M-Learning: Content Tool for Accounting

By

MUHAMAD FADZRIL B. MUHAMAD

Dissertation submitted in partial fulfillment of
the Requirements for the
Degree Bachelor of Technology (Hons)
(Information Technology)

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1) world wide web
2) internet in education
3) computer assisted instruction

CERTIFICATION OF APPROVAL

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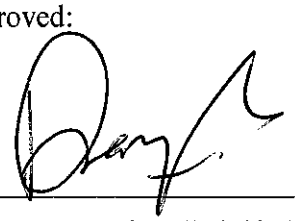

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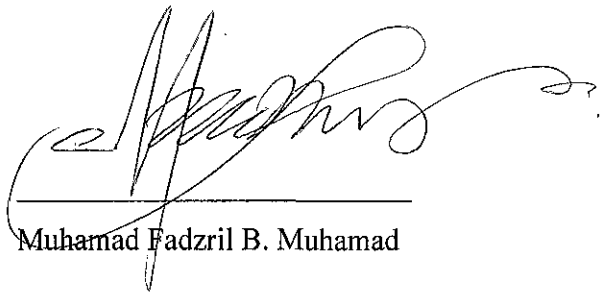
June 2006

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.



Muhamad Fadzril B. Muhamad

ABSTRACT

Independency of time and space are often named as the main advantages of e-Learning. The basic requirement of e-Learning is a Personal Computer (PC), and therefore a real independency of time and space is not given. Even with a notebook these independencies are not fulfilled, because a real independency of time and space means learning wherever and whenever you want to learn. Hardly anyone carries his notebook or his PC with him all the time. Due to certain requirements e-Learning fulfils just partly this demand of independency. Mobile learning (M-Learning), the next generation of the computer-aided and multimedia-based learning, is based on mobile phones. The market penetration of mobile phones in Malaysia is at a level of 81% and the numbers are rising. It can be said, that the great majority of the population has a mobile phone and carries it with them most of the time. Because of this fact the independency of time and space for learning is fulfilled to nearly a hundred percent. As a consequence the main advantage of mobile learning is learning wherever and whenever you want to learn. You can use idle periods for learning. For example: The times while you are traveling, while you are waiting for the bus or while you are waiting at the restaurant or at the train-station. Nearly every unused and wasted time can now be used for efficient and effective learning. Therefore mobile learning will be an important instrument for lifelong learning, because it will help us to use our time more efficiently.

ACKNOWLEDGEMENTS

First and foremost, I would like to praise God Almighty who have helped and guided me through the tough times in completing my two semester Final Year Project (FYP) in Universiti Teknologi PETRONAS (UTP). Without His blessing, I may not get to where I stand today.

My utmost gratitude goes to my FYP supervisor, Mr. Anang Hudaya B. Md Amin, lecturer in UTP Information Technology faculty who has been excellent in providing the information and guidance to me regarding the development of this project. Her leadership, supervision, and guidance have led to the success of this project. In addition, thanks to the FYP committee for providing me direction and guidance throughout the entire project. To all other IT/IS lecturers, who have helped me in direct or indirect ways, thank you.

In this little moment, I've would like to convey my deepest gratitude. It goes to my parents, Mr. Muhamad B. Md. Naim and Mrs. Roshaizan Harun, for their full encouragement and support.

To my very supportive housemates especially my beloved roommate, Khalid Yashaiya - thank you very much.

To any of the person(s) not mentioned here, I would like to say "thank you" for your support until the completion of this project.

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ABBREVIATIONS

1.	GHz	Giga-hertz
2.	RAM	Random Access Memory
3.	GB	Giga-byte
4.	Mbps	Mega-byte per second
5.	LAN	Local Area Network
6.	GPS	Global Positioning System
7.	GSM	Global System for Mobile communication
8.	GPRS	General Packet Radio Service
9.	3G	3 Generations
10.	PDA	Personal Digital Assistant
11.	J2ME	Java 2 Micro Edition
12.	CBT	Computer Based Trainings
13.	WBT	Web Based Trainings
14.	MLO	Mobile Learning Objects
15.	SMS	Short Message System
16.	MMS	Multimedia Message System
17.	IMS	Interaction Mobile Server
18.	MLE	Mobile Learning Engine
19.	PBL	Problem Based Learning
20.	GPS	General Problem Solver

CHAPTER 1
INTRODUCTION

1.1 Background of Study

Advances in computer technology, intelligent user interfaces, context modeling applications and recent developments in the field of wireless communications, including Wireless Fidelity (Wi-Fi), multi hop wireless local area network (WLAN) and the global wireless technologies such as GPS, GSM, GPRS, 3G and satellite systems have created a wide array of new possibilities for technology users. When these technologies stated to be used in conjunction with mobile computers, a new learning paradigm called mobile learning emerged.

Mobile learning or m-learning, has been define as learning that takes place via wireless devices such as mobile phones, personal digital assistances (PDAs), or laptop computers. In the different definitions encountered in the literature, it is only his employment of specific types of technology that seem to differentiate mobile learning from other forms of learning.

However, considering the mobility provided from the user's point of view, it can be argued that mobile learning goes on everywhere – for example, pupils revising for exams on the bus to school, doctors updating their medical knowledge while on hospital rounds, language students improving their language skills while traveling abroad. All these instances of formal or informal learning have been taking place while people are on the move.

A definition of mobile learning should therefore be widened to include the following:

Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies.

1.2 Problem Statement

1.2.1 Problem Identification

As discussed earlier, accounting subjects has been a major issue for most students. Traditional learning method such as attending classes and tutorial sessions does not fully assist students to understand and master the subject at their own pace and time. Furthermore, students are likely to answer textbook-based questions that do not provide them with the ability to receive immediate feedback, which gives them no option other than comparing their answers with the answer at the back of their book.

1.2.2 Significance of the Project

This project focuses on developing a web-based and mobile-based tutoring system that will overcome the problems stated under Section 1.2.1. The developed system prototype would be able to help students learn at their own pace and time, as well as gain their knowledge through quizzes or exercises and receive immediate feedback accordingly. Students also can opt to take online tests to measure their programming knowledge and skills with numerous test questions retrieved dynamically from the system's database. Furthermore, students would also be able to check their test results, and this way, they can measure their performance accordingly and take their actions respectively.

1.3 Objectives and Scope of Studies

1.3.1 Objectives

1. The main objective of the project is to provide a web-based and mobile-based tutoring system for students to learn accounting subject. This is to ensure that students are able to learn accounting at their own preferred time and pace of learning.
2. The second most important objective of this project is to provide a content tutoring where students can test their skills from learning the courses. This also eliminates the need for students to everyday access through e-learning.
3. The final objective of the project is to enable students to increase their understanding about the accounting course as they are currently learning by experiencing on the spot web-based test and quizzes as well as receive immediate feedback from the system.

1.3.2 Scope of Study

The scope of study for this project focuses on developing a web-based and mobile-based tutoring system for students learning accounting subject, as well as determining the learning contents that will be included in the prototype of the system. This study will focus on researching and developing an online web-based that act as a gateway or portal. A small-scale study of test questions from accounting's subject is also included in this study, as these questions will be used to measure student's skills throughout the course. Sample of exercises will be included in the course material for the system. However, the main focus of the project will be on researching and developing a web-based and mobile-based tutoring system, which has a informative and interactive contents.

CHAPTER 2
LITERATURE REVIEW

2.1 Initial Findings

2.1.1 A Brief History of Learning Theories and Their Influence on Learning Technologies

Although the current interest in 'e-learning' and 'm-learning' is a relatively recent phenomenon, especially fuelled by developments in the Internet since the WWW was created in 1992, in fact the history of learning with technology goes back much further. However, some of those theories have proved the most successful in developing tutoring systems, with a huge amount of empirical evidence for their effectiveness and however, they are, arguably, suited to a particular type of learning that involving the acquisition of procedural rules and skill in well-structured domains.

2.1.2 Associationism & CAL

The learning theories of the time involved the application of Skinner's brand of behaviorism which held that learning involved the simple association between a stimulus and a response, enabled by reinforcement. The method of operant conditioning was used to shape responses to particular stimuli. In terms of application to learning technology, the approach has been characterized as "drill-and practice", and "present-test-feedback". Typically, the learner is given some information or problem, they are then asked to respond to some question or questions, and then they are given feedback on their response. It was very much a transmission model of teaching, with the tutor seen as driving the learning process.

Applicability to m-Learning (content tool for Accounting):

Even if the learning approach adopted within M-Learning (content tool for Accounting) is not based on the simplistic model of learning at the heart of CAL approaches, recent developments in learner content management and the profiling of individual progress against curriculum goals may prove useful as a starting point.

2.1.3 Information Processing Theory

The methodology for testing the theory involved developing a computational model (GPS) and then comparing the results of the simulation with human behavior in a given task. GPS was intended to provide a core set of processes that could be used to solve a variety of different types of problems. The critical step in solving a problem with GPS is the definition of the problem space in terms of the goal to be achieved and the transformation rules.

Using a means--end-analysis approach, GPS would divide the overall goal into sub-goals and attempt to solve each of those. Some of the basic solution rules include:

a) Transform one object into another,
b) Reduce the different between two objects,
c) Apply an operator to an object. One of the key elements need by GPS to solve problems was an operator-difference table that specified what transformations were possible.

Declarative memory takes the form of a semantic net linking propositions, images, and sequences by associations. Procedural memory (also long-term) represents information in the form of productions; each production has a set of conditions and actions based in declarative memory.

The nodes of long-term memory all have some degree of activation and working memory is that part of long-term memory that is most highly activated. According to ACT, all knowledge begins as declarative information; procedural knowledge is learned by making inferences from already existing factual knowledge.

Applicability to m-Learning (content tool for Accounting):

It is not the goal of the M-Learning (content tool for Accounting) project to develop mobile intelligent tutoring systems, but there are aspects theory of contingent instruction / help-seeking which may well be useful in some contexts, particularly the health contexts. However, they are useful only once the learning goals and the knowledge domains have been well-articulated, in particular, for example, where a learner needs to learn a certain, well-specified procedure.

2.1.4 Problem-based Learning

Problem-based learning (PBL) starts from the observation that "existing educational systems are producing individuals who fail to develop a valid, robust knowledge base; who have difficulty reasoning and applying knowledge; and who lack the ability to reflect upon their performance and continue the process of learning" (Koschmann, Kelson et al. 1996).

They argue that some of the reasons for this are the complexity and interconnectedness of much of the conceptual material to be learned in both formal and informal (professional) learning settings. A reason for difficulties in applying knowledge, they argue, may stem both from the ill-structured nature of many domains and/or the ill-structured nature of problems in those domains. Finally, they argue that learners' inability to reflect effectively upon their own learning is a product of an educational system that fails to hand responsibility for learning and problem solving over to learners.

Koschmann et al (1996) set out six principles of learning and effective instruction in domains and problems that are complex and ill-structured:

- Multiplicity – knowledge is complex, dynamic, context-sensitive and interactively related; instructions should promote multiple perspectives, representations and strategies.
- Activeness – learning is an active process, requiring mental construction on the part of the learner; instruction should foster cognitive initiative and effort after meaning.

