

Mobile Learning-A New Paradigm of E-Learning

by

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Abstract

One recent significant change in the learning environment is demand for mobility. Growth in technology and availability of mobile and wireless devices enables different ways of communicating. The cost of mobile access to the internet is steadily decreasing. These mobile technologies have enabled a new way of communicating. What if these devices are used for delivering educational content to the learners? Like Desktops and Laptops are primarily used for e-learning, devices such as cell phones and PDA's are used for Mobile learning (M-learning). This helps in reducing equipment cost in delivering education. The trend toward the convergence of applications, the ubiquitousness of mobile devices, and continuing demand for smaller and more powerful devices indicated that these technologies are now indeed the mainstream. Mobile learning brings strong portability. It will be more effective and entertaining to use mobile devices as learning media.

The research is to investigate and develop a collaborative mobile educational environment. The resulting environment will be used as a component of a larger learning environment. The final product will be a web-based collaborative mobile educational tool. Surveys are used to analyze the perceived effectiveness and receptiveness to the proposed educational tool. This paper seeks to gauge student's receptiveness and willingness to utilize an web based mobile educational application to supplement traditional classroom lectures.

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CHAPTER 1: INTRODUCTION

Growth in technology and availability of mobile and wireless devices enables different ways of communicating. The cost of mobile access to the internet is steadily decreasing. These mobile technologies have enabled a new way of communicating. Mobile devices are part of normal daily interaction. People are always connected to geographically dispersed groups. In the recent years mobiles have become the part of life and most of the people could afford the cost. There are over 300 million mobile phone users in the world, double the total number of Internet users [4]. In addition there is a drastic growth in wireless and mobile networks and this has brought changes in mobile devices, standardization and user acceptance.

One recent significant change in the learning environment is demand in mobility. What if these devices are used for delivering educational content to the learners? The research aims towards implementing education through mobile devices. Like Desktops and Laptops are primarily used for e-learning, devices such as cell phones and PDA's are used for Mobile learning (M-learning). This helps in reducing equipment cost in delivering education. The trend toward the convergence of applications, the ubiquitousness of mobile devices, and continuing demand for smaller and more powerful devices indicated that these technologies are now indeed the mainstream. Mobile learning brings strong portability. It will be more effective and entertaining to use mobile devices as learning media.

Mobile learning is a form of e-learning that can help anytime at anyplace. Mobile learning is implemented and delivered over a wireless network so that it can easily adapt to meet

changing learning needs. This gives the users a chance to find and learn what they really wanted to and at a place that they like or suits them. Through M-learning it is also possible to collaborate with the instructors and other learners.

1.1 PROBLEM STATEMENT

There are many different methods of attempting to engage the learner through online learning environments. Technology holds great potential for improving the quality of education to students; however, if created technology is not designed with a user centric approach, it will inevitably fail to achieve the desired effect. In general, students are more acclimated to technology; this is primarily due to age and the environment in which they grew up. It is hard to gauge a learner's comfort level and ability to navigate and comprehend technology, which likely is directly correlated to the environment in which they grew up. To spread the information technology to educators and engage the learners, not only should the current tools available be easy for educators to use but the technology must also engage and interest the learners. Although there are many educational tools available, none are specifically focused and developed for use through mobile devices. The research focuses on the affordances and constraints involved in using the mobile devices for education and to analyze the factors to be considered in developing the application for use through mobile devices.

Due to several limitations of traditional classroom environments, educational institutions are moving away from traditional approaches and attempting to find alternative ways to engage the learner. The costs to build, develop, deploy these tools may put a strain on already stretched educational budgets. Many educational institutions budgets are already being strained by shortcomings in funding. The cost incurred to train, build and develop custom software to suit educational tools would usually exceed the allotment for information technology. Therefore, the

purpose of this study was to develop a low cost educator friendly and mobile oriented learning environment centered on ease of use and interactive technology for the educator and with the learner as the focus on the mobile learning environment, so that the users can gain access to the educational content anytime at anyplace.

1.2 RESEARCH JUSTIFICATION

With the aforementioned problem, we have come with a new mobile learning environment called the 'AUBURN MOBILE EDUCATOR' tool, which reduces the gaps in the currently existing issues. The currently existing environment 'Moodle' was more of a text based format and students found it uninteresting for use. Accessing the content totally in the text format through mobiles is also frustrating for the users. Another popularly used tool 'Blackboard' was available for mobile devices but it costs average sized universities is in excess of \$160,000 per year. It is important to realize that the Blackboard learning system can never be bought, it can only be rented. Many universities don't use the mobile version of Blackboard for cost maintenance purposes. Most importantly, these mobile versions are available for all the platforms. Regular blackboard can be accessed through the mobile browsers but was uninteresting for the learners to access due to usability and size limitations. So keeping these limitations in mind we have come up with a low cost, graphical user, web-based mobile interface that targets a wide range of platforms. The registered students can gain access to the content provided by the educators. There are other features like assessment tests, announcements and live discussion forum included in the application for user interaction. The students can find it interesting to access the content from a GUI through their mobile devices.

1.3 RESEARCH PURPOSE

The primary objectives of this research are to:

1. Investigate mobile educational tools currently available to facilitate and supplement traditional classroom learning.
2. Investigate the affordances and constraints involved in developing the mobile educational application that can support the educators as well as the learners in a capacity that is easy to use, meets all the requirements needed and is engaging for the learners.
3. Design and develop a web based mobile application that can be accessible across all different mobile platforms and can provide the educators and learners the ability to use the mobile system that is interactive, easy for educators to post their content, easy for the learner to access the content and accessible anytime and anywhere.
4. Determine if the developed prototype is better when compared to the currently existing mobile environments.

1.4 HYPOTHESIS

The main hypothesis of this study is that mobile learning environments would be more helpful for students to access the educational information. The students can access the information anywhere and at anytime and will be more engaging if the content is delivered through easy and interactive mobile environments.

1.5 DOCUMENT REVIEW

The rest of this thesis is organized as follows: Chapter 2 consists of literature review, which discusses, existing online environments, general requirements of mobile learning, its

affordances and constraints, challenges involved for the developers. Chapter 3 provides a description of the existing environments and their limitations, and describes the proposed environment. Chapter 4 goes over the detailed implementation of the proposed environment. Chapter 5 analyses the results that are collected from the pre and the post questionnaire about the developed prototype. Chapter 6 concludes the thesis along with the future work to come.

CHAPTER 2: LITERATURE REVIEW

2.1 E-LEARNING:

E-learning is a term that describes fields of online learning, web-based training, and technology oriented instruction. It can be defined as the delivery of individual, comprehensive, dynamic learning content in real time that helps the communities to develop knowledge that incorporates learners and practitioners with experts. It is a phenomenon of delivering accountability, accessibility and opportunity that allows organizations and people to keep up with the rapidly changing global environment. Simply, it is the convergence of Internet and learning. Through learner centered designs, the effectiveness of the e-learning experience can be enhanced. Learners remember more with well organized, extensive visuals, screen friendly fonts. Usability plays major role in enhancing the effectiveness of these learning environments when we assess how student behaves, what works, what doesn't and what confuses.

E-learning offer learners control over content, learning sequence, pace of learning, time and often media, allowing them to tailor their experiences to meet their personal learning objectives [1]. E-learning is a complement to traditional class room environments. E-learning offers higher level of learning effectiveness. Learners are more satisfied with learning materials and learning environments. Growth in technology, digitization and development of internet has influenced our society in many aspects. E-learning helps to integrate these technologies and knowledge and consent learners to learn new knowledge at anytime and anywhere with no time and space constraints.

In traditional face-to-face learning, learning activities and plans are all arranged from a teacher's perspective. Conventional patterns of education are adopted. One instructor is responsible for teaching many students in a particular area and evaluates their skills through regular tests. Teacher's material is the only source of learning materials. This doesn't reflect or improve each individual learner's competence. All learners are equally treated as naive though some of them might have already mastered. Here instructional model or traditional face-to-face environment may cause waste of time and that results in reduced learning motivation. In a classroom there are several learners with different learning styles and academic strengths and weaknesses. A child who is difficult to manage or who disrupts the classroom is going to take away time. It is simply not possible for one person to give each student the one to one interaction. It's not uncommon for the learners to become bored or frustrated. Some learn better by visual means, others with auditory means and other with hands-on practice. E-learning can be useful and may be interesting for these students. The traditional educational system is best choice and many argue that the standardized tests are necessary for measure of student performance. But interestingly, studies show that these tests are not very effective that they come at expense of learning. Case studies have proven that all students do not succeed in a traditional environment. It's proven that students would be able to master the important concepts on their own schedule, preventing them from becoming lost with the rest of the class moving on. The traditional system is not that effective in teaching students to learn. It ignores experimental learning which decreases effectiveness of learning. [2]

Timely Operated Guidance can be achieved via web based e-learning, has some set of registered students who can actively find the material needed and study them in a "virtual

community” that is similar to traditional classroom environment. This kind of e-learning has some limitations-

1. Teacher-centered knowledge management: Similar to the traditional classroom, the learning is completely dependent on the knowledge and experience of trainers or teachers. Hence there is a mismatch from the demand of trainees and expectations from the trainers. That is, a predefined teacher-centered content management can't meet the demand from various individuals in different scenarios.
2. Interactivity is not effective: Two-way communication between the trainer and trainees is achieved with the notion of blended learning. However, since the emphasis is put on the interaction itself, the trainer often concerns what the trainee can express with, but not the actual content. On the other hand, the trainee may prefer to ask questions more theoretically instead of what are really needed [11]. As a result, the interactivity may be helpless.
3. The evaluation mechanism: Most “Virtual environments” use traditional tests to evaluate the learning quality of the trainees. It means theoretical improvement of knowledge is only tested instead what skills trainees can develop. Computer education is a learning activity that may sound like individual learning, but involves grouped and situated learning activities. Looking at the current model, we will look at a new task model to build a solution for timely operating guidance.

Learning is a natural, life long process of human nature. This may be formal or informal. The objective of formal learning is to get certificate. Informal learning is blended learning that includes individual, grouped and situated learning together. One of the solutions can be mobile learning. Development of mobile learning includes 2 aspects: one is improvement on learning theories, the other is that how to use mobile technologies. Mobile learning is becoming more

personnel, more connected to surroundings at same time more potential for connected, collaborative activities.

The learning ways are changing with development of mobile technologies. By combining the face-to-face modalities, instructional methods and media used, blended learning is becoming more attractive. Based on space, time, fidelity and humanness, the interaction of learning is evaluated. The future use of blended learning will combine human users and the mobile devices more closely. So neither pure learning technologies nor learning theories will bring all applications to expected results. Hence all parts of specific learning applications are needed to be considered and a novel interaction model is needed.

