Design

With identified component parameters, the component is then designed. The deliverables of this process include UML diagrams and flow chart of each individual component.

3.1.3.3 Construction

In the Construction process, the UML diagrams and flow chart designed in the previous step are transformed into high-level programming language. Source codes are generated and debugged during Construction process.

The system uses Android platform. Eclipse Helios is used as the IDE for developing this system.

3.1.4 Integration

When all components have been developed, they will be combined and integrated to form full working system. The components might need to be adjusted in case the components could not interact with each other correctly and the full system is not working properly.

A full working system is to be delivered at the end of Integration process.

3.1.5 Testing

With the system fully integrated, a few users are invited to test the system. The purpose of this process is to check whether the system is working as expected or needs adjustments.

3.1.5.1 User Interface

User interface testing is conducted to evaluate the user-friendliness of how the application layouts are displayed.

3.1.5.2 Modules / Activities

The modules and activities in the application are tested to check whether the application is functioning accurately according to its purpose.

3.1.5.3 User Experience

User experience describes how user feels while using the system. Usability and learnability is the key aspects in conducting user experience testing. The application functions including navigation, buttons, and forms should be working as simple as it can in order to achieve better user experience.

3.1.5.4 Adjustments

Adjustments are made to the system according to users' feedback throughout the testing process. The system may need to be tested again to ensure proper adjustments have been made.

3.1.6 Release

The final system is working properly and ready to be distributed.

3.2 Milestones

Appendix 1 provides visual marks of milestones on Gantt Chart.

3.2.1 End of FYP I Week 2 (6th February 2011)

Completed Activity(s) :
- Exploration of the existing E-Learning system
- Problems identification

Deliverable(s) :
- Problem Statements
- Objectives

3.2.2 End of FYP I Week 5 (27th February 2011)

Completed Activity(s) : Research on theories and concepts of Mobile Learning and Context Awareness

Deliverable(s) : Extended Proposal (submitted in the following week)

3.2.3 End of FYP I Week 8 (20th March 2011)

Completed Activity(s) : Data Gathering (thus completing the Initial Analysis activity)

Deliverable(s) : Updated Interim Report on Results and Discussion;
This chapter is useful for Viva (Proposal Defence) in the following week

3.2.4 End of FYP I Week 9 (27th March 2011)

Completed Activity(s) :
- Specification of system requirements
- Viva (Proposal Defence)

Deliverable(s) : Updated Interim Report on Results and Discussion;
This is starting point of Planning activity

3.2.5 End of FYP I Week 10 (3rd April 2011)

Completed Activity(s) : The final draft of Interim Report is prepared and to be approved by supervisor before submission.

Deliverable(s) : Interim Report final draft;
The final draft is adjusted and the supervisor-approved Interim Report is submitted in the following week

3.2.6 End of FYP I Week 14 (1st May 2011)

Completed Activity(s) : Planning activity

Deliverable(s) : Updated Interim Report on Methodology with System Architecture;
This deliverable is used for FYP II as Dissertation

3.2.7 End of FYP II Week 3 (16th October 2011)

Completed Activity(s) :
- Database component development
- Web Services component development

Deliverable(s) :
- Server (Own computer is used as sever)

3.2.8 End of FYP II Week 6 (6th November 2011)

Completed Activity(s) :
- Modules / Activities development
- Notification development

(thus completing system components developments)

Deliverable(s) :
- System components
- Progress Report final draft (submitted in the following week)

3.2.9 End of FYP II Week 8 (20th November 2011)

Completed Activity(s) : Integration of system components

Deliverable(s) : Completed system (ready to be tested)

3.2.10 End of FYP II Week 9 (27th November 2011)

Completed Activity(s) : Testing activity in progress

Deliverable(s) : Poster for Pre-EDX presentation;
Poster presentation evaluation is on the following week

3.2.11 End of FYP II Week 10 (4th December 2011)

Completed Activity(s) :
- Poster presentation
- First testing on UI, Modules/Activities, and User Experience

Deliverable(s) :
- Dissertation final draft (to be submitted in the following week)
- Testing results (for further adjustments on the system)

3.2.12 End of FYP II Week 12 (18th December 2011)

Completed Activity(s) : Testing and system adjustments in progress

Deliverable(s) : Technical Report (submitted in the following week)