- Accommodation and adaptation – learning is a process of accommodation and adaptation; instruction should stimulate ongoing appraisal, incorporation and/or modification of the learner's understanding.
- Authenticity – learning is sensitive to perspective, goals and context, that is, the learner's orientation, goals and experiences in the learning process determine the nature and usability of what is learned; instruction, therefore, should provide for engagement in the types of activities that are required and valued in the real world.
- Articulation – learning is enhanced by articulation, abstraction and commitment on the part of the learner; instruction should provide opportunities for learners to articulate their newly acquired knowledge.
- Termlessness – learning of rich material is termless; instruction should instil a sense of tentativeness with regard to knowing, a realization that understanding of complex material is never 'completed', only enriched, and a life-long commitment to advancing one's knowledge.

Applicability to m-Learning (content tool for Accounting):

There is considerable potential in adapting some of the PBL approach in M-Learning (content tool for Accounting). It has been developed and refined especially for contexts involving life-long learning and professional development. It has had some proven success as a pedagogical strategy in domains of relevance to M-Learning (content tool for Accounting), especially medicine/health and business administration.

2.1.5 Constructivism – interactive learning environments

These direct manipulation interfaces presented many more possibilities for interactive learning activities. This approach has led to a more general pedagogical theory of 'learning by doing'. The 'ideas' were:

- Making thinking explicit
- Making reasoning and its consequences 'visible'
- Fostering effective problem solving & planning skills

- Learning to learn from errors (debugging skills)
- Developing reflective met cognitive skills

The general notion of constructionist was that by actively trying to create something concrete (either physical or computational) to solve a problem the learner naturally had to make their thinking – that which was implicit – explicit. Furthermore, having to make something concrete enabled the learner to 'see' the results of their thinking, whether it worked, and whether it needed revision (debugging).

Effective methods for structuring knowledge should result in simplifying, generating new propositions, and increasing the manipulation of information. There are three major principles in cultural aspects of learning:

1. Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness).
2. Instruction must be structured so that it can be easily grasped by the student (spiral organization).
3. Instruction should be designed to facilitate extrapolation and or fill in the gaps (going beyond the information given). In addition, three major phases through which learner's representations develop:

    - Enactive – at first the learner's representations involve active manipulation of physical objects
    - **Iconic** – internal representations now come to stand for objects but in a one-to-one correspondence rather than at a higher level of abstraction (e.g., a variable name)
    - **Symbolic** – internal abstract representations which no longer have a one-to-one correspondence (e.g., the concept of a variable). It is also not a theory that is restricted to child development.

The theory is largely concerned with transfer of knowledge and skills beyond their initial learning situation. For this reason, emphasis is placed upon the presentation of information from multiple perspectives and use of many case studies that present diverse examples. The learning environment presents multiple perspectives on the content, is complex and ill-defined, and emphasizes the construction of knowledge by the learner. The tutoring principles derivable from cognitive flexibility theory are:

1. Learning activities must provide multiple representations of content.
2. Instructional materials should avoid oversimplifying the content domain and support context-dependent knowledge.
3. Instruction should be case-based and emphasize knowledge construction, not transmission of information.
4. Knowledge sources should be highly interconnected rather than compartmentalized.

2.2 Guidelines to create architecture of Mobile Learning Content

2.2.1 What are guidelines?

The communication of aphoristic, practical knowledge presents certain problems. Practical books and articles often present advice or research findings as simple guidelines. In their more general form, guidelines have been termed 'slogans' (e.g. 'form is function'). Wright (1985) has been particularly critical of low-level (i.e. detailed) guidelines which, applied without sensitivity to their inevitably numerous exceptions, can do more harm than good. She also notes the sheer number of guidelines needed to cover the range of problems encountered in a given domain (in her case, text design).

Whilst guidelines can obviously be of great value, a major concern is that guidelines should not become detached from supporting evidence. A typical guideline might be 'Use simple language (Some name, some date)', without detailing those circumstances under which simple language might be misleading, or what constitutes simple language. More seriously, on following up the reference given

one can find that the cited author has simply remarked 'Use simple language' in a general context indicating what seems like a good idea. Research references have sometimes been used for persuasive purposes to lend authority to the guideline indeed, when non experts seek research references it is frequently for this reason.

Since guidelines are often either detailed enough for exact application or generalize enough through reference to a theory, they can appear to offer contradictory advice. Furthermore, it is also often difficult to bear in mind the number of guidelines that can apply to a design task.

For example, in the context of designing interactive interfaces, Alm (2003) observes:

"It is expected of a designer to consider at least a dozen, usually considerably more, different principles or guidelines in designing an interface. Such principles are associated with, for example, elegance and simplicity; scale, contrast and proportions; perceptual organization; module and program; semiotics in image and representation; interaction style; task, user and context characteristics, etc. There is simply no possibility for a human being to consciously keep track of the interconnections between so many variables or to calculate all the consequences and constraints which may emerge from putting all of the principles and guidelines together."

Guidelines are often offered in the form of checklists, but there is often little correlation, or systematic comparison, between one checklist and another. The inclusion of a particular guideline, for example, may be due to the author's success with that particular recommendation in a specific instance or application. Other experts, however, may not share this experience, and therefore make no reference to it. Items may appear because of the stated preference of a certain user group. The gap between preference and effectiveness of design in terms of comprehension, recall or usability is often unexamined or justified by empirical evidence.

Recommendations may be present because they have proved to be cost-effective in a particular setting. But in other situations, financial considerations may not be of primary importance. So it is important in the provision of guidelines that we ensure they can be located within contexts, that they are verifiable and that the original sources for the guidelines are specified. We are in the early stages of this work, and our aim is to have a database of guidelines that is being added to, and updated on a regular basis. But to avoid some of the problems already noted, we adopt the following principles:

2.2.2 Guidelines will be theory-informed "do and don'ts"

This in itself is somewhat problematic, given the current lack of evidence on effective teaching and learning with mobile technologies. We shall have to be careful that the guidelines are based on either:

a) Theory and practice of learning with conventional tools that are relevant to M-Learning (content tool for Accounting).
b) Evidence from desktop e-learning which we have good reason to believe will transfer to m-learning.
c) Findings, from those studies of m-learning that are available.

2.2.3 Guidelines will be validated

Each guideline is grounded in either theory or relevant empirical studies. Thus, our guidelines will provide references to the relevant sources, and a justification for their inclusion in our database. Other information, for example, known limitations a particular guideline, will also be included.

2.2.4 Guidelines will be segmented into audiences

A primary audience is direct users of mobile learning technologies, but there are other stakeholders, such as policy makers. This is a wide audience - ranging from teachers and students in higher education through health workers and other professionals, to families and tourists, as well as system designers and usability

engineers etc.

2.3 Differences between M-Learning and E-Learning

If e-learning took learning away from the classroom or campus, then m-learning is taking learning away from a fixed point. Where e-learning is an alternative to classroom learning - m-learning is a complementary activity to both e-learning and traditional learning.

M-learning respects that a user would like to interact with educational resources whilst away from their normal place of learning - classroom or computer. In one sense m-learning has been around for longer than e-learning, with the paperback book and other portable resources, technology is what shapes today's usage of m-learning. Technology now allows us to carry vast resources in our pockets and access these wherever we find convenient. Technology also allows us to interact with our peers instaneously and work together remotely in ways never before possible.

Whilst the opportunities that m-learning devices present us with are new - the challenges are quite old, smaller screen sizes, limited processing power, reduced input capabilities. These challenges mean that adapting existing e-learning services and content to m-learning is not a trivial task.

2.4 Challenges with m-learning

2.4.1 Connectivity

The connectivity is one of the main differences if we compare a mobile device with the PC (the usual medium for delivering e-learning). Nowadays mobile devices might be connected to 'The Net' via many technologies – WAP, GPRS, UMTS, Bluetooth, WiFi, etc. Although it is predictable that in the future the 'always on' will

be wide spread still it is not the case. Mobile devices often have periods of disconnection, either intentionally (when the connection is too expensive) or not (when no infrastructure is provided).

2.4.2 Hardware and software device's characteristic.

Devices' hardware and software characteristics have a big impact on what content is possible and meaningful to be delivered. Usually the web content is designed for desktop PCs, thus unpleasant and even rarely useful from a small-screened device.

Nowadays mobile phones are rapidly becoming increasingly powerful (both from hardware and software point of view) however their screens will remain comparatively small. Often also the navigation is hard. Equipped with a small phone-style keyboard or a touch-screen (for the PDAs) the users might lose more time in searching where on the page the information they need is than in reading it. We can imagine alternative ways of navigation, for example voice commands. The memory available on a mobile device is also relatively small. It is possible to use extension packs on some devices like PDAs, which reduces some of the restrictions.

2.4.3 Location

Location is a new thing to be considered. Although up to now we are talking only about limitations confronting m-learning and e-learning, there are also advantages. The small size of the device and the wireless connections make them available anytime and anywhere. The mobility opens variety of new scenarios. Services involving location-discovery are, for example, receiving directions on how to get to a certain room, or alerts for seminars/lectures that can be triggered while taking into consideration the current place and the time to get to the needed destination; location-aware printing of the learning content, etc.

CHAPTER 3
METHODOLOGY & PROJECT WORK

3.1 Methodology

The methodology that is used for this project is a custom methodology that is divided into five main phases. Identifying the right methodology for a short development cycle is important to ensure project completion. Graphically, these five phases are as displayed in Figure 3.9 below.

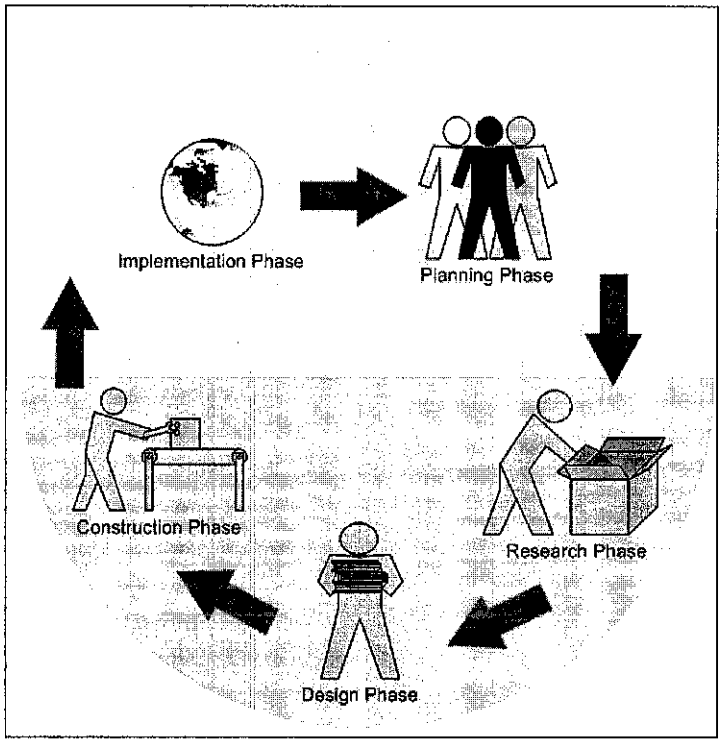

Figure 1 Project Methodology

3.1.1 Research and Planning

Before the system is constructed, through design and understanding of the system must be done. All information regarding the system that is going to be developed must be accessible, as it will help the design to be more accurate and able to define the system at early stage of the cycle.