In case of organizations, e-learning can deliver custom, sophisticated instruction to its employees. This also allows organization's training function to keep up with market. The training can be provided without taking workers away from their regular responsibilities. E-learning increases employee knowledge and skill levels. It has the flexibility to allow learners to learn anytime, reduce travel costs, they can learn just in time, more affordable per-student costs, can update himself easily, interactive content, graphics and animations, customized materials, self-paced programs and leverages existing infrastructure.

Table 1 indicates that the e-learning approach saves approximately 20% initially and later development costs are not the factor. The savings grow nearly 50%. The return-on-investment for e-learning can be 50%-60% greater than traditional training.

All these factors tell us the importance of e-learning and its benefits. E-learning can be more beneficial when taken to the next level. The growth in technology and availability of mobile and wireless devices enables different ways of communicating. The cost of mobile access to internet is steadily decreasing. These mobile technologies have enabled a new way of

communicating. Mobile devices are part of normal daily interaction. People are always connected to geographically dispersed groups. What if these mobile devices are used for implementing education?

	Classroom Training	E-Learning
Wages Of trainees (\$20/hr, burdened)	\$400,000	\$240,000
Travel Costs (50% of travelling people)	\$250,00	\$-----
Trainer Wages	\$47,500	\$11,400
Trainer Travel	\$200,000	\$-----
Development Costs (Custom Training)	\$160,000	\$400,000
Delivery Systems	\$-----	\$35,000
Totals	\$877,500	\$686,400

Table 1: ROI Comparison of traditional Training versus E-learning [3].

The research aims towards the implementing education through mobile devices. This helps in reducing equipment cost in delivering education. We will go through the effectiveness of e-learning when implement through mobile devices. The trend toward convergence of applications, the ubiquitousness of mobile devices, and continuing demand for smaller and more powerful devices indicated that these technologies are now indeed the mainstream. We will analyze their use for learning, following the same trend. If E-learning is implemented through mobile it is convenient to virtually access learning content anywhere and anytime. Mobile

learning brings strong portability. It will be more effective and entertaining to use mobile devices as learning media.

2.2 MOBILE LEARNING:

One recent significant change in the learning environment is demand for mobility. In recent years mobiles have become the part of life and most of the people could afford the cost. There are over 300 million mobile phone users in the world, double the total number of Internet users [4]. Apart from this there is a drastic growth in wireless and mobile networks and this has brought changes in mobile devices, standardization and user acceptance. Like Desktops and Laptops are primarily used for e-learning, devices like cell phones, PDA's are used for Mobile learning. Mobile learning is an e-learning that can help in anytime, anyplace experience. M-learning is implemented and delivered over a wireless network so that it can easily adapt to meet changing learning needs. This gives the users a chance to find and learn what they really wanted to and at a place that they like or suit them. Through M-learning it is also possible to collaborate with the instructors and other learners. The adoption of mobile learning in basic education like primary and secondary schools is slow rather than exponential. The major issues to be considered in mobile learning are knowledge management and learning communities. With the development of Web and Mobile networks M-learning will be very useful and powerful. We will look into some basic characteristics and advantages of M-Learning [5].

- ✓ M-Learning is Dynamic. Many sources and online experts are available.
- ✓ Learners get what they need, when they need it, where they need it.
- ✓ M-Learning can be collaborative. It connects learners with experts, colleagues and professional peers.

- ✓ Mobile learning is individual. Learners can select from a menu of his/her choice that's relevant to him at that moment.
- ✓ M-learning is comprehensive.
- ✓ The main credo is M-learning is learner-focus, learner-centric, learner-obsession.
- ✓ By providing multiple paths for learning increases the chances of success.

2.3 MOBILE LEARNING FRAMEWORK

It is predicted that the next phase of electronic learning development will be focused in mobile learning. Mobile learning is a point at which mobile computing and electronic learning intersect to produce an anytime, anywhere learning experience [5]. Mobile learning framework includes four levels:

- 1) Mobile Learning applications
- 2) Mobile User infrastructure (browser, handheld devices)
- 3) Mobile protocol (adoption of content with WAP)
- 4) Network infrastructure (cellular systems, satellites, etc)

This framework for mobile learning defines several functional levels, simplifying the design and development. Using this entity will not force single entity to do everything to build mobile learning systems. The frame work is divided into four levels. In the mobile learning application level, many new applications and many existing electronic learning applications can be modified for a mobile environment. When considering the potential mobile learning applications, we need to consider mobile learning activity management and proactive learning management. Mobile learning management activity must be able to evaluate the needs of the student so that it is possible to arrange the course material delivery accordingly, thus improving and enhancing the student's learning purposes and interest. The system should be able to help

learners to learn without the involvement of another person. The system should be able to guide the user through series of tasks that helps them to complete their learning tasks. In mobile user infrastructure level, the design of new mobile learning applications should consider the capabilities of the user mobile devices. Mobile devices and wireless networks can provide texts, video on demand, and information services. Learners would require such technology as appropriate mobile devices, and high bandwidth wireless networks. Connectivity is important because disconnection caused seriously affect the quality of information and students interest to use them. Devices must have appropriate display, memory, communication functionalities. Now many vendors have attracted users for handheld and smaller devices. These devices play a major role in mobile learning. Protocol level's aim is to hide the underlying network's details from applications and provide a uniform and easy-to-use interface. Mobile protocol connects different applications, tools, networks and technologies to provide a common interface. The World Wide Web Consortium specifications and WAP specifications can enable a wide range of mobile networking applications. A micro browser can support text, graphics and standard Web content. Several extensions of existing Internet standards have been developed so that mobile devices can be fully accessed. At networking infrastructure level, service quality primarily depends on network resources and capabilities. Mobile learning applications mainly depend on networking support. Transmission rate and coverage are the two major factors. Developers are now standardizing the wireless networks that they can support a bandwidth of several megabites/second. In general, mobile learning requires wireless quality of service that affects the performance of mobile learning applications in terms of delay, loss, and other quality attributes. Furthermore, reliable and survivable wireless networks are necessary. Learners must be able to access applications, even under varying degrees of network failures.

With the rapid, continuous development and growth of Internet, telecommunications and gradual rise of concept of modern education, compulsion in the future educational technology, mobile learning becomes an important factor for the progression of educational technology. This competitive century requires personnel with high qualities of capabilities and adaptabilities. This requires high-quality teachers. Instructional design is the formula for winning. Mobile learning based on E-Learning is an new type of learning based on Mobile communications Technology or wireless Network technology, uses mobile devices to get educational resources, educational information irrespective of time and place. The devices render the information and provide communication between users. This means learning is no longer confined to a classroom, a library or a student. Learners can be any one, ranging from farmers to teachers. Even elderly people can enjoy the learning any time and at any place. This provides broad space for education even in rural areas. This system can be achieved by a system that composed of three areas: Internet, mobile education network and mobile communication devices [6]. The internet serves as the effective carrier of the information and educational resources. The mobile educational network serves as the platform for the individuals and institutions to communicate and share the information (curriculum, course content etc).

The field of mobile learning is still in its infancy. We need to figure out and bring M-learning to basic education. To date limited understanding has been achieved on how mobile learning could be implemented in basic education. Research and application of DLDs is in an initial stage and a series of research and experimenting are still projects in process, the empirical data support from a learner' perspective is relatively limited. In relation to this, future research will exert more efforts to investigate how DLDs could improve academic performance as well as factors affecting users' intention to use mobile learning in basic education. The most appropriate

definition for M-Learning is “any kind of learning when the learner is not at a static or fixed location, or when the learner takes the advantage of mobile technologies [7]. Mobile learning compared with e-learning, wearable computing, mobile computing and ubiquitous computing is shown in Figure 1.

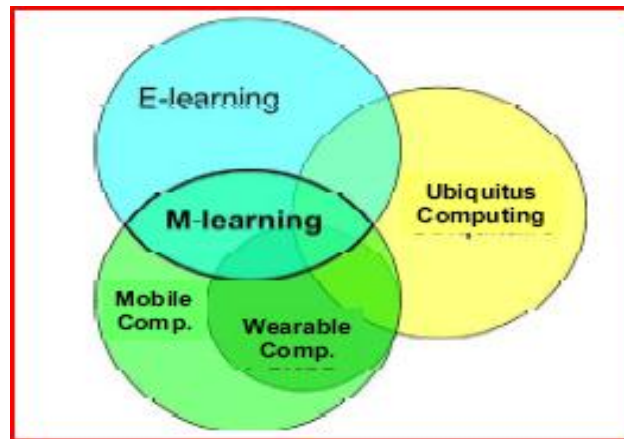


Figure 1: Mobile learning cartography [8]

Mobile learning can be categorized depending on characteristics like devices, mobility, context and location [8]. The mobile learning which takes into account learning context is called contextual mobile learning or context-aware mobile learning [9]. For example, a customer in a store can get to know about the product he is willing to buy. For a learner, his activity and context are central in determining his learning objective and learning content. So learning context is crucial in M-learning. The main interest is to apply mobile learning technologies in our daily lives like professional learning and training activities.

Despite the growth and development of mobile technologies, the mobile learning environment has not yet impacted education seriously. In higher education, the pedagogical use of mobile devices is not wide spread while in basic education mobile learning largely remains on the periphery of planning of most primary and secondary schools [10]. Let me portray the concept initiated by Noah, a leading provider of new educational electronic devices that offered an ideal and innovative mobile learning solution.

2.3.1 Noah's Solution for mobile learning.

Despite of growth and zeal, the fact is that M-learning is used occasionally and is just a supplement for traditional learning. This indicates the need for large scale adoption. Guidelines and experiences for implementing mobile learning in basic education are in short supply [10]. Noah's mobile solution is on large scale that is the great effort made by Noah in wide spectrum of domains and from experimenting and testing. They concentrated on making

- 1) M- learning easy to use
- 2) Mobile learning useful
- 3) Motivating students
- 4) Facilitating continuous use of M-learning
- 5) Integrating with classroom learning and online learning

✓ *Make M-learning Easy to Use:* There are many handheld devices that are available for mobile learning and are in varied relations with different technologies like iPod, iPad, PDA, smart phones. I chose jQuery to make M-learning easy to use irrespective of devices. jQuery works on most of the current mobile OS. JQuery is supported by iOS, Symbian, Blackberry, Andriod, Windows and more. Learning materials are displayed with full screen presentation in an interactive and easy to understand and easy to use manner.

✓ *Make Mobile learning useful:* make it useful by providing the useful material, examples, organizing some notes, taking an exam that can assess the knowledge on one particular topic etc.

✓ *Motivation is important factor in adoption M-learning.* Intrinsic motivation appears to be especially important, because education brings not only sense of gratification but also pressures.

✓ *The material is needed to be updated continuously.* Though it is difficult to constantly update the materials, it is required to update in a decent manner in order for the students to continuously use M-learning.

✓ There is a high dropout rate found in online courses due to sense of isolation, lack of personnel contact, immediate instructor feedback. So this can be reduced by preparing learning material in accordance with the prescribed textbooks.