3.2.13 End of FYP II Week 13 (25th December 2011)

Completed Activity(s) : Testing activity

Deliverable(s) :
- Functioning system
- System documentation

3.2.14 End of FYP II Week 14 (1st January 2012)

Completed Activity(s) : System documentation

Deliverable(s) :
- Distributable system
- Completed FYP

3.3 System Architecture

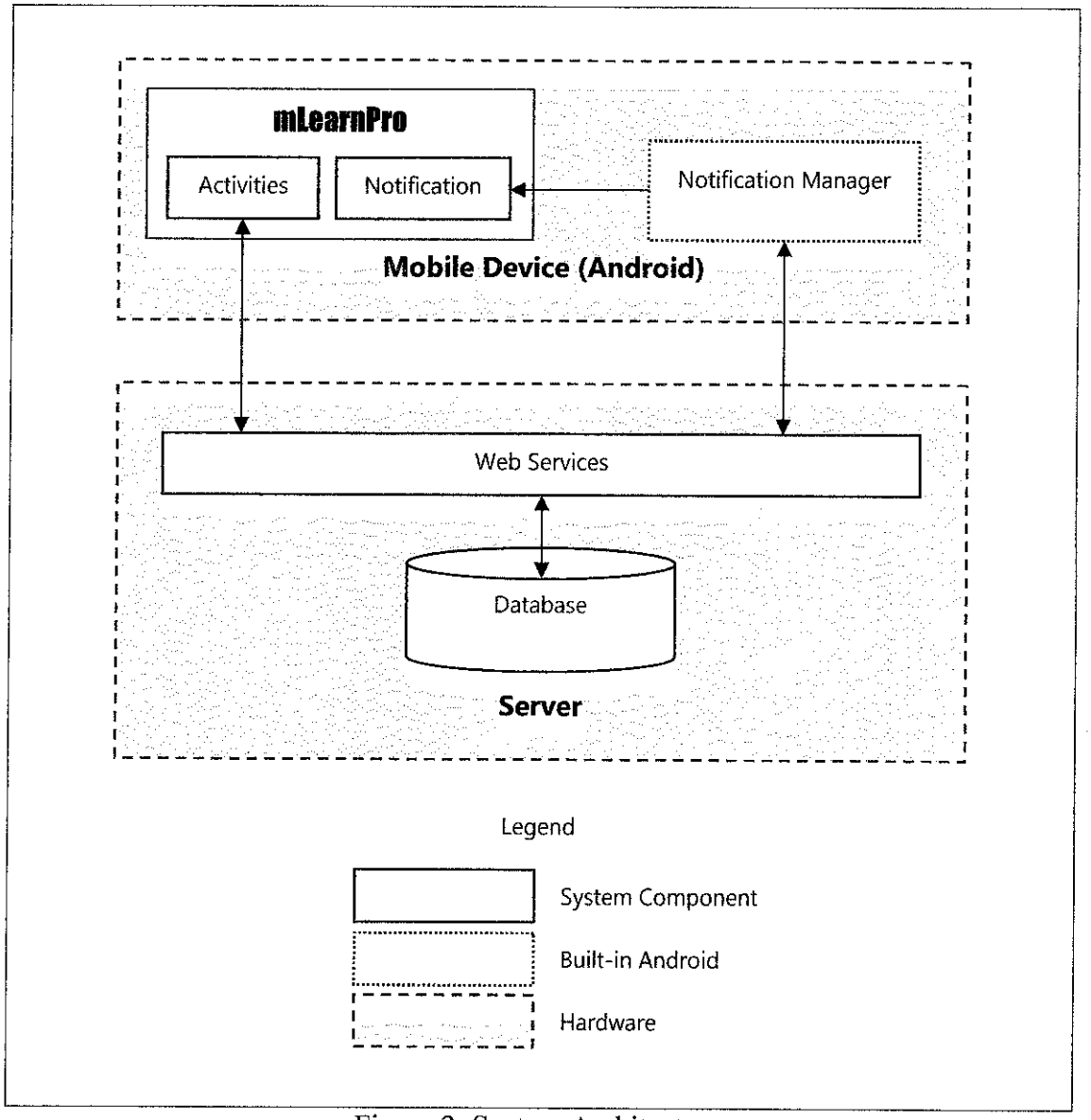

Figure 2: System Architecture

The system architecture of the project is depicted as in Figure 2. In the big picture, the system involves two communicating hardware – an Android device and a server. The Android application developed in this system is labelled as Application. The project final deliverable, which is the Android M-Learning application, is named mLearnPro.

The process of generating notification is visualized in Message Sequence Diagram Depicted in Figure 3.