3.1.2 Testing

Testing is done at all time during the design, construction and implementation phase. There is no single testing cycle as it is important to make sure that the system is well-developed and no errors should be left for tomorrow. However, a short and brief single testing activity is done when the project reaches the implementation phase. This is to test the integration of the subcomponents of the system, which is important to ensure that the components are able to communicate together as one whole system. Several test methods are adopted during the design, construction and implementation phase. These methods include path testing, usability testing and bottom-up testing.

3.1.2.1 Path Testing

Path testing is a structural testing strategy whose objective is to exercise every independent execution path through a component or program, thus, path testing is used when testing the flow of the system to make sure every pages contains executable methods, as well as true and false conditions. The true and false condition is usually applied during logging in into the system, as well as when answering quiz questions from the system.

3.1.2.2 Usability Testing

Usability testing is done to ensure the look-and-feel of the system is user friendly, easy to understand and helpful. Proper usage of color and text is important since the main function of the system is to deliver tutorial contents in a better approach. Hence, usability testing is done at early development stage when designing the system's interfaces.

3.1.2.3 Bottom-Up Testing

Bottom up testing is done by testing lower-level components individually, and then working up the hierarchy of the modules until the final module is tested. As mentioned, bottom-up testing does not require the architectural design of the system to be complete, thus, this approach can be started at early stage n the development process. During the development of the system, bottom-up testing is done to each subcomponent to ensure that they are defect-free. As development progresses, tests are focused on integrating subcomponents to ensure proper communication between them.

3.2 Project Work

3.2.1 The MobileAware Solution

MobileAware eliminates the device diversity headache for the author by adding a few simple steps to the preexisting content development process. Instead of having to learn new tools and languages, the author uses familiar tools such as BEA WebLogic Workshop and familiar markup languages such as HTML and JSP.

It provides a comprehensive device database containing more than 500 devices and device classes. This store contains information about each of the different device capabilities and their unique content requirements.

3.2.2 Standards-Based Authoring

MobileAware uses HTML/XHTML as the basis for defining the presentation of content. This is the W3C standard for defining web content and is familiar to many web developers.

Mobile Interaction Server (MIS) has an intelligent transformation engine that

automatically transforms the HTML/XHTML for each of the different device classes into the required markup language, such as XHTML MP, HTML 3.2, CHTML, and WML. This transformation engine also performs device tailoring, modifying the output to address the slight modifications required by different devices in a device class (images capability, table support, and so on).

These capabilities mean that MIS can work with a single source of content as the basis for delivery to all these diverse device channels. MIS is deployed as a J2EE servlet filter in your J2EE web application, coexisting in the same server tier. See Figure 5.

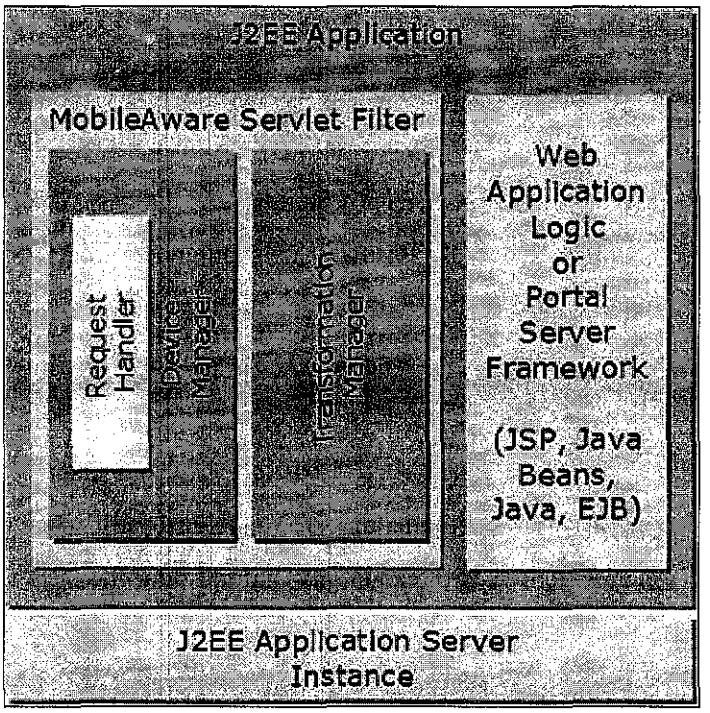

Figure 2 MobilAware's MIS architecture

3.2.3 Laying Foundations

Authoring with MIS extends the existing process so similar to how to design any piece of web content, start by considering the layout of a page that are going to deliver. First, the author decides on the layout of your navigation menus, header/banner images, and main content locations. Then, define the look and feel,

preferred colors, and necessary images.

The next step is to create the HTML framework in which to position and display the components of this design.

With the software qualification, it extends these steps by asking the developer/designer to consider the channels they are developing for. Our guide is that there are three main device classes: PC, PDA, and Mobile Phones. These three device classes are the only channels the developer needs to design for. Within MIS, these device classes are described as "FullBrowser," "PDA," and "MenuDriven," respectively.

We will take the example of the "MenuDriven" device class. Consider this class an abstract grouping of all mobile phones, encompassing all the different markup languages required by these myriad devices. This simplifies the potential headache of designing for the different markup languages and the subtly different device requirements, leaving it to MIS to handle all these complexities.

The mobilization process is categorized into two main stages: grouping and presenting content. Step 1 is to logically group the sections of the page. Step 2 is to define how to present this content for the device classes.

During the normal web design process, the designer has already considered the broad grouping of content to be delivered to the PC. MobileAware extends this thinking to consider the page in terms of which groups (or indeed, subgroups) of content we want presented on each device class.

In some cases the application may be only for a subset of the PC, PDA, and MenuDriven device classes, for example, a mobile phone-only site. In these instances, it is only necessary to think of this device class, and this further simplifies the design role.

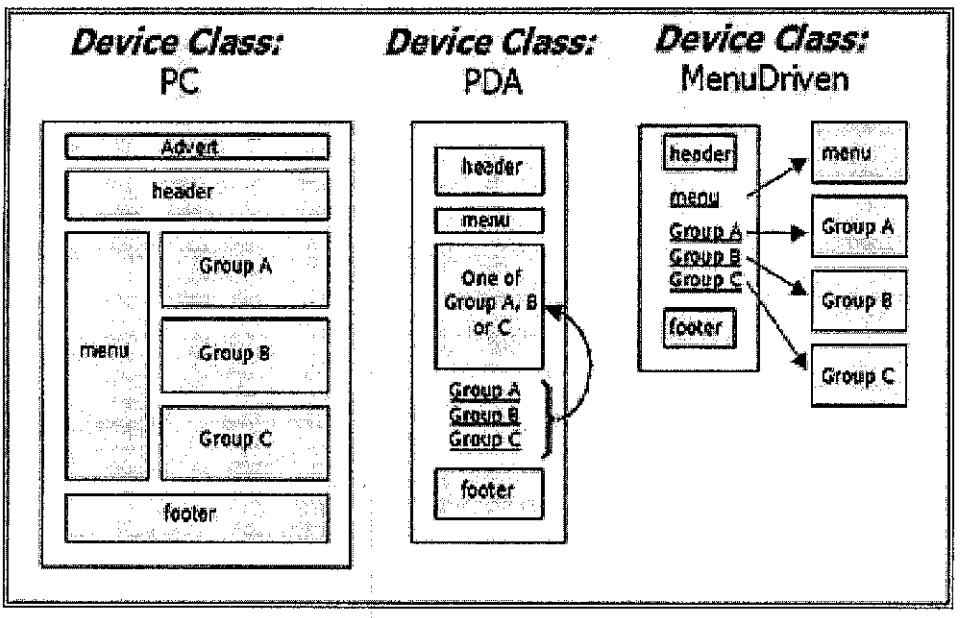

Figure 3 Designing for the three device classes

In Figure 6, we can see a design view of a PC page, broken into its logical groups. This is followed by the design view of how these groups are displayed on the mobile devices. As stated earlier, as a designer we are only concerned with three device classes and not with the differences in markup languages, image capabilities, and so on.

After the design phase, the page is marked up using HTML/XHTML. The author has extended XHTML to include extra mobility tags. At the very simplest, it only needs to add three mobility tags to make the HTML/XHTML page transform and be delivered to any handheld device.

Pagination is the splitting of large pages into multiple smaller pages suitable for delivery to devices with limited content capacity.

In addition to this initial transformation, extra tags can be added to fine tune the content for a specific device class or to handle images, for example. MIS will automatically convert HTML content to the correct markup language for the requesting device as well as perform automatic intelligent pagination if required.

3.2.4 Mobilization Recap

To recap, the original page is written in HTML/XHTML following the normal authoring process. This is the content that is delivered to PC browsers. Then, define the groups. Next, add some presentation information for how we want the groups delivered to MenuDriven devices as described above and also to PDAs in a similar manner. MIS will transform the author-selected content into the correct markup language for the requesting device.

The web developer only needs to focus on the content and does not need to worry about the device diversity headache! MIS will automatically present the best possible content to the device. For example, if a device supports color images, these will be sent to the device. If the device supports only black and white images, however, then a WBMP (black and white wireless bitmap) will be sent. The following listing shows a typical marked up page. The additional markup does not have an impact on the `netui:tags` and uses the existing HTML that developers are familiar with. The resultant content from MIS will be HTML, WML, and so on, depending on the device's markup requirement.

Figure 6 also shows how some presentation ideas for pagination have been considered. For the PDA device we have considerable flexibility in how we present the content to the user. In the illustration we have decided to display only one of three groups on a page at a time, giving the user a more manageable subset of the information to work with.

MIS will display one of these groups in full on the page and automatically add a navigation menu allowing access to the pages containing the other groups. Header, Menu, and Footer groups are displayed on all pages. So from the one original PC page we now have a set of three PDA pages, with a navigation menu to link between them, all created automatically.

Looking at the MenuDriven design, the author has decided that the header and footer groups will be displayed on the main page with Group A, Group B, and Group C displayed as a menu of links. Clicking one of these links will bring the user to the

complete content of the selected group. Automatic breadcrumb-like navigation links are added to direct the user back to the original page.

As mentioned earlier, if the content is too large for the memory capacity of the device, the content is split over various "decks," with automatic navigation links directing the user through the complete content. Refer Figure 7.