Education technologies, including mobile learning, online learning and conventional fact-to-face learning are integrated in accordance with respective advantages, in which mobile learning appears to be a bridge and therefore form a new style of blended learning.

2.4 GENERAL REQUIREMENTS ON MOBILE LEARNING

M-learning can be kind of learning that is pedagogically very similar to traditional face to face teaching activity. Learners have strong demand for specific contents, which can be provided in ways of different media such as teaching flash, audio or video anytime and anywhere. M-learning can also be a kind of learning different from teacher centered learning. Here the learner does not have much knowledge and strong intention to learn before the learning process starts. Mobile devices not only offer ways to complement, improve and enhance current face-to-face learning, e-learning and other technology supported learning and to respond to practical constraints and barriers, but offers new opportunities to move beyond current ideas of teaching and learning. The flexibility to carry these devices helps the teachers and learners to interact with each other, taking the advantages of the following features that the current mobile technologies provide [11].

- Easy connection and collaboration.
- Portable sound recording and video recording.

- Cameras for taking photos and making video clips.

The concern is how we put them together to achieve learning objectives effectively. Assuming that all the technologies are available here is my proposed mobile model. This Proposed model includes: Topic contents, examples, assignments, exams, assignments, announcements, e-mail and discussion forum. Topic content includes the most recent data and information according to the choice of the user. This information is updated effectively according to the changing requirements. Examples and assignments are for the practice of the user that enables him to use the content with interest and clear understanding. Exams help the users to test his skill accordingly and asses himself. To make the learning environment more interactive and help the student not to get an isolated feeling and make him participate in the daily learning process a discussion form is included. All these features together effectively makes the learning environment interesting. Figure 2 depicts the basic model of a mobile learning application.

Apart from these it would make the environment more interesting if we include additional features like Web based Chat room, Effective interactivity, video conferencing. A chat room is one of the useful features that provide a platform for both the teachers and students can actively interact. Structuralized content management is very important. This provides ease of searching the content required. With rapid development of mobile technologies and according to the functionalities supported by the current mobile communications, interactivity can be achieved by SMS, email, Video phone, Video Conference, MMS etc.

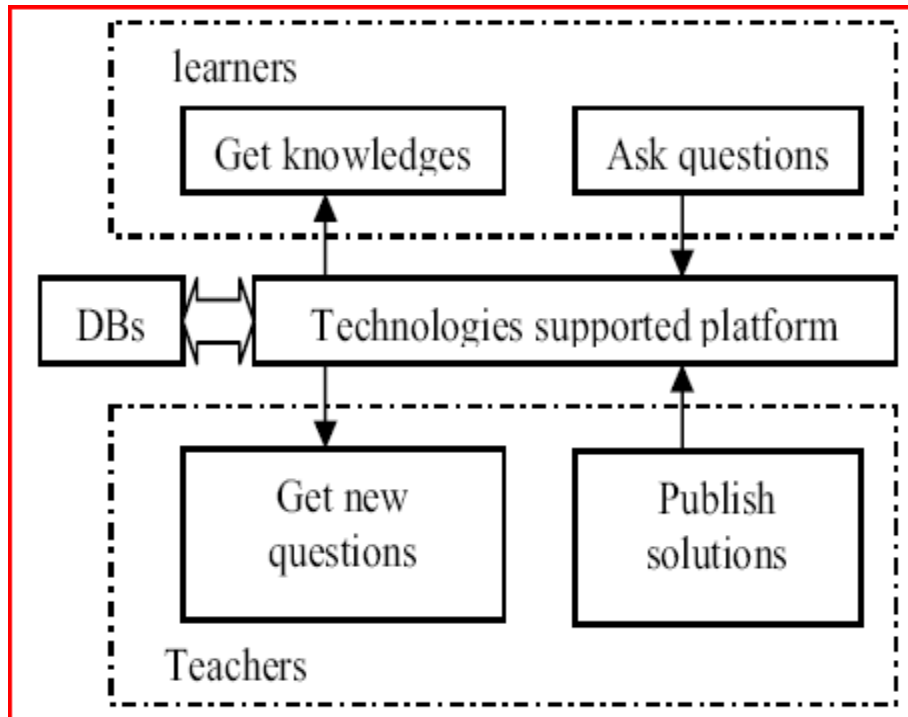


Figure 2: Basic model of mobile learning

2.4.1 Enabling Mobile learning on social contexts:

Few calls have been made for developing a “mobile education theory”. Researchers are exploring a relationship between existing educational theories and how they can be applied and observed in mobile learning [13]. Learning can take place as long as people hope to start and adopt their activities to enable educational behaviors. Vavoula in a study of everyday adult learning episodes, discovered that 51% of a total of 161 learning episodes took place at learners’ home or workplace, while 21%, 6%, 5% and 2% of episodes happened respectively in a workplace outside the office, at places of leisure, outdoors and in a friend’s house [14]. Other locations took 14%, including places of worship, medical offices, cafes, hobby stores, in cars. In addition, 48% of mobile episodes were found to be associated with work and 1% occurred on public transport. This indicates there is a chance to provide learning opportunities for people to utilize unproductive travelling time.

Mobile learning will be favored if a learner is situated in right situation. It will be productive if learner is on the move or at 'non-place'. Mobile learning lends itself well to motivate learners intrinsically by offering versatile learning experiences.

2.4.1.1 Behaviorism:

Behaviorist theories are relevant in mobile learning because quick feedback or reinforcement can be facilitated through mobile devices. Classroom response systems ranging from anywhere in the range of formative, summative, and just keeping student attention in a blended classroom can support behaviorist research [15]

2.4.1.2 Constructivism:

Mobile learning enables immersive experience in gaming environments or simulations through constructivist methods. Users work their way through these environments and build their own knowledge. Handheld devices also support constructivist educational activities through collaboration among learning groups. This results in increased motivation. The promotion of interactive learning activities facilitates control of the learning process and its relationship with real world [12]. Because of the low cost of most handheld devices, it's easy for students in most parts of the world to acquire them. Now the whole world is learning center. Users have access to class materials, information databases, recording devices, and communication with teachers and other students.

2.4.1.3 Situated Learning:

Teachers prepare situations for students to use their mobile devices to solve problems in case based learning. Users taking their mobile devices to authenticating learning environments or context aware environments like museums are examples of situated learning.

2.4.1.4 Collaborative Learning:

Here participants join in group discussions and emphasize practice with faculty and other users to learn from each other. Mobile devices provide an additional means of communication and a portable means of electronic information gathering and sharing among friends. A quantitative study showed that students using mobile devices did not collaborate naturally, unless directed to, and they sometimes fought over use of the device [12].

2.4.1.5 Informal and lifelong learning:

This learning emphasizes activities that take outside a regular learning environment. Informal learning can be intentional or accidental. As long as mobile devices facilitate information in an unobtrusive way, mobile learning can be suitable for offering informal and lifelong learning experiences. These learning experiences can be integrated and combined instead of being separated. Mobile learning makes it possible to form a learning space which is socialized, personal and digital, trusted, pleasant and emotional, creative and flexible, certified, open and reflexive, which will facilitate learning and knowledge management [16].

2.5 AFFORDANCES OF MOBILE LEARNING [12]

From the time Distance education has introduced, many researchers have examined the strengths and weaknesses of learning environments where teachers and learners are in separate places. Mobile learning is in no way different from this and could be included in many of those strengths and weaknesses. But it has its distinction and advantages when compared to stationary e-learning. There are number of studies where the advantages and trade-offs are involved with taking learning to mobile devices.

The most important and primary benefit of mobile learning is that the devices used are small. Hence they can be carried to anywhere, any place, any time, providing knowledge

available to the user in a ubiquitous fashion. Through Mobile learning users have access to real-time data whenever and where ever required, in addition to gathering features like note taking, imaging, videos, lecture notes and e-books among others.

2.5.1 Mobile Device as a Representative Tool

Mobile devices, flexible to be carried to anyplace and with modern technologies, can be used to gather information and demonstrate work through various media. This information gathering was demonstrated in a case study. In a K-12 science class room study, students went to a field trip and were asked to learn specific properties of plants and take an assessment and should create a report when they were back to classroom. This learning was measured by providing some students with mobile devices and other group used paper and pencil. In another case study, the advantages of using mobile devices included taking less time with the images afforded more pictures and more investigation. Most students preferred picture taking to drawing. Students using the hand held devices felt more comfortable and freer form the tools provided to explore the learning activities.

2.5.2 Mobile Device as a Communication Tool.

One of the important benefits of mobile devices is its ability to communicate. Mobile devices can be used to communicate at any time and any place and can be used as discussion tool whenever the idea is fresh. It involves some form of broadcasting the idea so participants can access the information when it is convenient to them.

2.5.3 Limited learning versus No learning at all

In many developing countries, mobiles users are outnumbered wired users. In some countries mobile devices are more when compared to its population [17]. If students were unable to attend any class on a particular topic they want to, and they don't have access to a computer

for extended periods of time, then mobile learning affords delivering a limited form of instruction verses no instructions at all. Because of the pervasive deployment of mobile devices in the developing world, mobile learning is often used as leap frog over existing e-learning.

2.6 CONSTRAINTS OF MOBILE LEARNING

Some of the mobile learning constraints are similar to areas of e-learning. These include lack of contact between the teachers and students, isolation issues and technical support problems. We will look into some of these issues.

2.6.1 Size of the Mobile Device

Though the main affordance of mobile learning is the size of the device, the primary limitation is also due to its size. Several constraints are related to size that includes battery life, screen size, rate of text input. Instructors could communicate with students in synchronous mobile learning contexts, but should not ask for substantive feedback from students due to text input limitations. This lack of convenient input tools pushes the research in exploration of new forms of user interfaces which may include sound or mobile scanning tools as input and output [18] Small screen size is another size related constraint. Though many colors are available, users cannot view content in same format as on the smallest of laptop computers. New approaches to formatting are needed. We have to rethink of how data is stored and retrieved. This may be even driven by market forces in mobile use of technology ahead of mobile learning.

2.6.2 Connection Issues

Mobile learning requires connection with server. Researchers have suggested engineering a pure connection and pure mobility mode for the mobile device so that it can download and store what is needed for most of the learning process and be able to function with minimal or no

connection for longer period of times. In this case mobile devices turns into a small computer with no communication function [18].

2.6.3 Inconsistent Platforms

The effort of developing an application that can be used for broad selection of mobile devices is nowhere near that of developing for regular computers. The lack of cross platform consistency in mobile devices is a drawback in developing mobile learning applications.

2.6.4 Distracted Mobile Learners

Multi-tasking is not always a productive way to learn. Virginia Tech researched the extent to which mobile learners could be distracted while trying to learn through their mobile devices. It involved 76 students to conduct the study. Group of people were asked to sit at a computer and complete a task while the other group was given the same task with mobile devices. The group that sat at desk scored higher than the group that walked with a mobile device.