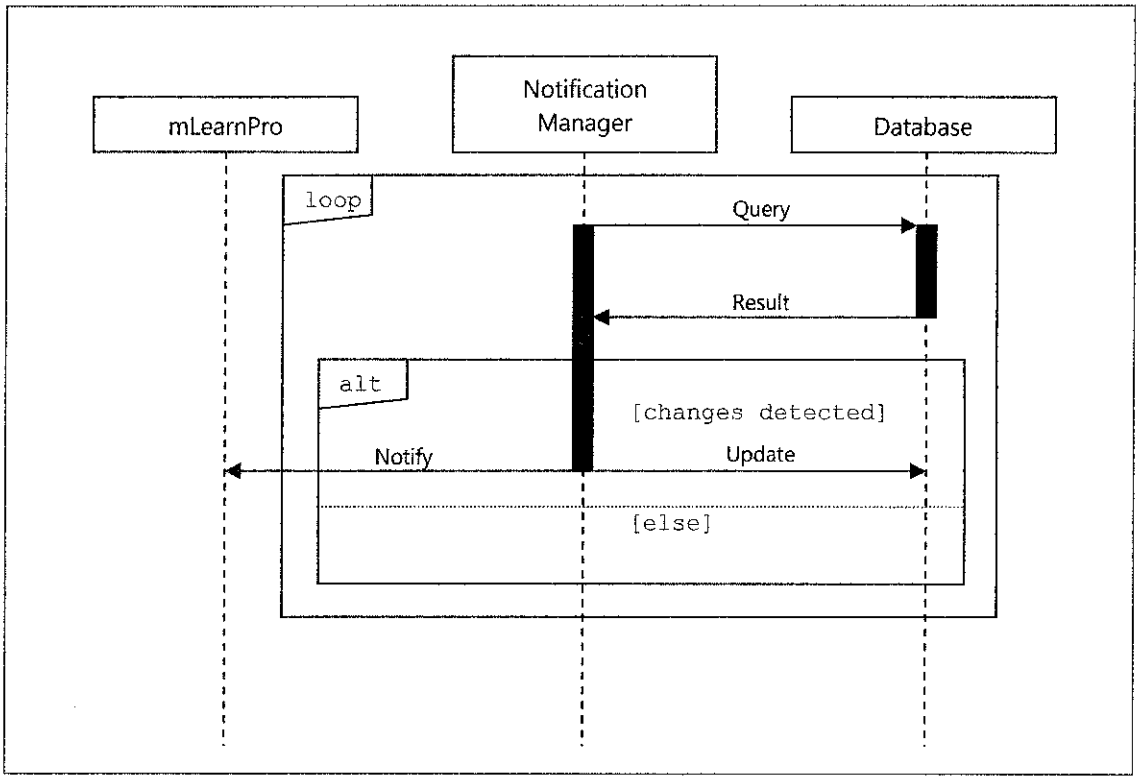

Figure 3: Notification Generation Process

3.3.1 Mobile Device (Android)

mLearnPro consists of two main components which are Activities and Notification (uses Android's built-in Notification Manager).

3.3.1.1 Activities

In Android, an Activity is a single focused thing a user can do. Activity is responsible in displaying UI and providing functionality to user. In this project, the application consists of three main Activities which allow users to perform tasks with notes, quizzes, and assignments, respectively.

3.3.1.2 Notification

Notification is a component developed in the application to provide pop-up reminder notification (is called Toast in Android) and list of pending task in Activities.

3.3.1.3 Notification Manager

Notification Manager is a built-in Android component that provides automated notification capability to user in both foreground (during the

mLearnPro is opened) and background (during mLearnPro is minimized or on idle).

3.3.2 Server

In this system, a server is the remote hardware where E-Learning information is stored in a database. The idea of M-Learning is applied in this project with the fact that E-Learning information is located in a remote server and is accessible by mobile devices.

3.3.2.1 Database

Database is a component developed in the server using a DBMS (preferably MySQL), responsible to store data in a way that the data can be retrieved and modified from the application's Activities.

3.3.2.2 Web Services

Even though Android platform is Java-based, it is not provided with Java remote database connectivity API since this API is quite heavy for mobile device processor. The alternate method for the mobile application to access database in remote server is via Web Services. The advantage of this method is that database accessibility is defined in the server of which cannot be modified from mobile devices. Mobile devices can only request information specified by web services.

3.4 Development Tools

At full scale, this project requires a server with properly-configured DNS and a mobile device with Android 2.3.3 API Level 10 or above.