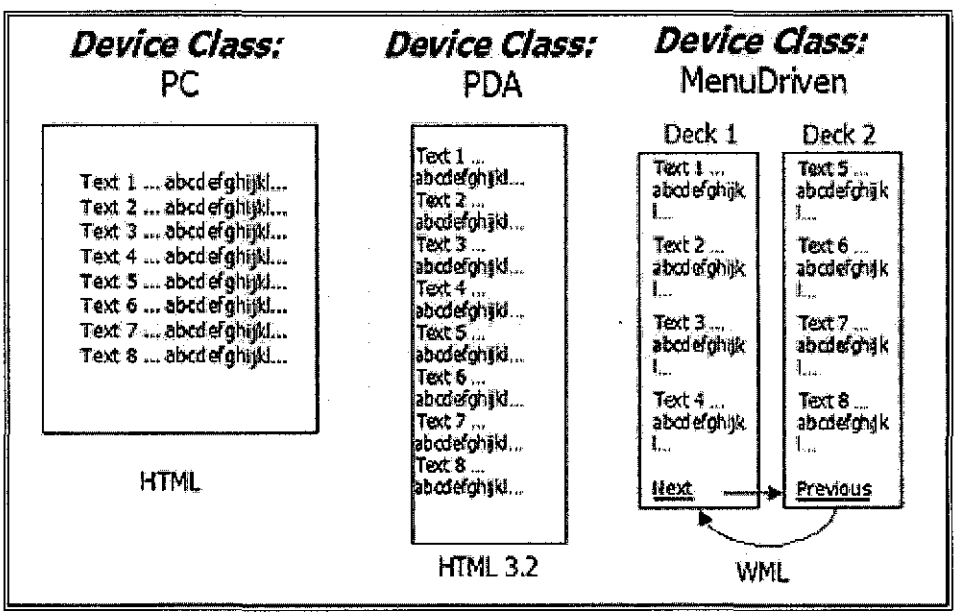

Figure 4 Automatically paginated content for a device with a limited deck size

Referring to Figure 7, Deck 1 splits just before hitting the maximum page content size for this WML device. This pagination will be performed for any mobile device, WML, XHTML MP, or i-Mode, where the device supports a limited amount of content and the content supplied is too large for that available space. Once again, the author does not have to be aware of these limitations or the markup language that is required.

When desired, the author is free to indicate within the content the best (or worst) locations for any automatic pagination to occur.

3.3 Tools required

There are seven (7) tools that will be used to develop this project. The major tools that will be used extensively for this project are as follows.

3.3.1 Software

i. Operating System
   - Microsoft Windows XP Home SP2

ii. Application Server

   The application server is required in order to use WebLogic Mobility Server, but not required prior to installation.
   - BEA WebLogic Platform 8.1 SP2 and above
   - BEA WebLogic Mobility Extension
   - BEA WebLogic Server Platform

iii. Internet Browser
   - Netscape 4.75 and above
   - Internet Explorer 5 and above

iv. Database (optional)
   - Oracle 9i, 10i
   - MySQL 3.53 and above
   - SQL Server 2000

v. JDK
   - Sun JDK 1.4.x or JRockit 1.4.x

vi. Emulators
   - Nokia 5100 SDK
   - Openwave v7 SDK
   - BEA PDA emulator

vii. Images and Graphics Authoring
   - Adobe Photoshop CS (Creative Suite)

For the purpose of development work, Microsoft Windows XP Professional Edition is chosen because the platform offers more stability and reliability over other Windows platforms. The chosen operating system also supports most of today's software which includes the above listed tools that will be used for the development. Windows XP Professional's stability over handling multiple web servers, which in this case Bea Workshop with mobility extension are vital for the project's success. Since the server is also used as a development system, necessary supporting components that supports deployment and usage of the tools above is needed. This component, which is available for free from www.sun.com is Java(TM) 2 SDK, Standard Edition Version 1.4.2.

3.3.2 Hardware

Apart from software, a development machine is vital for the purpose of web hosting, database storage, system development, testing and simulation. A complete desktop personal computer with specifications below is used for the project:

- Pentium 4 2.0GHz
- 512MB RAM
- 20 GB of hard disk space for operating system, development software, web server software and so on
- 10/100 MBPS network card with LAN connectivity available

Since the desktop personal computer is used for almost all activities (development, web server hosting, database server), it is very resource consuming to the system, thus it is important to make constant backups. Backups are done manually by storing important files into other location, either into different hard disk, different media or different location. The period of backing up files varies between each development cycles.

CHAPTER 4
RESULTS & DISCUSSION

4.1 M-Learning in context: Informal, Lifelong Learning

Having explored the mobile learning context, we shall now turn our attention to the implementation of mobile learning. The remainder of this document is dedicated to the development of guidelines for

a) Organization and institutions who want to enable their employees or students to learn on the move
b) Teachers who want to support their students in their mobile learning efforts
c) Learners who want to take advantage of mobile technologies to enhance their learning experiences and expand them beyond their usual fixed locations. We concentrate on two sources to devise the guidelines: first, we will review theories of learning in an attempt to identify the closeness of mobile learning to traditional notions of learning and to decide how practices of learning can be translated for mobile environments; and second, we will review cases of implementation of mobile learning to date in an attempt to identify elements of success and to abstract them into more general success criteria.

4.2 User Acceptance Test.

User acceptance test has been conducted in order to obtain the user's view regarding the finished system. This is important as to know how the users would preserve the system functionality and efficiency. The test was conducted on 10 students who are taking Accounting subject from Universiti Teknologi Petronas.

The students evaluated the system using the form as shown in the table below. They will assign values from 1 to 5 based on the definition scale defined below.

Attributes	**Rating**				
	1	**2**	**3**	**4**	**5**
1. User Friendliness					
2. Functionality					
3. User control and freedom					
4. Visibility of system status					
5. Aesthetic and minimalist design					

Table 4.1: Sample Evaluation Form

The definition for scale is:

1 – Very Poor, 2 – Below Average, 3 – Average, 4 – Meet Expectation, 5 – Outstanding

Each of the evaluation characteristics are explained to the volunteers. They are:

- User Friendliness: Evaluation of the overall system interface design including its efficiency, visual visibility, ease of use and color coordination.
- Functionality: Evaluation on the importance of the functions inserted in the system as well as the usefulness of the data and the automated personality test.
- User control and freedom: Evaluation on the ease of use and undoing action function.
- Visibility of the system status: Evaluation on informing the user on the page the user is currently visiting.
- Aesthetic and minimalist design: Evaluation on the system content, whether it contains enough relevant data within the page to be useful for the user.

The results of the user acceptance test are shown in the figures below in the order of the criteria measured. Please note that the full score of the rating is 5.

4.2.1 User Friendliness

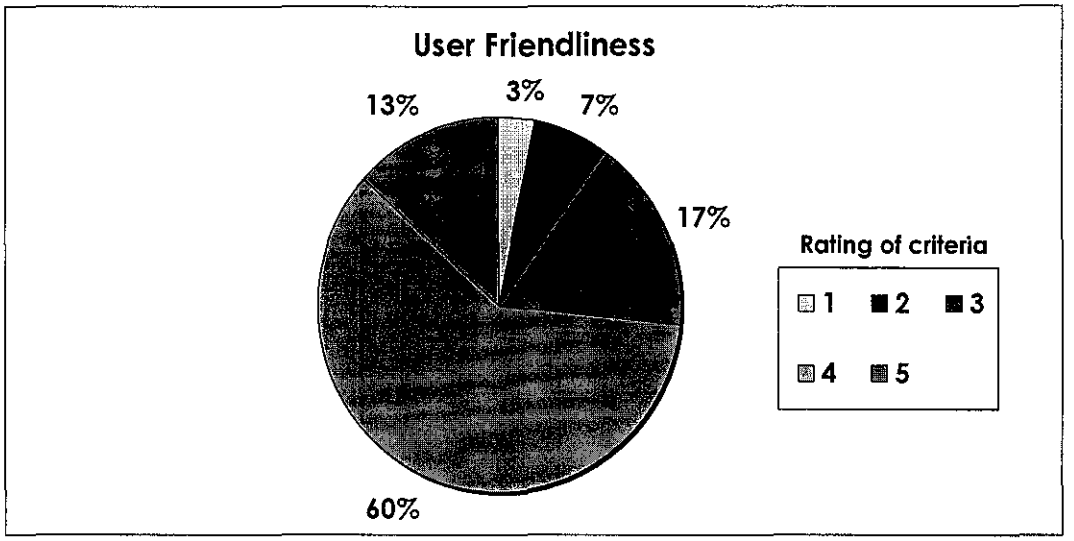

Figure 5 Summary of User Friendliness criterion

73% of the students gave rating above average for this criterion. Based on an informal interview session, the students perceived the website will need some improvement in terms of its consistency between the web page layouts with the personality test automated system. However, they agreed that the system's layout is attractive enough to attract them to use the system.

4.2.2 Functionality

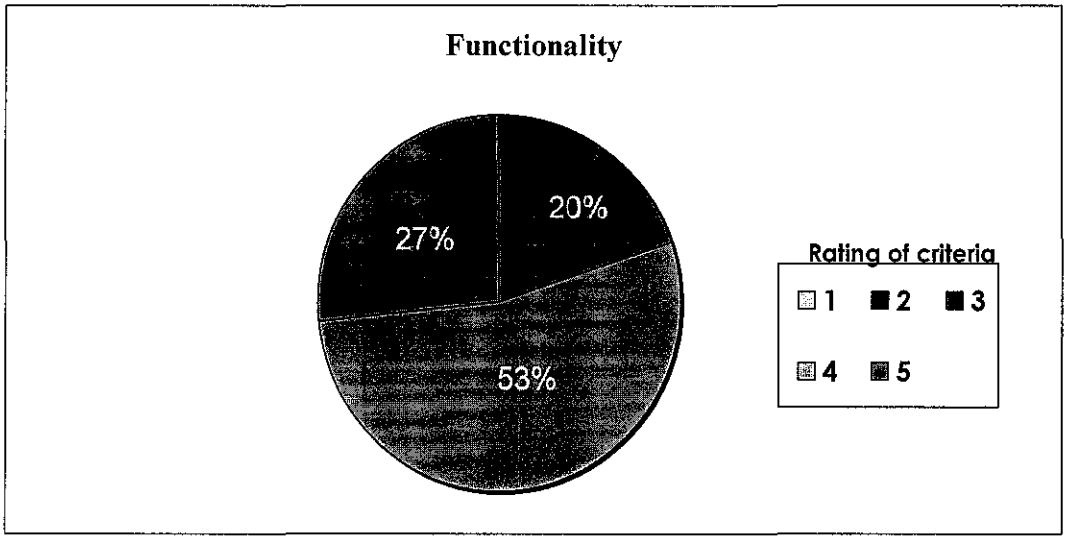

Figure 6 Summary of Functionality criterion

80% of the students gave scores above average for this criterion. All the samples agreed that the system provided enough information for the user to make decision and view the real working environment.