2.7 CHALLENGES FOR DEVELOPERS

In computer environments if a player is outdated, it is automatically and immediately updated. But this is not the case with mobile devices. The variations in screen size and platform prohibit easy deployment of applications. The key challenge in mobile learning is to enable the content or applications to be delivered through variety of access mechanisms with minimum effort. Implementing a website or an application with device independence in mind could potentially save costs, and assist the authors in providing users with an improved user experience anytime, anywhere [12].

2.7.1 Strategies for Developing Mobile Learning

As there are many number of platforms and until these platforms become standardized, designers need to develop the applications for broad range of users. This can be easily done by using style sheets that can adjust to screen and device limitations. So I chose 'jQuery mobile'. It is a cross plat form programming language that can work on iOS, Android, Symbian, Blackberry, Windows mobile etc.

2.7.1.1 Short Learning Objects

Learning modules should be short, ranging from five to ten minutes. This can help learners to concentrate. If learning modules are lengthier there are many chances that learners may become distracted. Some kind of assessment would be helpful, this helps users to start and finish modules without much distraction or he can move on to other section.

2.7.1.2 Learn By Doing Adaption

In developed countries, users are expected to have computational skills. But in many developing countries mobile phones are the user's first computers. Learning activities as well as application interface should be designed in such a way that the users can adapt easily and should feel comfortable while learning.

2.7.1.3 Motivate Students

Mobile learning should have guidance that supports both ends of educational spectrum, and enables users to access unplanned exercises and information. Teachers should motivate students by having adaptable programs that can adjust and similar to the flow of classroom learning.

2.8 SUPPORTING DISTANCE EDUCATION:

Mobile learning through mobile devices will give rise to new possibilities for extending learning opportunities to all socio- economic levels. Introduction of mobile learning will give light to distance learner communities, including problem teenagers, social employees and ageing people. Mobile learning tends to make more sense when it serves as effective conduit for learner communities to access training and education. Advancement in broadband and wireless technologies helps mobile devices to transmit text, voice, video and animated images irrespective of place and time. This helps in establishing a strong technical basis for converting mobile learning from theory to actual practice. The wide penetration of mobile devices proposes that the number of users of mobile learning services has far exceeded the amount of students within the current education system [19].

Mobile devices are increasingly deployed among ordinary consumers due to increasing sophistication and affordability in mobile devices. As a result, sooner or later people would begin to look for new ways to activate learners. In particular it will help those with academic ambitions but are reluctant to or can't enroll in formal education systems. A Europe-wide mobile learning project has been launched for educationally disadvantaged young adults, such as teen dropouts and those who are unemployed [19]. It is also clear that a number of new learner communities could benefit, and be involved, and become an indispensable part of the future mobile learning landscape.

2.8.1 Enabling Mobile Learning for New Learners:

It is clear that mobile devices help in amplifying the reach of education to all socio-economic levels. This flourishes the importance of mobile learning for the communities that are not reachable for conventional educational approaches. These new learners cannot be neglected.

2.8.1.1 Engaging Problem Teenagers and Illiterates:

It is undeniable that many teenagers are insatiate with classroom based educational learning and hence they dropout without pursuing their higher education. These dropouts are hard to reach by with the traditional educational approaches. This results in future illiterates. In UK 10 million adults lack confidence in using literacy skills. There are still about 796 Million illiterate adults aged over 15 worldwide [20]. According to Pytel report [21] early dropouts lead to serious problems for the society. These are more prone to be unemployed, in prison, living in poverty, poor health.

With a potential to suit the characteristics of today's generations, mobile learning appears to be ideal solution. Current young people show a clear inclination for technology applications. With an information technology mindset this generation converges on connectedness and social integration with a preference for group-based methods in education.

Mobile learning has great ascendancy as it accommodates the solitary nature of these individuals in comparison to traditional approach. It is also true that many might never be able to afford a personal computer or enroll into formal education, a mobile device which is increasingly prominent among young people, becomes a desirable medium for delivering education. According to Attewell, [22] there are many advantages to trigger mobile learning for problem teenagers as well as illiterates:

- ✓ Helps learners to improve literacy skills, numeric skills and identify their existing abilities;
- ✓ Can be used for promoting independent and collaborative learning experiences;
- ✓ Helps learners to determine where they need assistance and support;

- ✓ Mobile learning helps to combat resistance to the use of ICT and can help overcome the divide between mobile phone literacy and ICT literacy;
- ✓ Mobile learning helps to remove some of the formality from the learning experience and engages reluctant learners;
- ✓ Mobile learning helps to concentrate a learner's attention for longer periods;
- ✓ Mobile learning helps to raise self-esteem;
- ✓ Mobile learning helps to raise self-confidence.

2.8.1.2 Supporting the informal and lifelong learning of employees

As societies become more knowledge based and competitive, employees have to adopt more learning activities to renew and update their knowledge and skills to remain competitive in their workplace and also to fit their changing technological environments. Today's workforce is increasingly mobile. About 40-50% of the American workforce is mobile. The global mobile work force is expected to reach 850 Million [19]. Hence there will be limited time for employees to learn at a stationary place.

In this regard mobile learning appears to a desirable way to provide training and education to an increasingly mobile workforce. Great benefits can be achieved by initiating mobile education. This helps the enterprises in saving cost, time enhancing customer services. Mobile learning also helps to improve job satisfaction and reduce stress as well as employee turnover. Mobile learning can help to address some challenges faced by businesses as follows [19]:

- ✓ Enables business entities to provide learning to mobile staff and to distribute learning quickly.

- ✓ Enables the delivery of key data at the point of need— particularly relevant for workers who need access to updated product specifications, pricing details or other time-sensitive information.
- ✓ Mobile learning enables companies to utilize staff downtime, those short periods of time, waiting or travelling.

2.8.1.3 Facilitating the retraining of aging people:

Aging is an inescapable phenomenon. In the Asia-Pacific area, people aged 50 and above are expected to take up 31% of total population by 2025, while in Japan, one in three will be elderly. By 2050 it is expected that one third of the world's working population will be aged 50 or above. Aging people will become an increasing part of future workforce. Hence the requirement of training the aging learners is intensified. Unlike young and prime adults, these learners will have unique learning requirements and traits like aging learners require learning approach that provides review of learning materials as they incur a biologically based decline in the intelligence. In this context, mobile learning has many advantages as it addresses these issues through training. When compared to computer-based or class-based learning environments, little economical and physical effort required for aging people to learn via mobile devices.

CHAPTER 3: METHODOLOGY

3.1 MOTIVATION

Computing technologies have been applied to support educational curriculum for the past two decades. These technologies have been utilized to make concepts easier to learn for the student. The aim of computing technology in education is to make learning an easy, interactive process while helping the learner to access the content of his/her choice. The use of computing technologies in education really flourished with the advent of the internet. This has resulted in the concept of e-learning.

There are many advantages with the convergence of learning and the Internet. E-learning offers students control over content, learning sequence, pace of learning, time and often media that they choose to support their learning process. This allows students to tailor their experiences to meet their personal learning objectives [1]. E-learning offers a higher level of learning effectiveness. Learners are more satisfied with learning materials and learning environments. Hence many schools are implementing e-learning and many online learning communities have come into existence [1]. E-learning helps to integrate computing technologies and educational content materials and support learning in collaborative learning. Although e-learning has been extensively implemented, there are some constraints with respect to time and place where the learner is. The learner should be at a fixed location with a computer and the Internet connection to access the content and materials. This is a real barrier. If we make education truly accessible,

by providing real-time access to information, anywhere the learner wants to access it, then we can overcome the access barrier.

Growth of mobile technologies in recent years is promising and is a new revolution that can be comparable with the growth of the internet. The cost of mobile access to the internet is steadily decreasing. Mobile technologies have enabled a new way of communicating and mobile devices have become the part of normal daily interaction. There are over 300 million mobile phone users worldwide, double the total number of internet users [4]. People are always connected to geographically dispersed groups. What if mobile devices were utilized to support the delivery of content materials for education? Like Desktops and Laptops are primarily used for e-learning, devices like cell phones, PDA's are used for mobile learning. More and more devices with improved capabilities are appearing on the market. Mobile learning is a combination of mobile computing and e-learning. Will e-learning undergo a revolution like, extraordinary growth and utilization of the Web? We do not know, but we must try to answer the question, by trying to imagine how mobile devices can enhance e-learning and change it for better. This research aims towards the implementation of educational technology through mobile devices.

3.2 CURRENT ENVIRONMENTS.

There are many tutorials available online and these can be accessed from mobiles that have basic browsing features. Many online environments like Blackboard, Moodle, Microsoft SharePoint, Logi Campus and Tutor can be accessed over mobile browsers.

3.2.1 Modular Object-Oriented Dynamic Learning Environment (Moodle) [23]

Moodle is likely the most widely used open-source content management system available. It runs on many different platforms, though it is recommended to run in a Unix/Linux

environment. As of January 2010, Moodle has a user-base of over 45,000 registered and verified sites serving over 32 million users in 3 million courses. Moodle's interface supports many plugins for activities, question types, graphical themes, enrollment methods and content filters. The philosophy of Moodle includes a constructivist and social-constructivist approach to education, emphasizing that learners and not just teachers can contribute to the educational experience. By Moodle being an open source, it poses one problem that many academics have an issue with, when there is an issue, who do you go to for support? As the case with most open source applications, there is no central repository for direct help. While the software may be free, it does cost money to support and if the cost to support runs over the cost of other proprietary systems, then the savings of using open source software have evaporated [23].

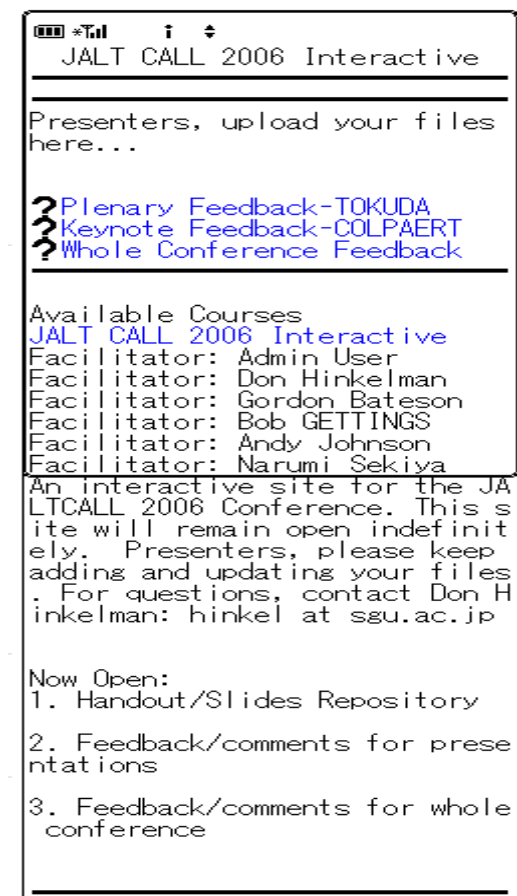


Figure 3: Layout of Moodle

Figure 3 depicts the layout of mobile version of Moodle. Accessing all the features of Moodle in a mobile environment is difficult and hence is not very effective. Mobile Moodle supports user login, course navigation, activities like quizzes and feedback. But the mobile version of Moodle does not support any graphical interface. Hence it is frustrating for the users to access the information from the small mobile screen. It will be easy for the users to access the information from the mobile devices with graphical user interface and many learners will be attracted towards and will have a chance to access the information regularly.