3.4.1 Hardware

3.4.1.1 Server

For the purpose development, own personal computer is feasibly used as a server. When the project is completed, database and web services can be transferred to a real server. A server hosting can be purchased with proper domain later when the project is completed.

3.4.1.2 Mobile Device

Similar to server, mobile device with mentioned Android platform is simulated using built-in emulator in Eclipse Helios IDE called Android Virtual Device (AVD) throughout the project development. Once mLearnPro has been completely developed, it can be installed in real mobile devices.

3.4.2 Software

Software used for project development includes IDE and DBMS.

3.4.2.1 Eclipse Helios

Eclipse Helios is a free IDE for Java development. Since Android is Java-based, Eclipse Helios can also be used for Android development by installing Android SDK and AVD Manager.

3.4.2.2 PHP

PHP is a general-purpose server-side scripting language originally designed for web development to produce dynamic web pages. For this purpose, PHP code is embedded into the HTML source document and interpreted by a web server with a PHP processor module, which generates the web page document.

However, in this project, PHP is used by Web Services to process queries and updates requested by mobile device. Hence, Web Services return results as strings of data rather than web pages.

3.4.2.3 Macromedia Dreamweaver

Macromedia Dreamweaver is used to develop PHP files for Web Services.

3.4.2.4 Apache Web Server

Provides web service with HTTP protocol on machine's Port 80. Mobile devices will access Web services via this port.

3.4.2.5 MySQL

MySQL is a commonly used DBMS for managing databases on a server. It is used in this project to maintain database for its ease of use.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Findings

Data gathering activities including questionnaires and interviews have been done to UTP students. 114 students have responded to questionnaires and 5 students have been interviewed.

4.1.1 Existing Systems Weaknesses

The E-Learning system that is currently used in the university is explored and analyzed to identify flaws and weaknesses that can be overcome in the project. The weaknesses that have been identified are:

1. Fully web-based

   The existing E-Learning system is fully web-based. Hence, the application can only be used via mobile phones using web browsers. This results to less user-friendliness of the web application layouts in mobile phones. The layouts are rather complicated and suitable to be viewed only in desktop or laptop computers.

2. Inconsistency of links

   Even though the web-based application can be viewed in phone's web browser, the download links of materials sometimes don't work. In fact, if they work, the materials can only be open using other applications such as PDF reader or Quick Office.

3. Lack of notifications

   Students need to login and check for any new tasks in E-Learning. Besides that, new tasks are not properly labelled as new task. Hence, students cannot identify whether tasks and notes are new or not.

4.1.2 Applied M-Learning Concepts

This project applies two concepts of context categories mentioned by Bill Schilit [22]:

1. Time Context

   Time context is the context that measures the time where new tasks are posted and their deadlines

2. History Context

   History context measures user's actions history towards tasks which is useful for deciding whether to notify and remind user or not.

4.1.3 Smart Phone Usage

Questionnaire on smart phone usage among UTP students is listed in **Appendix 2**.

The result has shown that 34 (29.8) out of 114 respondents do own (at least) a smart phone, 52 (45.6%) respondents are planning to have one, while others (24.6%) do not have a smart phone.

Among 34 respondents who own smart phones, 14 of them are using Android, 12 are using Symbian, 7 are using iOS (iPhone), and only 1 is using Windows Mobile. For those who are planning to have a smart phone, more than half a planning to buy one with Android OS.

Facebook notification on mobile is rated in average of 3.89 from scale of 0 to 5.

The graphical representation of these results is illustrated in **Appendix 4**.

4.1.4 E-Learning Usage

Questionnaire on E-Learning usage among UTP students is listed in **Appendix 3**.

The result has shown that 42 (36.8%) out of 114 respondents do login to E-Learning once a week, only 7 (6.1%) login more than once per day, 4 (3.5%) login sometimes, while others login once in 2 through less than 7 days.

All of the respondents (100%) usually login E-Learning in their hostel rooms. 106 (93%) of them login E-Learning via laptop computers while other 8 (7%) via desktop computer. None of them login E-Learning via mobile devices.

The graphical representation of these results is illustrated in **Appendix 5**.

These results prove that the existing E-Learning system is lacked of mobility features, and average of the students do login to E-Learning only once or twice a week only to check for new notes or announcement. Students may fail to receive important tasks at this low frequency of logins, assuming lecturer does not announce anything in class. If lecturers still need to announce new thing in class, the purpose of E-Learning is not fully utilized.