4.2.3 User Control and Freedom

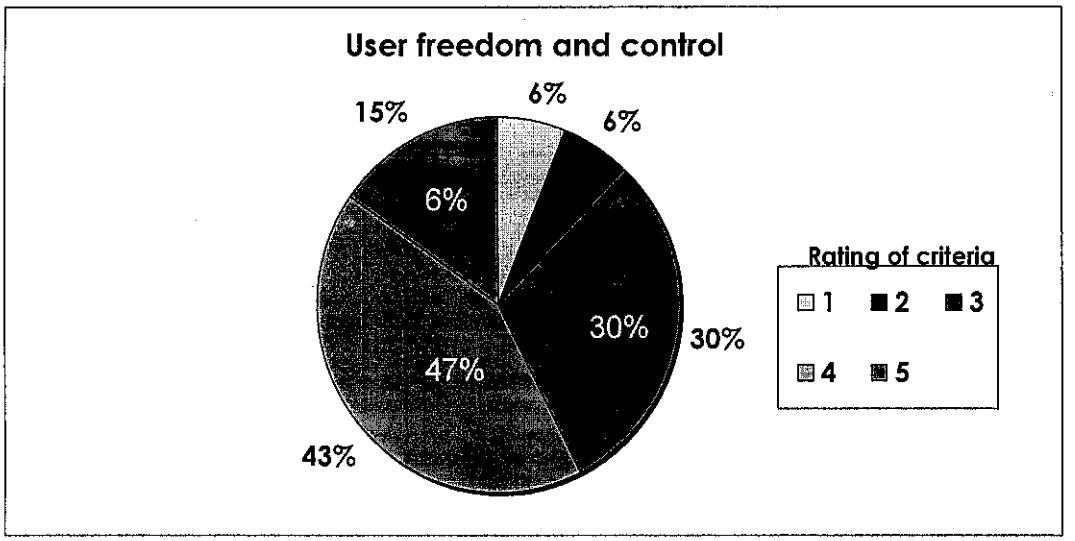

Figure 7 Summary of User Control and Freedom criterion

53% of the students gave scores above average for this criterion. Every student agreed that the system offers freedom to users. They are most impressed that the system allows user to go to navigate between pages as simple as a click of a link or a button. However since the percentage given above average is slightly above half, improvements need to be done to better this criterion.

4.2.4 Visibility of the System Status

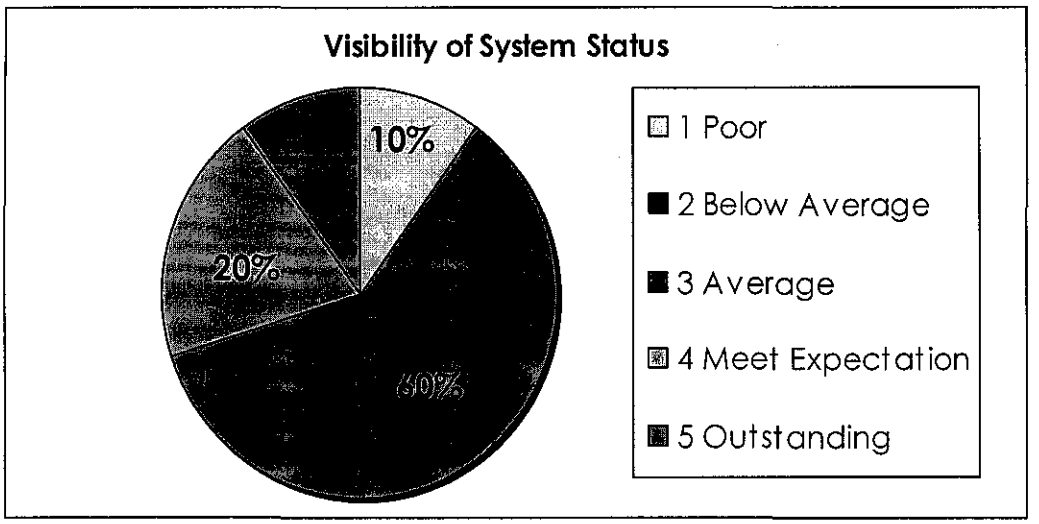

Figure 8 Summary of Visibility of System Status criterion

Based on surveys, 80% of the students gave scores above average for this criterion. This show that the system has completed its objective that is to increase the effectiveness of the system's user friendliness in providing information on the system status.

4.2.5 Aesthetics and Minimalist Design

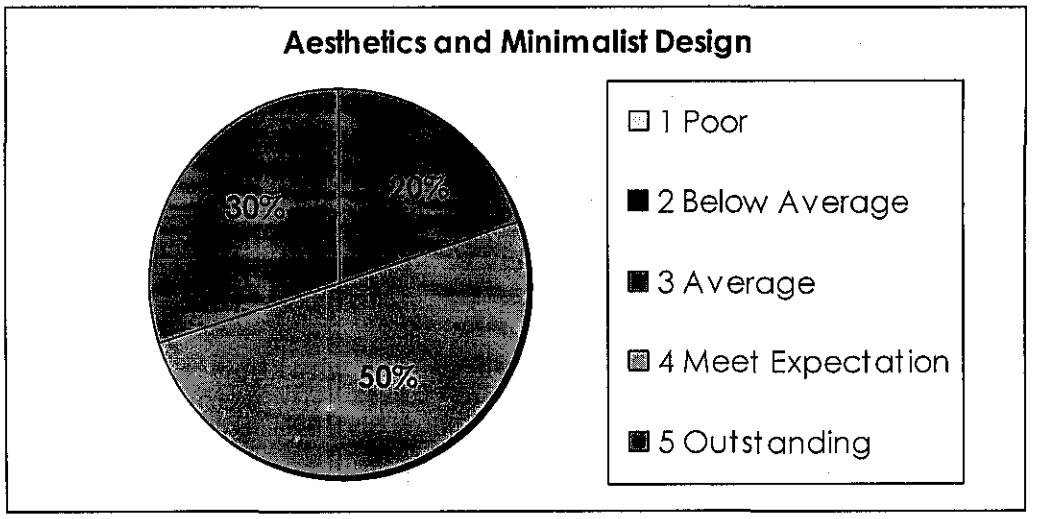

Figure 9 Summary of Aesthetics and Minimalist Design criterion

All of the participants agreed that the system does not contain any irrelevant information. All the information presented during both parts of the system is relevant to the context given. They concluded that the system contains consistent data that conform to the objective of the system which is to deliver interactive yet informative content for learning.

Overall, the students are satisfied with the performance of the system. Although there are some minor drawbacks, they have agreed that this system can be used as an alternative for academic advisement which has been lacking in the current educational system in Malaysia.

The same user acceptance test was conducted on Universiti Teknologi Petronas students in order to obtain how a more mature mind would grade the system. The samples used were five students who are taking Accounting subject. As a result, the scores are tallied and presented in the histogram diagram below.

4.2.6 Scores from 5 users of UTP students based on web-based.

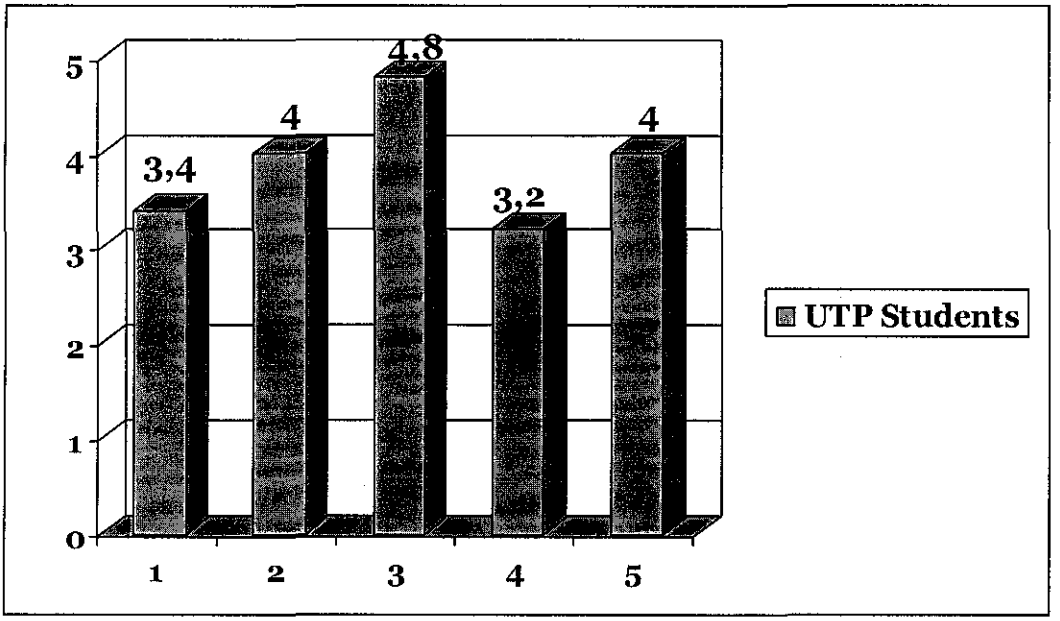

Figure 10 Average score of the system tested by UTP IT Students

As the figure shows above, the entire criterion tested scored above average, where the average value is 3. This proves that the developed system is acceptable to most of the accounting students in UTP.

4.3 Discussions

4.3.1 Methodology of structuring and organizing a mobile learning application

Kerres (2002) defines four categories to structure and organize a computer-aided and multimedia-based learning application:

- Exposition
- Exploration
- Construction
- Communication

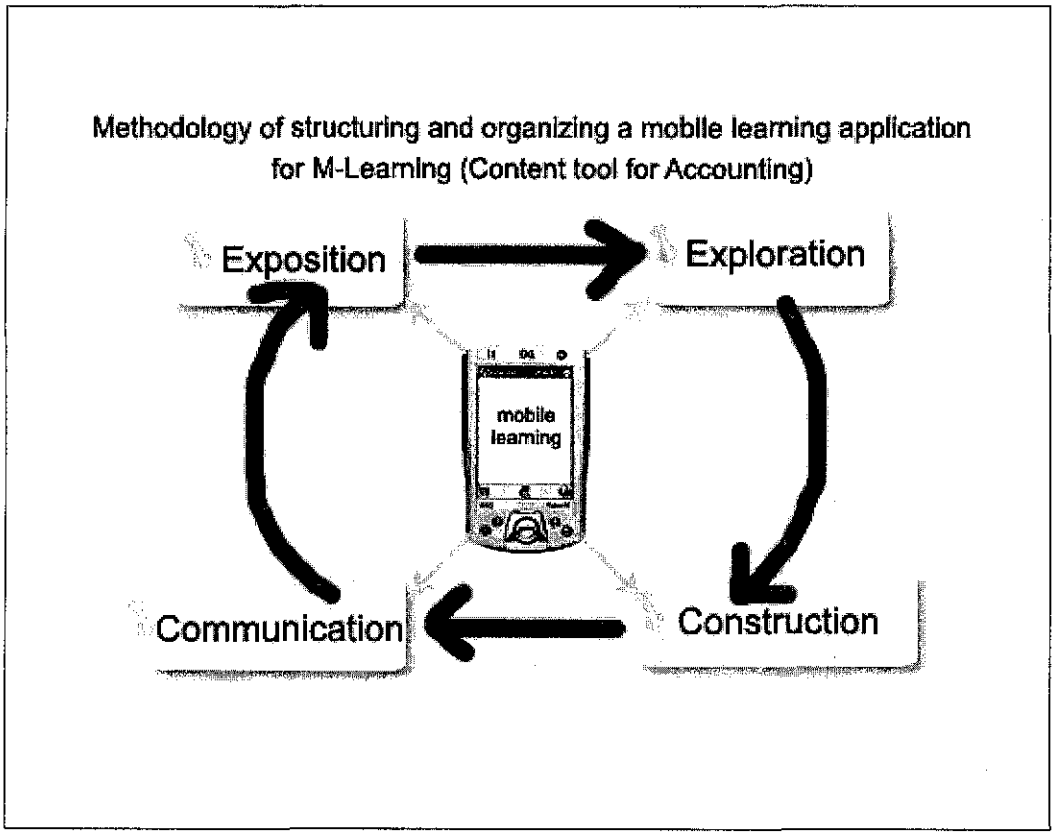

Figure 11 Methodology of structuring and organizing a mobile learning application

A mobile learning application is a computer-aided and multimedia-based learning application too. Therefore it should fulfill as many of these four fields as possible to achieve a greater learning-richness. How these four categories can be realized within a mobile learning application will be covered in the following chapters.