3.2.2 Microsoft SharePoint

Microsoft's SharePoint is also a CMS with integrated functionality developed by Microsoft that allows users to work in a web-based collaborative environment. SharePoint is not a single tool, but a collection of products and software that include web browser collaboration functions, process management modules, search modules and a document management platform. SharePoint is not widely used as developers have not grown to enjoy developing for SharePoint. SharePoint is often criticized for its lack of well integrated tools for developers and its complex software architecture that differs significantly from other web based applications. However, SharePoint does have its benefits, for example, it includes all the tools necessary to run and host collaborative communities without the need for additional software but its usefulness is limited because it lacks developer support [27].

3.2.3 LogiCampus

LogiCampus is another open source course management system that is designed specifically to fit the needs of distance learners. LogiCampus provides built-in master calendars and textbook requisitions. LogiCampus provides tools that are found in other content management systems such as the ability to create online courses, process assignments, make tests

and stay in contact with students. LogiCampus is not as widely used as the aforementioned content management systems [28].

3.2.4 ATutor

ATutor is an open source learning content management system that prides itself as being the only content management system to be fully accessible. ATutor is currently the only CMS that complies with the software evaluation criteria established by The American Society for Training and Development. A few of the accessibility features of ATutor are text alternatives for all visual elements and keyboard access to all elements of the program. ATutor is also formatted to run on a wide variety of technologies such as cell phones, personal data assistants and text-based web browsers. The system allows for increased adaptability in design principle, themes, privileges, tool modules and groups [24].

3.2.5 Blackboard [29]

Blackboard is a software company; their content management system is the Blackboard Learning System. Blackboard is the preferred content management system for many universities in the United States. Blackboard's main purpose is to be used in conjunction with traditionally face-to-face taught courses to deliver content such as lectures, assignments, quizzes and tests. Blackboard also has features that allow discussion on a posted topic. Blackboard went public in 2004 and is now a publicly traded company on the NASDAQ stock market. Blackboard unlike Moodle is proprietary and to use Blackboard costs average sized universities is in excess of \$160,000 per year. It is important to realize that the Blackboard Learning System can never be bought, it can only be rented. However, while the software is rented it is also fully supported (i.e. less people need to be trained at the university level to troubleshoot the system) a call to Blackboard should resolve the issue. The cost analysis of utilizing a proprietary system versus

open source should be taken into effect prior to deploying either system. Blackboard is the only popular Mobile version of CMS. It is available for operating systems like iOS, Android, Blackberry. But this would further increase the cost as different mobile versions have to be bought for different operating systems and to be maintained. Regular Blackboard can be accessed through the mobile browsers but was uninteresting for the learners to access due to usability and size limitations.

Accessing the content from the browsers of mobiles is frustrating for the users due to limitations in the screen size and view and it is also difficult to access the regular web pages in the mobile environment. Identifying the importance of mobile learning and its importance many companies are developing the mobile versions of their content management systems so that people can access them from their mobiles. But these have the usability issues and the much supported and popular user friendly models like Blackboard are very expensive. Though the applications are developed for mobile devices, they have to be developed separately for different operating systems, which is difficult and becomes more expensive for development and maintenance. Hence I came up with a web based application with a new mobile technology that can be accessed across all platforms with the same usability features. Results proved that accessing the content over this new technology is more interesting and user friendly for the users and this reduces the cost of developing multiple applications for different platforms. Looking at the limitations of the current systems we planned a mobile tutorial that has the basic content management systems features and can be accessed over wide range of mobile operating systems concentrating on the usability features and also reducing the cost of development and maintenance.

3.3 PLANNED EDUCATIONAL ENVIRONMENT

The planned educational environment consists of a learning environment that is CMS style structured. It is a mobile learning environment that is structured for certain courses or degree but at the same time is open to more users who want to utilize mobile environment. The planned environment is poised to replace the current mobile environments like Blackboard which is not portable to different mobile platforms. The overview of the proposed model is shown in the figure 4.

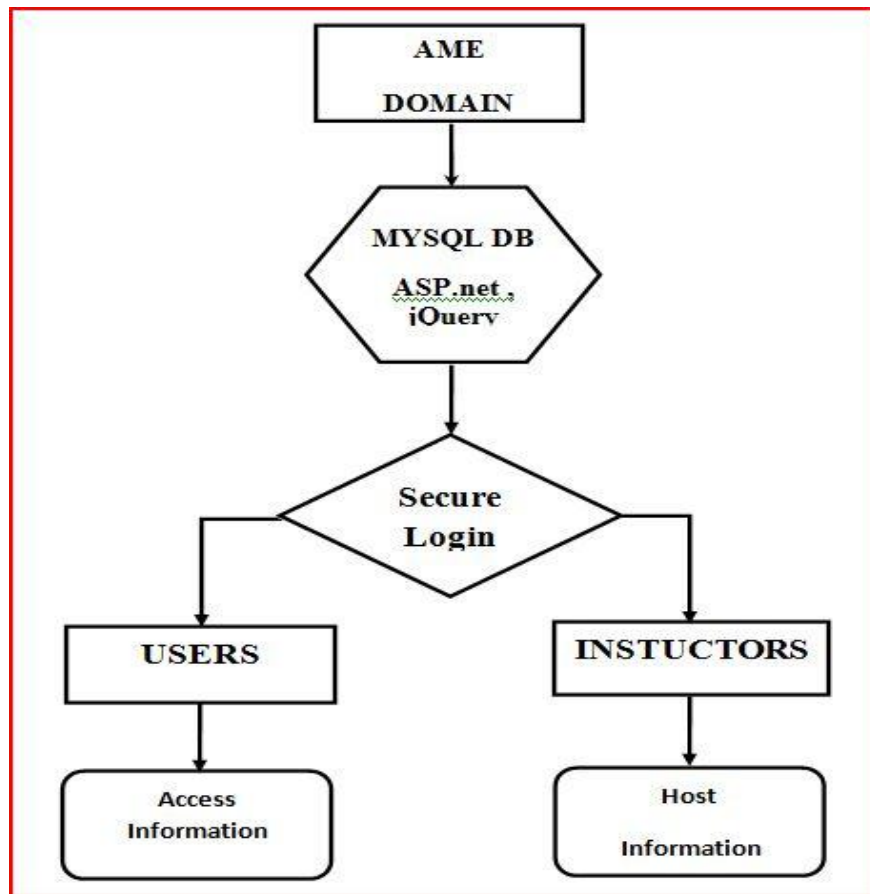


Figure 4: AME Software Model

The current environment can be accessed across wide range of mobile platforms. The teachers/instructors can host their lessons easily without knowing the details behind HTML and for students to comment on the lessons as well as allowing the teacher respond directly to the

student's questions in a way that benefits the entire community. However, teachers can respond directly to individual students by sending them a message to their inbox. The students can access the content from any of their mobile devices and the interaction becomes much simpler.

The environment consists of mainly two sections: users and instructors. The users can register and can access information of his/her choice of interest and can interact with the instructors and the registered users through a discussion forum. The users can also have the provision to assess their skills by taking the exams in the lessons. In addition, features like announcements, assignments, e-mail are also included. The instructors can host the lessons and can make changes to them dynamically which will be displayed at the use end. AME will provide services to the users and also collaborate with other systems as indicated in figure 5.

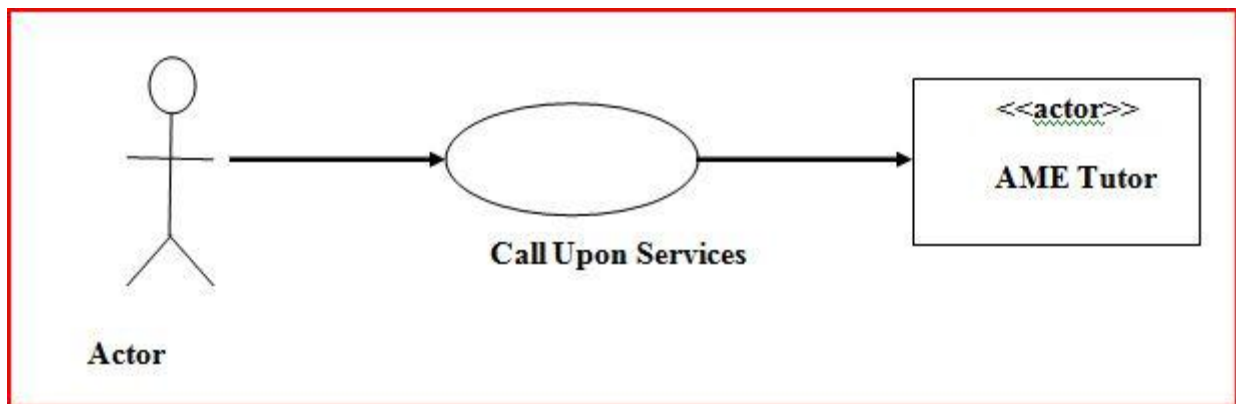


Figure 5: AME Context diagram

3.4 AME MODELING AND LIFE PROCESS

In this project we employed a Evolutionary Prototyping (EP); whose main goal is to build a robust and flexible prototype in a structured manner and constantly refine it. Thus an Evolutionary Prototype is the foundation of the main system whereas the new system is a product of improvements of the initial system based on new requirements and changes from users. This process allows a continuous refinement of the system and is based on an

acknowledgement that designers don't understand all the requirements and will build on those well understood requirements while adding features as they begin to fully understand the requirements. Evolutionary prototype is illustrated in figure 6.

One advantage with EP is that it can implement most of the features a user wants to integrate but on an interim basis with minimal functionality until the system is delivered. At the same time, it allows developers to develop parts of the system that they better understand without the need to worry about those they understand less (i.e. developing a holistic system).

The partial system is sent to users for testing. When users work with the system they find missing features and make requests through feedback to the developers. The developers then use the feedback/requests along with their expertise to employ sound configuration-management practices to change and update the requirements, update the design, recode and retest.