4.1.5 Interview

The purpose of conducting interview is to gather more specific information. However, unlike questionnaire, this method is very time consuming for high number of respondents. Therefore, only 5 students are selected and 3 results are explained.

4.1.5.1 Student 1

- Why do you login to UTP E-Learning?

  To get lecture slides, check important announcement

- Have you ever login to UTP E-Learning via web browser on mobile phone? Explain.

  I've tried. The web page is not optimized for mobile web browsers and some functionality does not work.

4.1.5.2 Student 2

- Why do you login to UTP E-Learning?

  To check announcements and lecture notes. Sometimes, quiz is conducted in E-Learning.

- Have you ever login to UTP E-Learning via web browser on mobile phone? Explain.

  Never. I don't think I can. In fact, I only check E-Learning when something came up and people are doing it too.

- Have you ever missed something from E-Learning?

  I usually just in time knew something has been posted in E-Learning. But yes, I did missed something couple of times.

4.1.5.3 Student 3

- Why do you login to UTP E-Learning?

  Lecture notes

- Have you ever login to UTP E-Learning via web browser on mobile phone? Explain.

  No, can we? I don't think so. If yes, I hope the system gives notifications like ones in Facebook.

4.2 Prototype

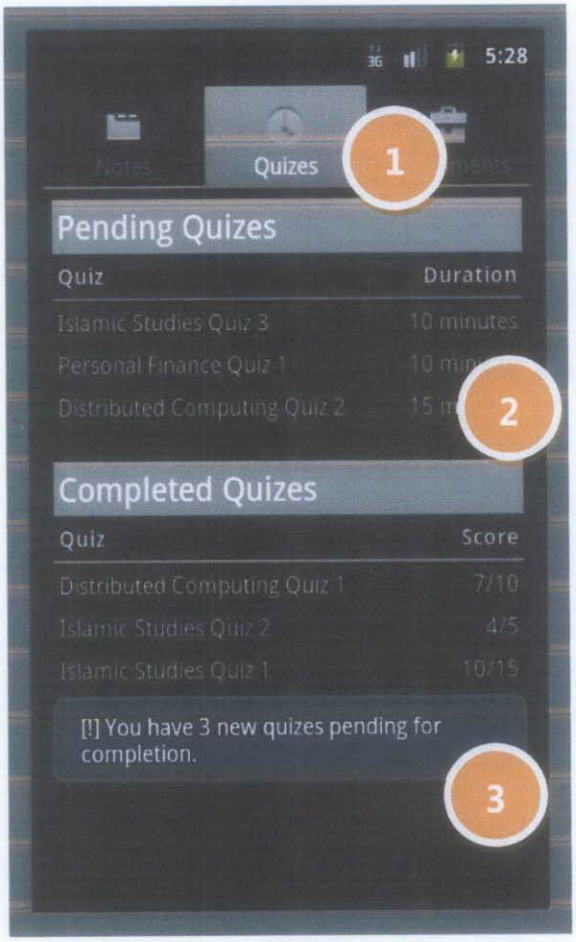

Figure 4(a): List of Quizzes Notification Screenshot

As illustrated in Figure 4(a), labelled UI element is described as follows:

1. Tab Menus

   There are three tab menus, respective for notes, quizzes, and assignments activities. Navigating throughout the tab menus does not change the content of each tab. This means that we can switch at other tabs with the content of the previous tab remains unchanged.

2. List of Notification

   Pending task is listed on top of completed task.

3. Pop-Up Reminder

   In Android, a pop-up message is called a Toast. In this application, toast is used to notify users on new tasks as well as reminding users if pending tasks are delayed for a long period of time.

Figure 4(b) illustrate the UI on answering a quiz question..