4.3.1.1 Exposition

The field of the Exposition covers the learning objects as they are known from Computer Based Trainings (CBTs) or Web Based Trainings (WBT). The learning objects are characterized through a defined and sequential learning path. The learning matter is presented on a sequence of slides and concluded with a set of questions. These questions can either be intended to check the knowledge of the user or to strengthen the newly gained knowledge.

The basic learning theory behind the Exposition is behaviorism. Learning objects for mobile learning (mobile learning objects - MLO) can be structured generally the

same way as learning objects for eLearning. The main difference lies in the way they are presented and the amount of information. Due the limitation of the screen size very little continuous text should be used. Instead different kinds of media should be applied. For example: figures and pictures, videos or audio and spoken text.

Another aspect that should be considered within the creation of a mobile learning object is how it is used. If a user goes through a CBT or a WBT it can be assumed that the user takes a certain amount of time and concentrates on the subject. For example a person is waiting at the bus-station and uses this time for learning on his mobile phone. Suddenly the bus arrives, so he has to stop to enter the bus. After he is seated he wants to continue learning till he arrives at the desired destination. The learning object should be structured in such a way that the user can stop learning immediately and continue learning after a certain amount of time. This special kind of use requires the structure of the learning content in small and homogeneous "information nuggets". These information nuggets should fit to one page or slide. If the user stops immediately it should be possible to continue learning just by going through the last information nugget.

4.3.1.2 Exploration

Exploration is derives from explorative means without a learning path. If applied to mobile learning, the user can explore on their own the available learning content. A realization for explorative learning would be a hypermedia system (networked multimedia-based content) and in the broader sense a knowledge system.

Explorative learning gives the responsibility and the power to the user. He can learn whatever he wants to learn and that usually increases the motivation for learning. Due the lack of a learning path, explorative learning is more suitable for users, who already have a basic knowledge and the skill for learning on their own. Whereas learning with learning object is more suitable for inexperienced users.

The main problem of explorative learning is the lost phenomena. If the navigation and the status information are insufficient, the user gets lost in the hypertext system. This leads to frustration and the possible end of learning. Within the adaptation of a hypermedia system for a mobile learning application only the presentation of the

content has to be considered. Due the small screen size the same problems occur within the *exposition.*

4.3.1.3 Construction

The field of *construction* can be described as "learning by doing" and is influenced by the learning theories of cognitivism and constructivism. Simulations and models are the main instruments for *construction.* The main problem with these instruments is the processing power required that is not yet available for Smartphones. Therefore a Simulation could just be realized by a thin-client system today. The solution would be that a server makes all the processing and calculations and the client (the Smartphone) displays the pre-processed results.

4.3.1.4 Communication

Communication is one main demand of constructivism. Synchronous and asynchronous communication instruments would be for example: Chat, eMail, video and audio conference, for a, blackboard, etc. These instruments should help to build up relationships between the students and to the instructors. Students with a similar knowledge can discuss problems or simply ask a human teacher, no matter where the people are located. Also team-projects can be realized over these communication methods.

Instruments for communication are not a great problem on Smartphones, because the main features are already realized on the devices, like the ability for audio and video conferencing, SMS, MMS and eMail. An additional, suitable communication instrument would be a multimedia-forum with the ability to store recorded speech and videos. The input of text is not very suitable for a mobile phone, because the input needs lot of time. Therefore it would be easier to simply record the user's voice and store it as a forum-entry.

4.3.2 Data Sanitization

It is critical for a personality test question and result to interact in a proper manner to provide valid results. Processing between the questions and reference counter of

personality type must be properly done and errors must be identified to verify the output of the system. Matching between results and courses has to be properly prepared. The main aim to produce a good integrated system is to ensure the subcomponents integrating the system is fully tested and verified as error-free. Although there is no such thing as "bug-free" system, technical errors must be minimized at all costs to prove that the automated system is better as compared to the pencil and paper approach.

4.3.3 Model and realization of a mobile learning application

The M-Learning Content (in short: MLC) is a computer-aided and multimedia-based learning application created for mobile phones. It was developed with the Java 2 Micro Edition (J2ME) and runs therefore on a broad variety of mobile phones. Its platform independency makes it possible to handle:

- Different operating systems (Symbian OS, MS Pocket PC, Palm OS, etc.)
- A variety of different screen resolutions
- Different input possibilities (keypad, keyboard or pointer device)

4.3.4 Next Step

The learning objects for the MLE are written in XML (eXtensible Markup Language). XML is an open and international standard which is easy to learn. The use of XML makes it possible to present every kind of learning content. So the MLE is not restricted to some learning objects which are integrated in the application nor is it restricted to some kind of learning content.

Within learning objects the author can define interactive questions. The answer to these questions will be analyzed and corrected by the application itself. The author can also define hints for questions. This means, if the user tries to solve a wrongly-answered question, he gets a hint at the correct answer before the question is really solved. This hint should lead him to rethink his answer and with the help of this hint he should come to the correct solution by himself. So the user is not punished with a "WRONG-message" instead he gets encouraged. By solving the question on his/her

own he/she gets a feeling of success and has learned something.

The distribution of new learning objects is done by a central internet server: the learning platform. Here all available learning objects are hosted. If the user wants to use a new learning object he can download it right away from the server with the MLE. If the learning object has once been downloaded, it can be used without a new connection to the server. Relationship between the MLE and the learning platform:

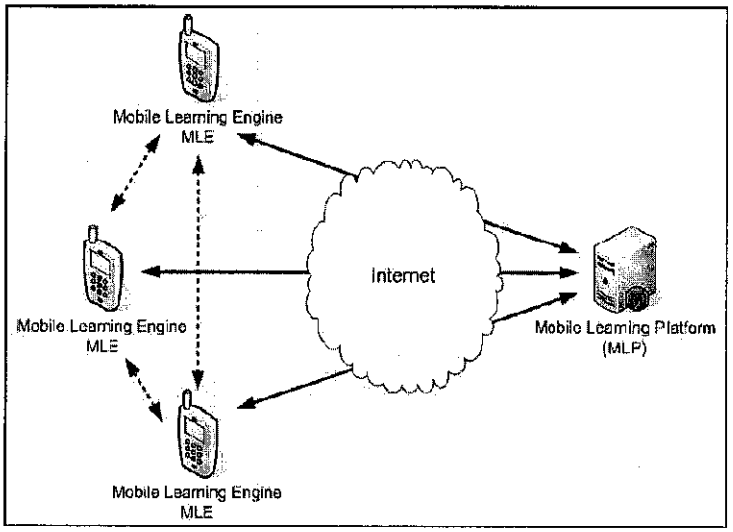

Figure 12 The learning platform is a central internet server that serves all MLC clients

In combination with the learning platform the MLC can also realize a hypermedia system. In broader sense the MLC can implement for example a knowledge network or generally any kind of hypertext or hypermedia system.

4.4 Problem Identification

4.4.1 Current state of developing applications on mobile phones

The main restrictions for a learning application on a mobile phone are:

- The limited processing power and resources
- The variety of screen sizes and the general low resolution of display
- The variety of different input possibilities

- The variety of different operating systems.

The first two restrictions conclude that not every mobile phone is suitable for a mobile learning application usage. Thus, more powerful devices are needed such as the next generation of mobile phones called Smartphones. Smartphones are a combination of a Personal Digital Assistant (PDA) and a mobile phone. They could be described as a pocket computer that can also be used as a mobile phone.

Most of the new mobile phones available to date are in fact Smartphones or even wireless Handhelds. The definition of a wireless Handheld is similar to the definition of a Smartphone. In general, wireless handhelds are more powerful than Smartphones and look more like a PDA.

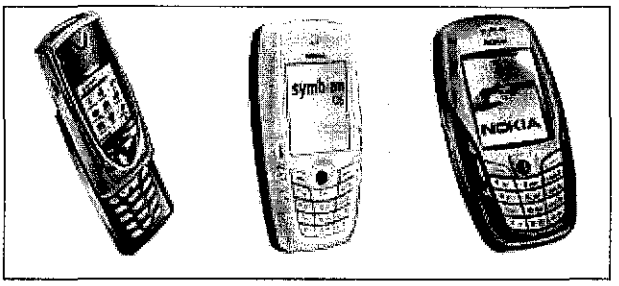

Figure 13 Examples of smartphones available in the market

The variety of input possibilities leads to the problem of incompatibility. Two input possibilities can be mentioned:

- Input over a keypad or a keyboard
- Input over a pointer device or touch screen

Applications that can be used over a pointer decide leads to fewer problems than an application for keypad use. The way of input over a pointer device is the same for every device. The application needs touch-sensitive symbols, which are big enough for the user to click them to cause an action. Input over a keypad leads to the problem of a variety of different key-layouts. The following example describes the problem in detail:

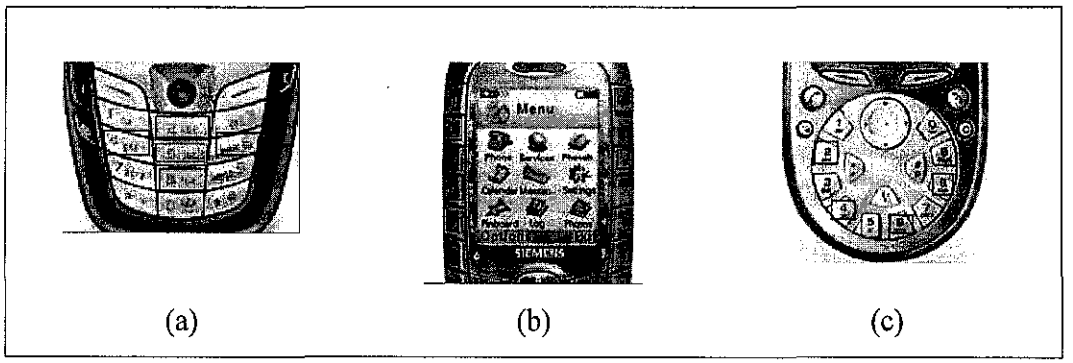

Figure 14 Key layout for (a) Nokia 6600, (b) Siemens SX1 and (c) Nokia 3660

Figure 2(a) shows the key layout for a specific type of Smartphone, Nokia 6600. This key layout realizes a simple navigation: up and down for the scrolling of the content, left and right for the navigation to new elements and the key in the middle to activate an element.

Figure 2(b) and 2(c) shows the key layout for two other Smartphone.

Whereas on the first Smartphone (Figure 2a) the key layout was intuitive and logical, on the other two Smartphone devices (Figure 2b and 2c) the same key layout leads to a catastrophe and is nearly impossible to use.

4.4.2 Current system developed

After extensive research, it can be concluded that the system being developed has never been implemented in Malaysia. However, certain countries provide a similar system but with a high price to pay. From the documentation provided from the websites, the development group has conducted of surveys and interviews to finally finish the system. With the limited resources and time constraints, it is feared that the project developed would not reach the standards to become a useful tool in assisting the students to enjoy learning in easier way.