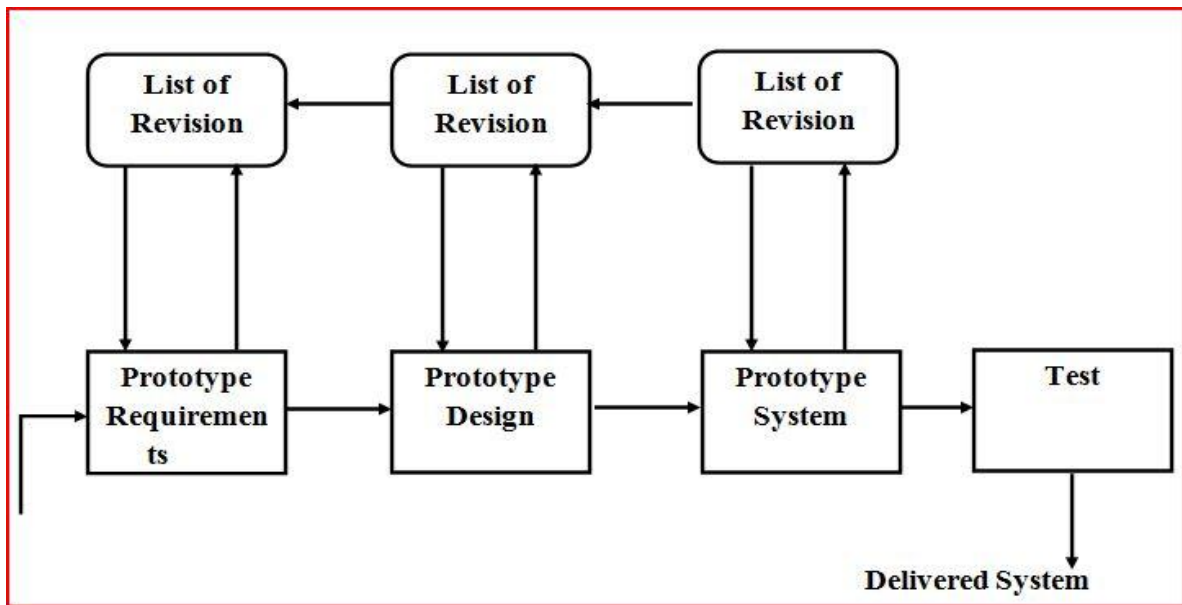


Figure 6: AME Prototyping Model

The prototype system is based on actors, currently these actors consist of any learners who want to access information through their mobile devices and teachers/instructors. How each actor or group interacts with the system or domain, varies based upon what the system allows the

actors to perform. A detailed diagram of how actors can interact with the system is shown in AME Domain Diagram, figure 7; this model serves as basis for implementation of the system, however some changes are made according to the requirements of the users.

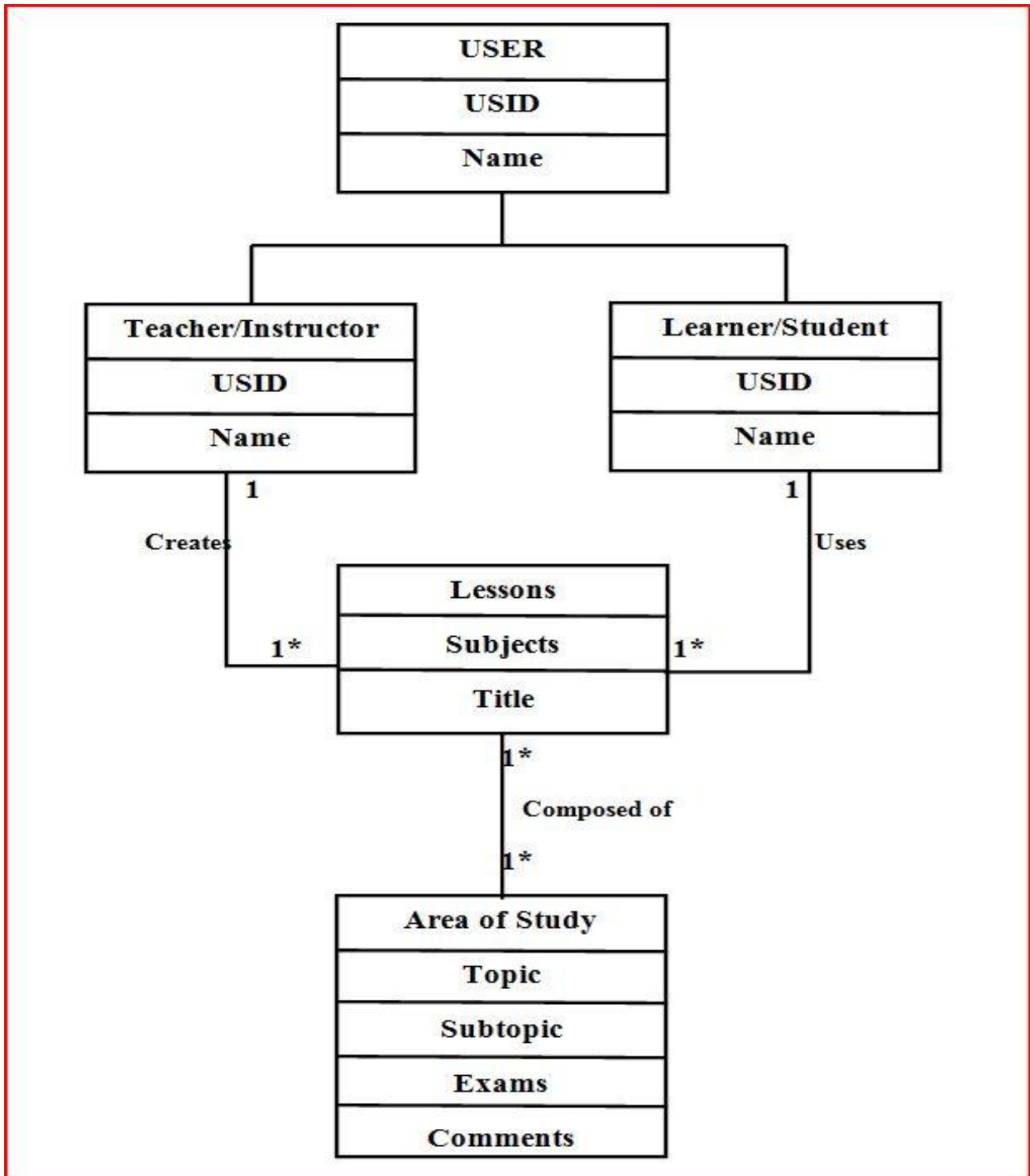


Figure 7: AME Domain Model

The user or actor may interact with the system as shown in figure 7 in different ways. A few of these interactions are demonstrated in use-case diagram in figure 8 and figure 9. A use-case diagram in Unified Modeling Language (UML) is a behavioral diagram defined by and created from use-case analysis. It represents a graphical overview of functionalities provided by the system in terms of actors, their goals and any dependencies between those use-cases. The main function of the use-case diagram is to show what system functions are performed for which actor.

3.4.1 AME Use-Case Scenarios.

3.4.1.1 *Instructor.*

Primary Actor: Instructor/Teacher

Secondary Actor: None

Description: The registered users will login, instantiate a new session and chooses an action from the options provided to either add or edit or posts a lesson materials. They can also add/delete exams.

Pre conditions: The user should have a valid username and password so that he/she can login from any internet browser to host the information.

Post Conditions: The user must be able to host and provide the information for the Learners/Students in particular area of study.

Basic Flow:

1. The user (Instructor/Teacher) Signs up for the account or login for the AME.
2. Once he logs in, the list of courses that he already hosted can be seen.
3. He can add a new course, view or edit existing courses.
4. He can add exams at the end of lessons.

5. Can involve in the discussion in any particular topic.
6. The system saves the details and posts them at the user end.