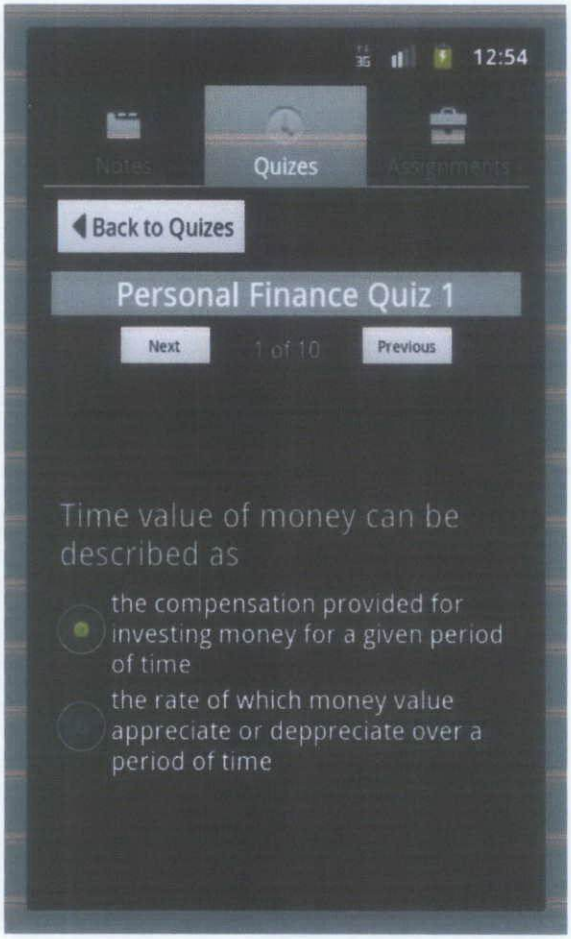

Figure 4(b): Performing a Quiz Screenshot

4.3 Testing

5 students have been selected to test the application. The aspects to be tested are User Interface, Modules/Activities, and User Experience

4.3.1 User Interface Testing Result

UI Testing Evaluation Form is shown in **Appendix 6**. The result of UI Testing is summarized in Table 2(a).

Table 2(a): UI Testing Results

	Ratings		
	User-Friendliness	Usability	Learnability
Student 1	3	4	3
Student 2	4	3	3
Student 3	3	3	4
Student 4	5	4	4
Student 5	3	3	2
Average	3.6	3.4	3.2

4.3.2 Modules/Activities Testing Result

Modules/Activities Testing Evaluation Form is shown in **Appendix 7**. The result of Modules/Activities Testing is summarized in Table 2(b).

Table 2(b): Modules/Activities Testing Results

	Ratings			
	Activities Effectiveness	Navigation	Activities Accuracy	Information Completeness
Student 1	5	5	4	3
Student 2	3	4	3	4
Student 3	4	5	3	4
Student 4	4	4	2	3
Student 5	2	3	3	2
Average	3.6	4.2	3.0	3.2
	Comments: This system should include important announcement.			

4.3.3 User Experience Testing Result

User Experience Testing Evaluation Form is shown in **Appendix 8**. The result of User Experience Testing is summarized in Table 2(c).

Table 2(c): User Experience Testing Results

	Ratings			
	Notification	Reminder	Timeliness	Smoothness of Task
Student 1	5	5	2	2
Student 2	4	4	1	3
Student 3	4	4	2	3
Student 4	5	4	3	2
Student 5	4	4	4	3
Average	3.4	4.2	2.4	2.6
	Comments: ▪ The system is quite heavy. ▪ Notification works well ▪ Pop-up messages do not really appear in real time.			

CHAPTER 5

CONCLUSION AND RECOMMENDATION

The ubiquity of mobile computing has potential to enhance learning process. This project intends to enhance learning process via existing E-Learning system by adding values of mobility and context-awareness. Mobility feature can be added by developing a mobile application which allows access to E-Learning materials from mobile device; hence, M-Learning. In this project, E-Learning materials include notes, quizzes, and assignments. On the other hand, context-awareness feature can be added to M-Learning system by embedding automated notification and reminder to users. This allows users to become more aware of new materials and pending tasks. The results of this project have shown that the objective of transforming the current E-Learning system into M-learning with context-awareness is successful.

Despite of the success of this project, there are some areas need to be enhanced including the materials involved. From the results, some students have suggested to provide newsfeed for "Important Announcement" from E-Learning. The project did not include this material in the first place to maintain "learning" as its scope. This suggestion however is taken into consideration to make this project more reliable and useful, not just as a learning medium, but also as an effective knowledge management tools in the university.

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APPENDICES

Appendix 1: Project Schedule Gantt Chart

Milestones are marked with orange vertical line "|".

Table 3(a) and Table 3(b) shows the Gantt Chart of project schedule during FYP I and FYP II respectively.