4.4.3 Programming Knowledge Limitations

Programming is not the main area of study of the author, as well as for this project, but additional knowledge proves useful when developing this system. With the author's limited knowledge in JSP programming, some sections of codes might be unacceptable for expert programmers. Though so, the system has been slowly developed from scratch using the author's limited capability and strong will to search for helpful resources.

CHAPTER 5
CONCLUSION & RECOMMENDATION

Mobile learning should not be used as a replacement for e-Learning. It should rather be seen as an addition to e-Learning. Just imagine sitting at home, next to your desktop computer with the big display, and you are learning on your small mobile phone with the tiny display. That makes no sense and seems rather stupid. Mobile Learning makes sense, if it is used outside, where no other and especially better means of computer-aided learning are available. The best way would be the integration of e-Learning and M-Learning. But if the author of a learning object doesn't use them and spends no time in planning and designing, the output will be a vast disappointment to the students. So the authors of the learning objects have a great responsibility and the quality of their work will determine the success and the acceptance of the **M-Learning** (content tool for accounting).

5.1 Relevancy to the project

This research aims you could learn at home with your desktop computer and if you are outside you could continue learning on your mobile phone. Due the fact that the learning objects of the **M-Learning** (content tool for accounting) are written in XML, it is possible to present these learning objects on a desktop computer as well. Also the reuse of existing learning management systems (LMS) for the **M-Learning** (content tool for accounting) was considered in its development. So this further step of integration is possible with this project.

Like e-Learning, m-Learning suffers from a problem, describes as "a lack of didactical fantasy". The **M-Learning** (content tool for accounting) for example offers a broad range of possibilities to create learning objects. On the other hand, this research also aims to understand the concept of learning delivery methods, which includes the design of course contents and test questions.

5.2 Suggested Future Work for Expansion and Continuation

Should the system development continue in the future, more functionality should be added into several areas of the system. These functionalities are as follows:

- To include user interface personalization, where users are able to choose their preferred color, font and so on after logging in.
- To allow the users to view personalized information regarding their quizzes taken, and make a brief analysis about it.
- To include he usage of multimedia elements such as sound and video in course modules.

The functionalities mentioned above will provide students with more features when dealing with the system, and in the same time will produce better results of using mobility devices, hence, brings greater value over traditional learning methods.

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APPENDICES

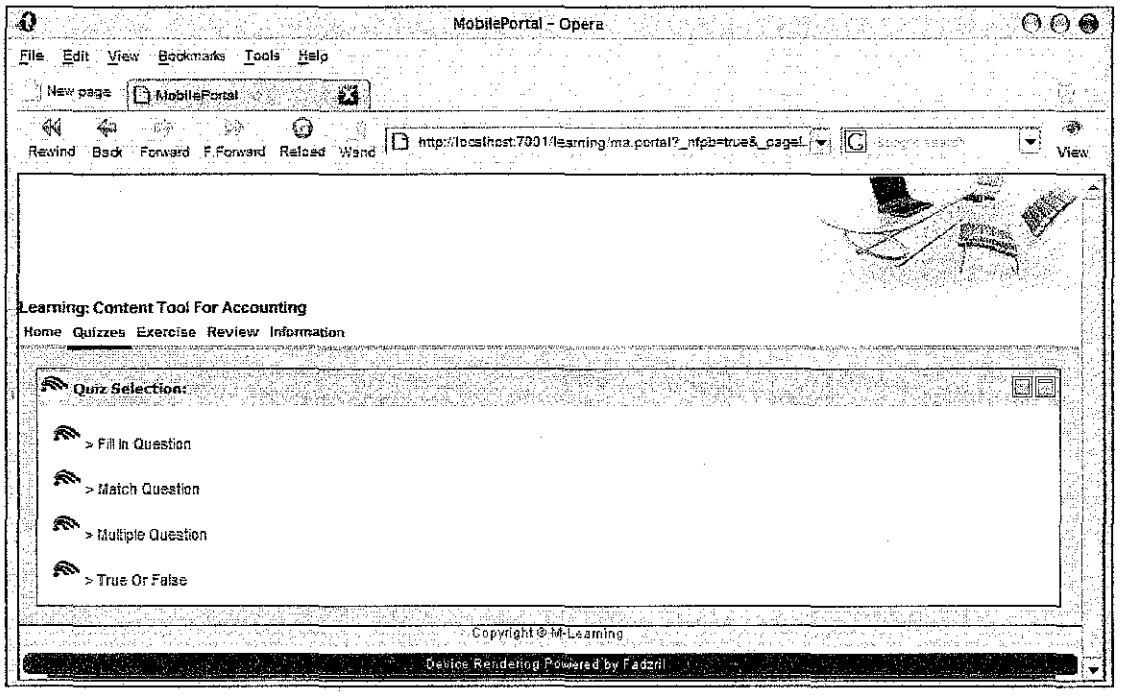
APPENDIX A: Sample web service platform for M-Learning Content tool for Accounting

APPENDIX B: Sample index.jsp previewed in PDA emulator

APPENDIX C: Sample index.jsp previewed in Smartphone Browser emulator

APPENDIX A

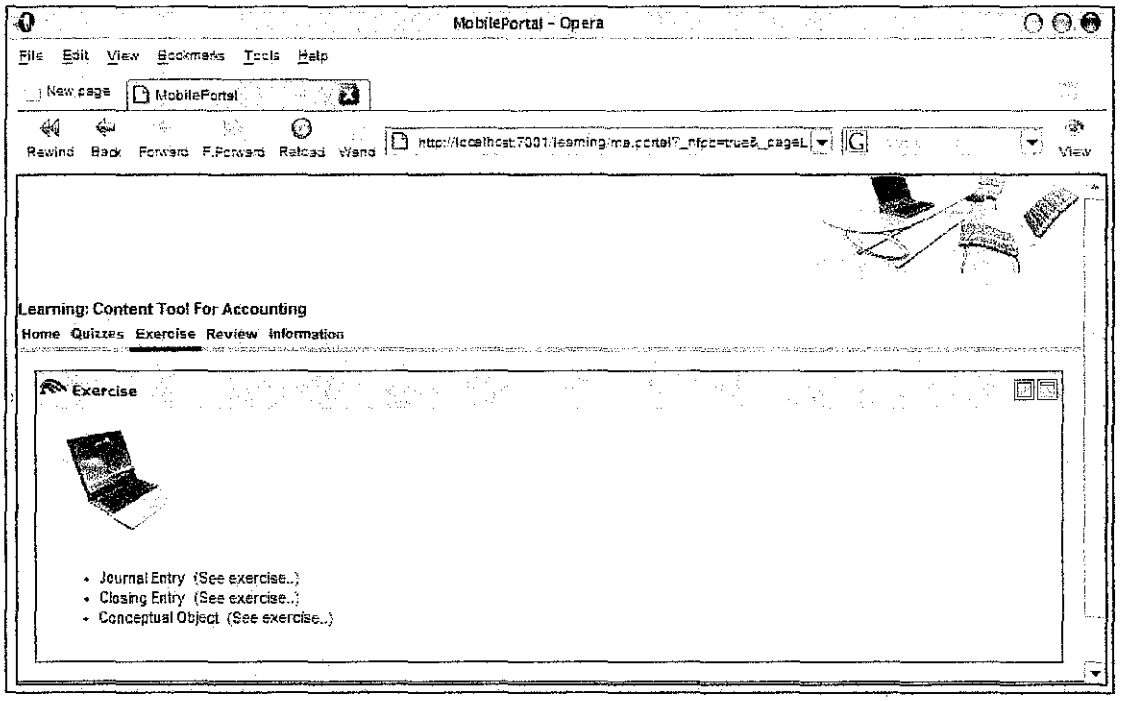
SAMPLE WEB SERVICE PLATFORM FOR M-LEARNING CONTENT TOOL FOR ACCOUNTING



Preview of Quizzes page.

APPENDIX B

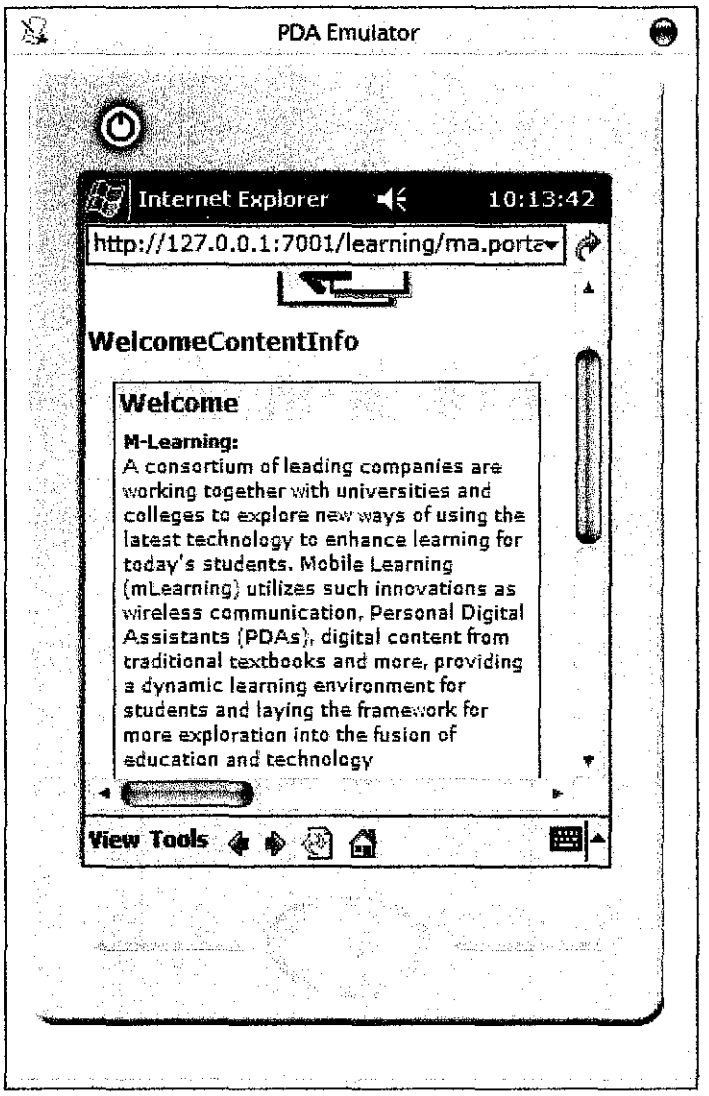
SAMPLE EXERCISE PAGE PREVIEWED IN LOCAL BROWSER.



Preview of selection Exercise page: Select the exercise given.