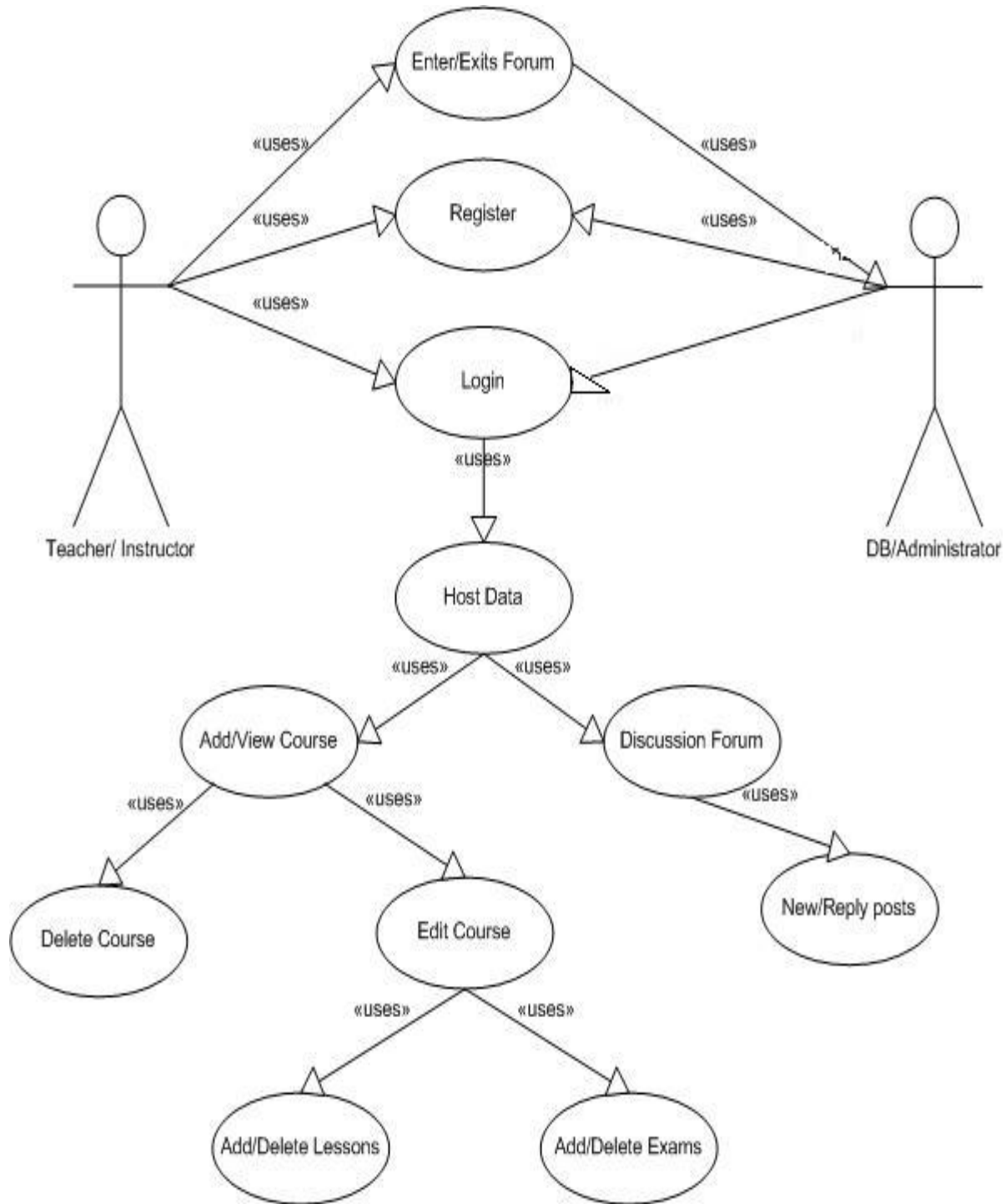


Figure 8: AME Instructor Use Case Diagram

3.4.1.2 Student.

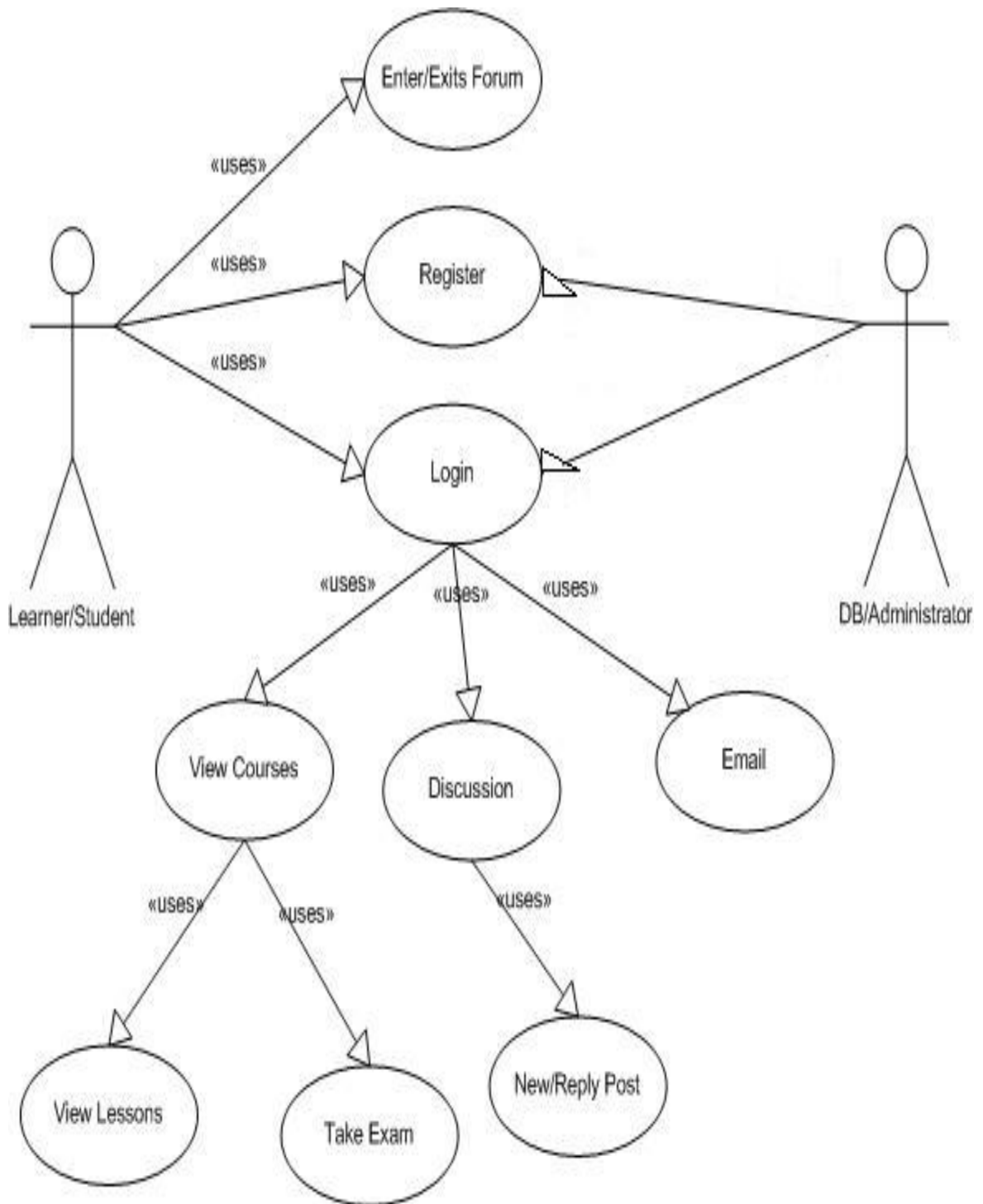


Figure 9: AME Student Use Case Diagram

Primary Actor: Learner/Student

Secondary Actor: None

Description: The registered users will login, instantiate a new session and chooses an action from the options provided to either view/take exam or involve in discussion.

Pre conditions: The user should have a valid username and password so that he/she can login from mobile device with internet and a browser.

Post Conditions: The user must be able to view the courses available in particular area of study and can be able to assess his skills by taking exams.

Basic Flow:

1. The user (Student) Signs up for the account or login for the AME.
2. Once he logs in, the list of courses available can be seen.
3. The user can view courses and learn from the content available from any mobile gadget from anywhere irrespective of time and place.
4. The user can take exams to assess his skills acquired at the end of lessons.
5. Can involve in the discussion or create a new one in any particular topic.
6. The system saves the details.

Another important aspect of the system is how, if working properly, the system responds to tasks. There are many ways to illustrate how the processes operate with one another. Sequence diagrams model the flow of logic within the system in visual manner. These are used to show the interactions between the objects in the sequence they occur. The following sequence diagrams, depicts the sequence of actions of student and instructor actions respectively. Figure 10 represents the sequence diagram of student/instructor registration and login actions. And figure 11 represents the sequence diagram of the task of instructor to add or edit a course.