Table 3(a): Project Schedule during FYP I

Activities	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Initial Analysis														
Explore existing system														
Conceptual research														
Mobile Learning														
Context-awareness														
Data Gathering														
Interview														
Questionnaire														
Planning														
Requirements specification														
System design														
Database														
User Interface														
System Components														

Table 3(b): Project Schedule during FYP II

Activities	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
System Components Development														
Database														
Analysis														
Design														
Construction														
Web Services														
Analysis														
Design														
Construction														
Modules / Activities														
Analysis														
Design														
Construction														
Notification														
Analysis														
Design														
Construction														
Integration														
Testing														
User Interface														
Modules / Activities														
User Experience														
Adjustments														
Release														

Appendix 2: Mobile Phone Usage Questionnaire

1. Do you own (at least) one smart phone?
   - ☐ Yes
   - ☐ Planning to
   - ☐ No

2. What OS is used (or you planned to use) in your phone?
   - ☐ iOS
   - ☐ Symbian
   - ☐ Android
   - ☐ Windows Mobile
   - ☐ Others

3. From the scale of 0 to 5, how do you rate the importance of Facebook notification in mobile phone? (1 is for least important, 5 is for very important)
   - ☐ 5
   - ☐ 4
   - ☐ 3
   - ☐ 2
   - ☐ 1
   - ☐ 0

Appendix 3: UTP E-Learning Usage Questionnaire

1. How often do you login to UTP E-Learning?
    - ☐ More than once a day
    - ☐ Once a day
    - ☐ Once in 2 days
    - ☐ Once in more than 3 days
    - ☐ Once a week
    - ☐ Sometimes
2. Please indicate which of the following places you mostly login to UTP E-Learning
    - ☐ Home
    - ☐ Hostel room
    - ☐ Academic Block
    - ☐ Outside Campus
    - ☐ Other
3. What device do you usually use to login to UTP E-Learning?
    - ☐ Desktop Computer
    - ☐ Laptop Computer
    - ☐ Tablet Computer
    - ☐ Mobile Phone