APPENDIX C

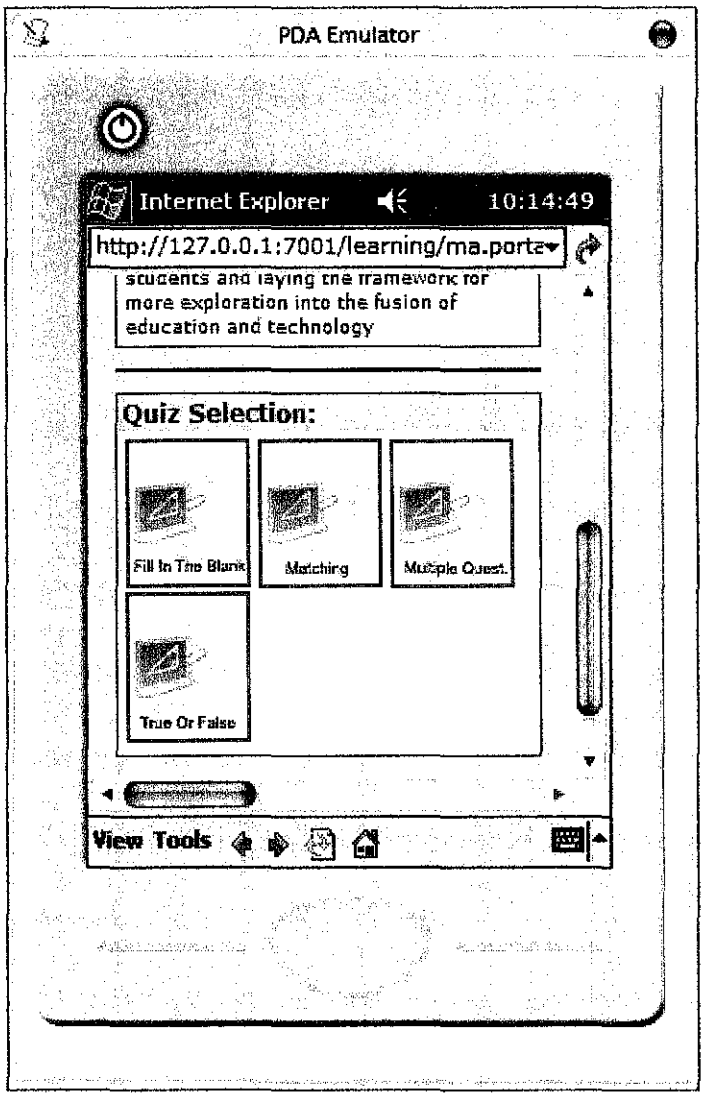
SAMPLE INDEX.JSP PREVIEWED IN PDA EMULATOR



Preview main page: index.jsp in Personal Digital Assistant (PDA's)

APPENDIX D

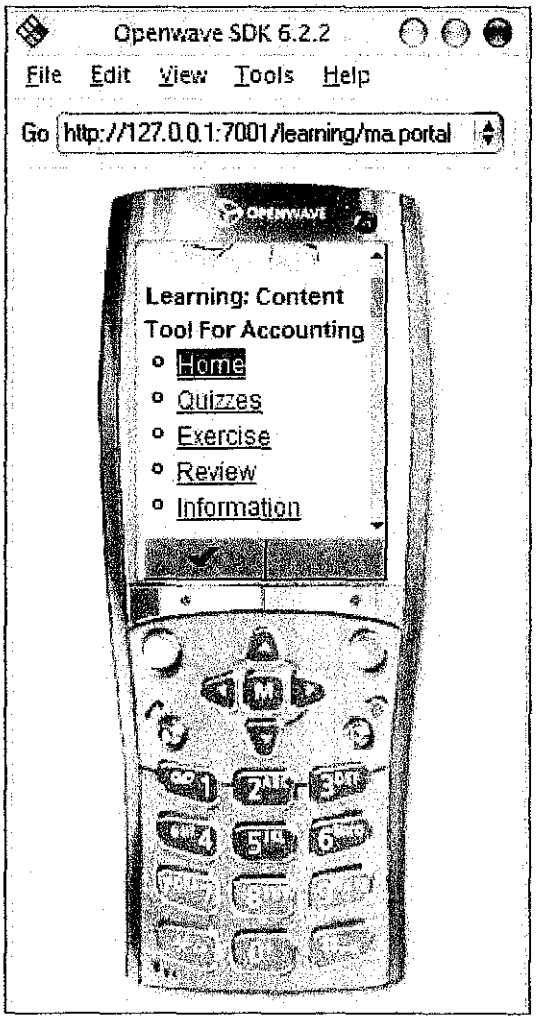
SAMPLE OF QUIZ PREVIEWED IN PDA EMULATOR.



Preview of quiz selection: index.jsp in Personal Digital Assistant (PDA's)

APPENDIX E

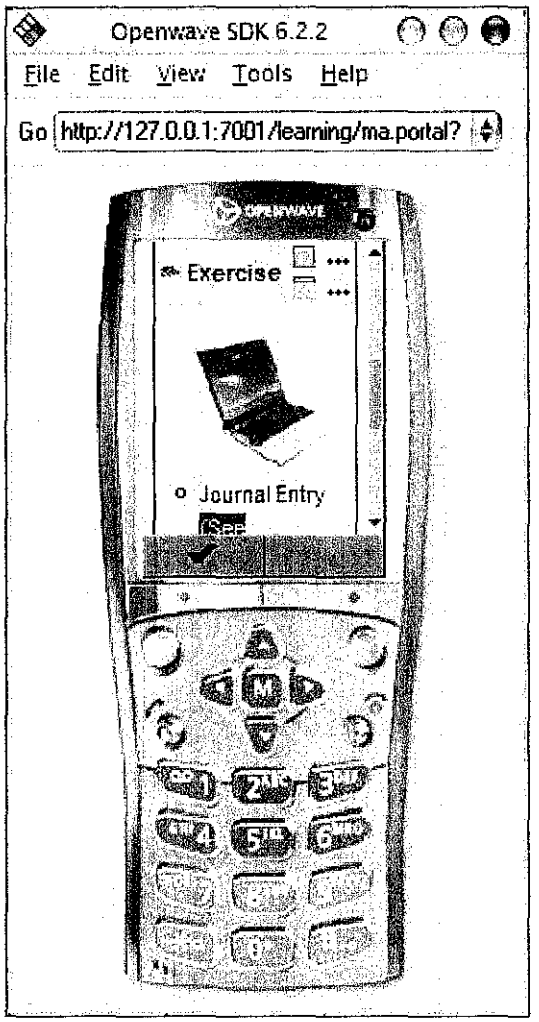
SAMPLE INDEX.JSP PREVIEWED IN SMARTPHONE BROWSER EMULATOR



Preview main page in Smartphone browser

APPENDIX F

SAMPLE EXERCISE PREVIEWED IN SMARTPHONE BROWSER EMULATOR



Preview of Exercise page : Select

APPENDIX D

SAMPLE EVALUATION FORM (USER ACCEPTANCE TEST)

The purpose of this user acceptance test is to serve as an evaluation on the overall system performance.

Attributes	Rating				
	1	2	3	4	5
1. User Friendliness					
2. Functionality					
3. User control and freedom					
4. Visibility of system status					
5. Aesthetic and minimalist design					

1 – Very Poor, 2 – Below Average, 3 – Average, 4 – Meet Expectation,

5 – Outstanding

Thank you for your kind co-operation in completing this questionnaire.

APPENDIX E

GANTT CHART

GLOSSARY

Glossaries

Adaptive Learning—Learning where the content presented to the learner, and the order that content is presented, varies depending on the results of pre- and post assessment of the learner s mastery of the content knowledge.

AICC—An acronym for the Aviation Industry CBT Committee. In a learning system context, the acronym AICC is usually used to refer to the standards created by this committee that define how learning content should communicate with a learning environment. www.aicc.org

Assessment—A tool used to evaluate a learner s skill or knowledge level in a particular subject area.

Assessment item—A question or measurable activity used to determine if the learner has mastered a learning objective.

Asynchronous collaboration—Interaction with learners and instructors that is not in real time, such as e-mail conversations or posting comments to a discussion.

Asynchronous learning—A learning event where the interaction is delayed over time such as a correspondence course. Also sometimes used to describe a learning event that is delivered after the original live event (usually as a recorded version of the event, with associated materials).

Asynchronous learning delivery system—A learning delivery environment that can combine a number of asynchronous collaboration components.

Authoring tool—Software application used to produce electronic learning content.

Broadband—Term for sufficient bandwidth to receive streaming video and sound. (Usually refers to bandwidth equal to or greater than DSL or Cable Modem speed).

Certification—Program and process where a learner completes prescribed learning and passes an assessment or series of assessments. Results in a formal certification of a learner s knowledge or skill level.

Computer-based training (CBT)—Any instructional event that can be accessed via a standalone computer.

Content item—A small piece of information that is stored in a database and is used to communicate skills or knowledge. It can be in any media format including text, graphics, animation, video, audio, and HTML plug-in.

Content Management System—An environment where learning developers can create, store, reuse,manage, and deliver digital content from a central object repository.

Degree Audit—In higher education, a formal evaluation of a degree candidates learning progress against the standards set for awarding a specified degree.

Delivery Management System—A range of technologies that support the delivery of learning content to a learner in self-paced, collaborative, real time, and asynchronous modes.

Distance learning—Any learning event where the learner is not required to travel to a specific location.

Gap analysis—Assessing the gap between existing versus desired skill levels, competencies, and certifications. A term typically used in the corporate as opposed to the education environment.

Human Capital Development—A term used to describe extensions to LMS vendors product offerings that are intended to help clients link learning more directly to the improvement in the productivity and value of their human capital i.e., their employees and partners.

IEEE LTSC—IEEE Learning Technology Standards Committee. This group approves internationally recognized standards for e-learning interoperability. ltsc.ieee.org

IMS Global Learning Consortium—IMS is an important player in the development of e-learning interoperability standards. www.imsglobal.org

Informal/formal learning—Formal learning is a class, a seminar, a self-study course everyone recognizes it as learning. Informal learning is over the water cooler, asking a coworker in the next cubicle to help out, collaborative problem solving, or watching an expert.

Instructor-led training (ILT)—A scheduled event conducted by an instructor, either in a classroom or through network delivery.

Learner—A more general term than student, learner refers to any person receiving training or education in a formal or informal environment.

Learning Content Management System (LCMS) — A content management system specifically intended for learning objects.

Learning Management System (LMS)—An LMS can range from simple course-by course registration systems to a complex system that deals with learning plans, prescriptive learning, degree audit/gap analysis, and other learning related functions.

Learning object—From an operational perspective, learning objects are chunks of data that are used by e-learning systems they are authored, stored, cataloged, assembled, delivered, and reported on. A more down-to-earth approach is to think of a learning object as a digital part of a course ranging in size and complexity from a single graphic to an entire course itself.

Metadata—Information about learning objects that allows them to be stored in and retrieved from a database in a meaningful way. Metadata describes what is inside a chunk of learning.

Offering—Any learning event or service that is offered to learners.

Portal—A specific view into a set of applications that matches a person s role and requirements to the available services and learning offerings.

SCORM—An acronym for Sharable Content Object Reference Model. The U.S. Federal government s reference model for the use of learning content standards and specifications. It is built on the work of AICC, IMS, and IEEE. www.adlnet.org

Self-paced learning—An offering where the learner determines the pace and timing of content delivery.

Subject matter expert (SME) — An individual who is recognized as having proficient knowledge about a subject area. Usually considered as a source of content in the e-learning context.

Synchronous learning—Learning event delivered in real time to the learner that can include immediate, two-way communication between participants.

Virtual classroom—Delivery of a scheduled offering to multiple locations (either desktop or classroom) via a networked solution.

Web-based training (WBT)—Any instructional event that can be accessed via the Web.