Appendix 4: Smart Phone Usage among UTP Students

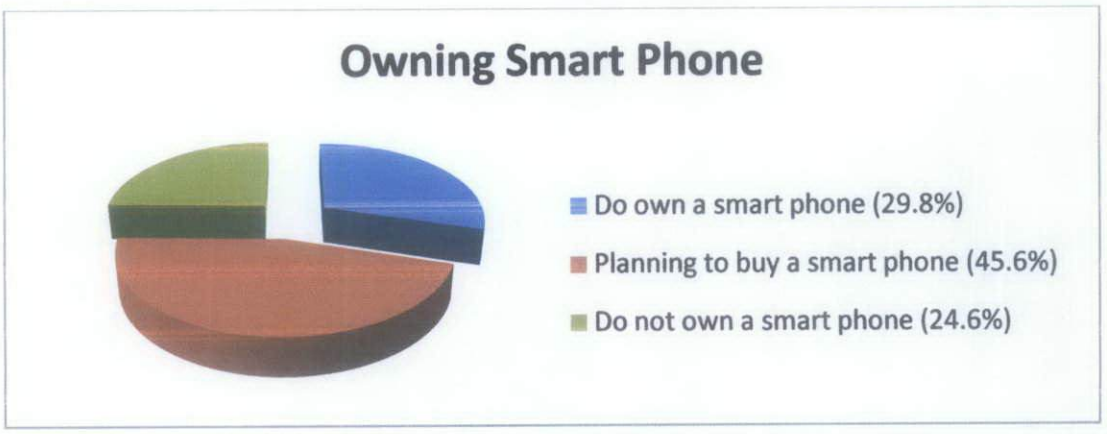

Figure 5(a): Students Owning Smart Phone

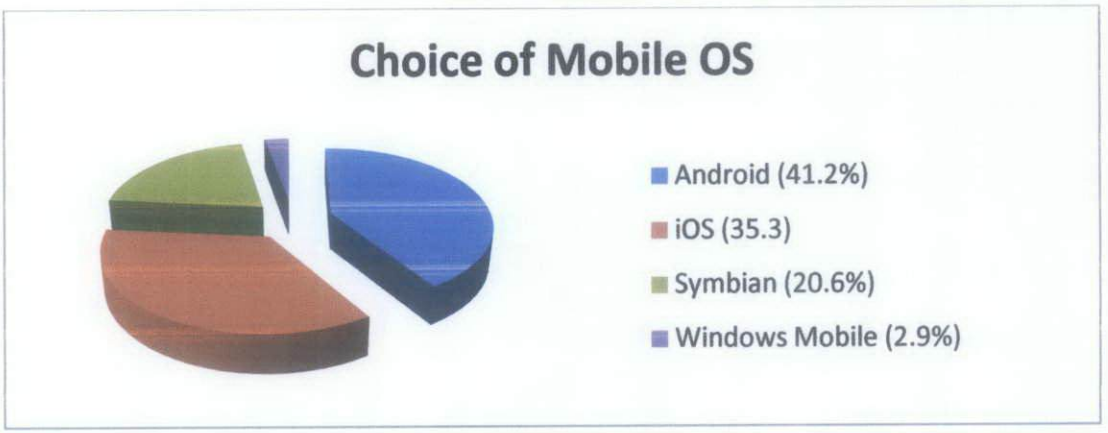

Figure 5(b): Choice of Mobile OS

Appendix 5: UTP E-Learning Usage

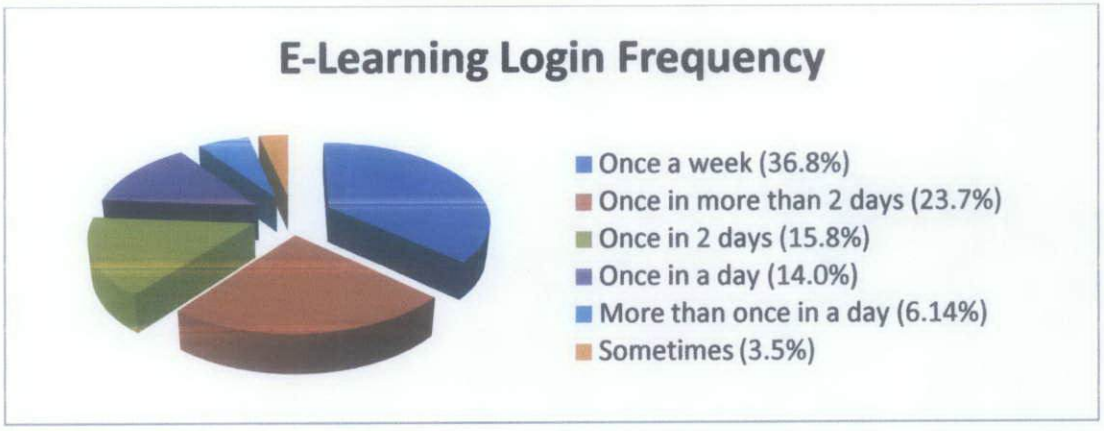

Figure 6(a): E-Learning Login Frequency

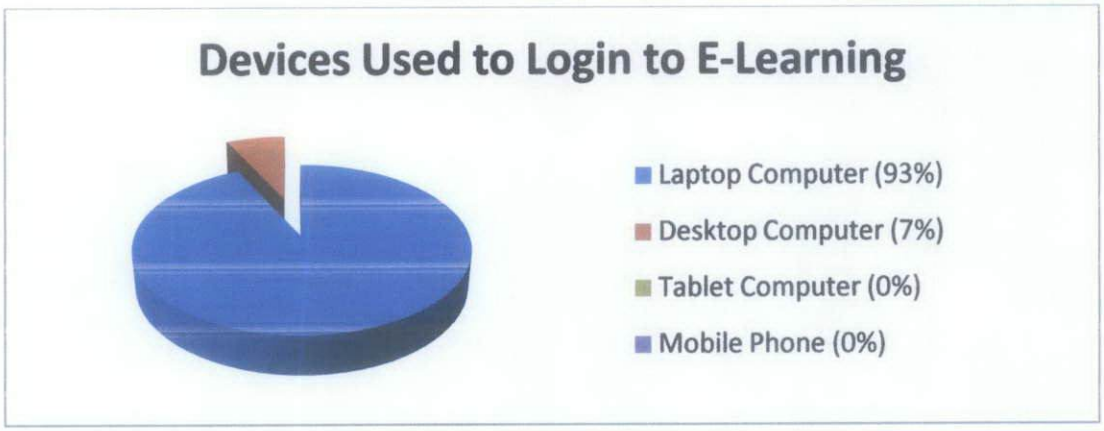

Figure 6(b): Devices Used to Login to E-Learning

Appendix 6: UI Testing Result Form

Aspects	Rating Very Poor 0	1	2	3	4	Very Good 5
User Friendliness						
Ease of use (Usability)						
Ease of learn (Learnability)						
Comments						

Appendix 7: Modules/Activities Testing Results Form

Aspects	Rating Very Poor 0	1	2	3	4	Very Good 5
Activities Effectiveness						
Navigation						
Activities Accuracy						
Completeness of Information						
Comments						

Appendix 8: User Experience Testing Results Form

Aspects	Rating					
	Very Poor					Very Good
	0	1	2	3	4	5
Notification						
Reminder						
Timeliness						
Smoothness of Task						
Comments						