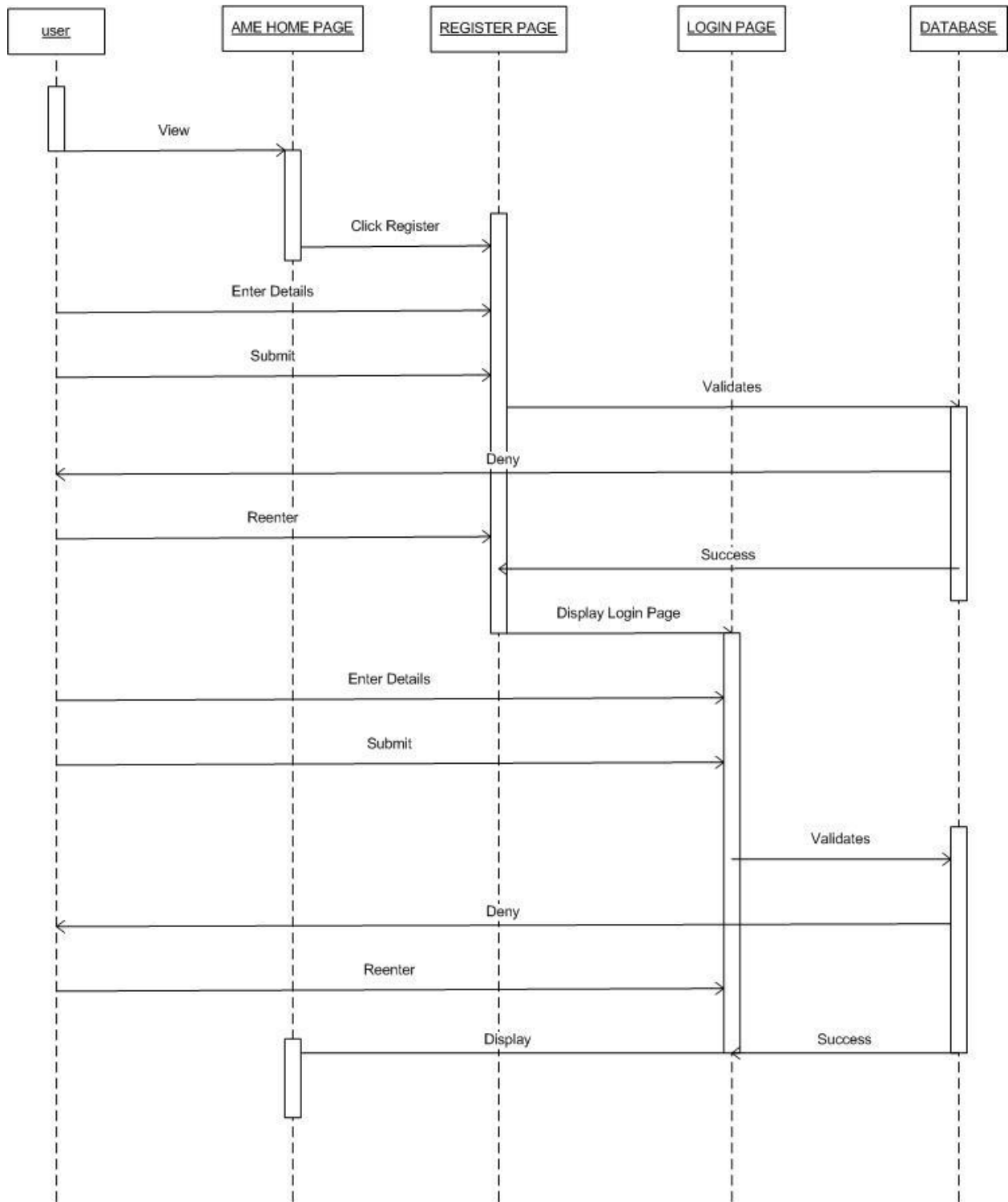


Figure 10: AME Registration/Login Sequence Diagram

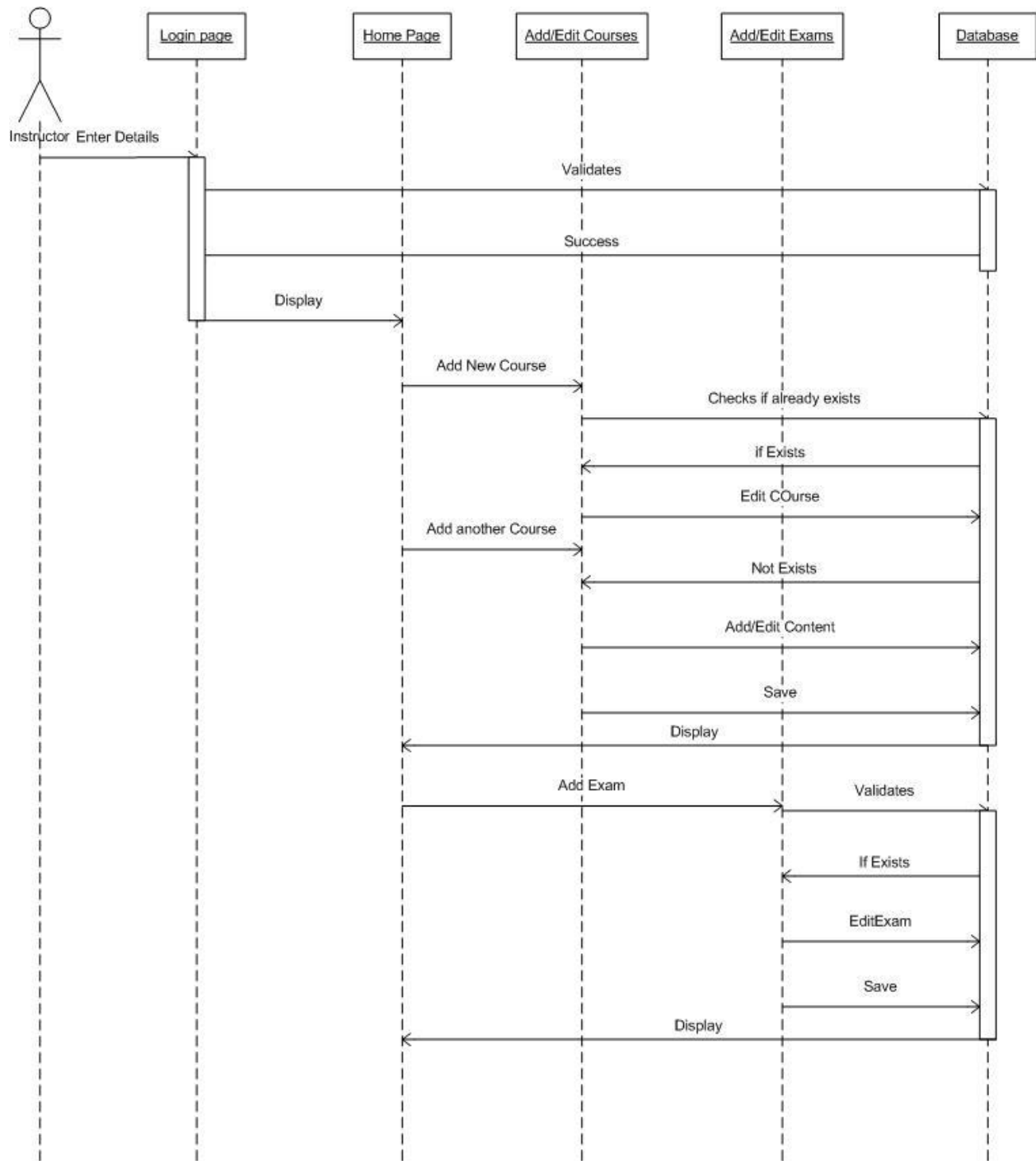


Figure 11: AME Add/Edit Course Sequence Diagram

3.5 TESTING EDUCATIONAL ENVIRONMENT

Testing the proposed educational environment is planned with the use of a survey that involves any mobile learners. In particular we chose HCI students. The surveying will be done with users that have experience using any of the online tutorials aforementioned. The users recall their experience using the existing environments and experiment with the designed new educational environment and then provide feedback based on their experience. The results from the survey will be illustrated and presented in chapter 4.

3.5.1 Test Environment and Experiment.

Initially, a study was conducted to analyze the needs of the users in using an online educational environment. As the planned environment is to be used through the mobile devices, we initially analyzed what users are comfortable with using the online educational environment through desktops and tried to incorporate the same features in the mobile environment. Data was gathered to find if the planned environment is right and then created a set of questions that needed to be answered by each of the participants. All the participants identified themselves as being good with accessing mobile gadgets. The testing participants were given the access to the environment and then asked to complete a detailed, but brief survey of their experiences.

3.5.2 Experimental Procedure.

The main hypothesis of this study is that mobile learning environments would be more helpful for students to access the educational information. The students can access the information anywhere and at anytime and will be more engaging if the content is delivered through easy and interactive mobile environments. Online learning environment better supports

students as opposed to structural educational environments. But accessing the environment requires computers and the user can access them at limited restrictions like time and place. To be able to allow the user to access these environments, mobile gadgets are the best possible option. With the revolution in mobile technology, mobile devices have become the basic essential element in human lives. If we can use them as media to deliver the information, the user can access it irrespective of time and space. In order to test these hypotheses, a set of variables were configured. For the study independent variables were determined to be the developed application that can be accessible across a wide range of mobile devices and a group of students who wanted to access the information through these devices. For the hypothesis a pre and post questionnaire were given. The questionnaire is comprised of set of questions, each having ratings for the user to specify his level of agreement of how comfortable he feels with the application.

The test environment for all the subjects was any of their mobile devices that have the basic browser features. The specification of the device was not a concern, it requires only those which can render the basic html pages and should support flash. The test subjects consist of 2 groups. The first group was CS java-II students just to determine if they are comfortable in accessing the materials through mobile devices and to know if the application support all the basic features required. The second group is HCI students who determine the UI features of the application.

The experiment includes 3 major sections: Pre-Questionnaire, AME Tutor (the educational environment) and Post Questionnaire. Figure 12 shows the flow chart of tasks the participants were to complete. The feedback will be used to improve the application further.

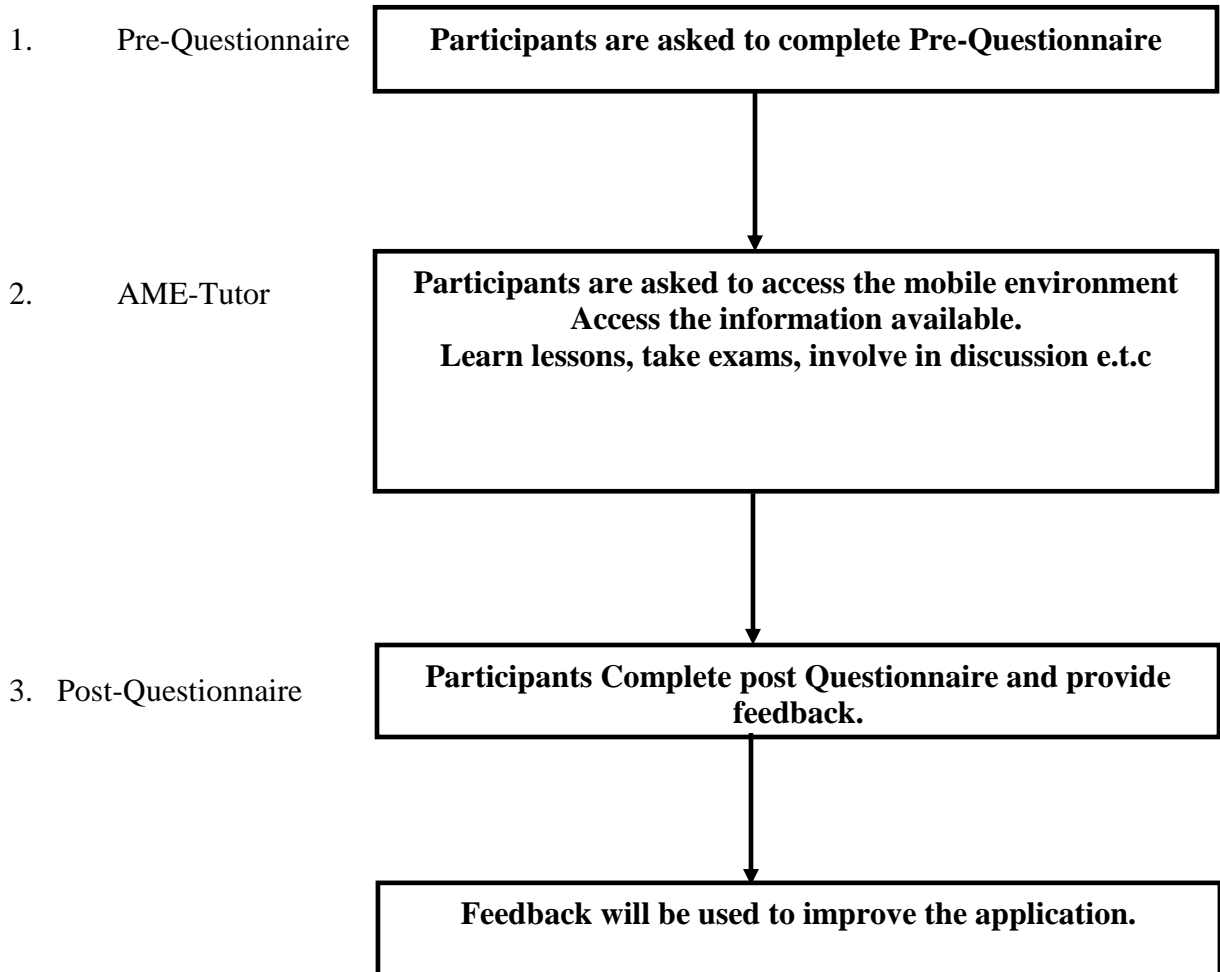


Figure 12: AME Survey Flowchart

CHAPTER 4: IMPLEMENTATION

As we discuss in the earlier chapters, we designed and developed the prototype by using an open source scripting language called 'jQuery Mobile', Asp.net with C#, MySQL. The IDE (Integrated Development Environment) used was Microsoft Visual Studio 2008. This chapter discusses the details behind successfully configuring and developing the proposed model for the mobile learning environment. For developing and implementing the model there are some essentials required which are discussed further.

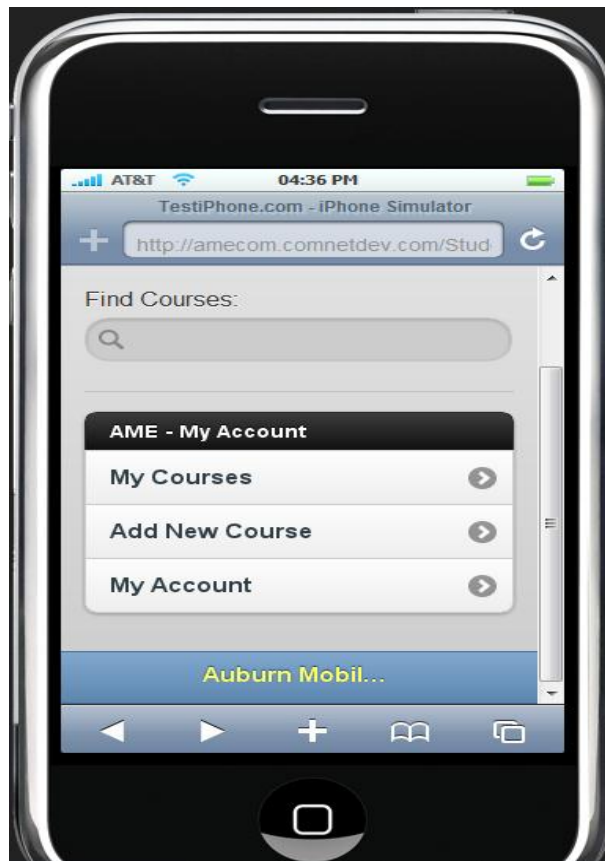


Figure 13: AME Student Home Page

4.1 DOMAIN REGISTRATION AND HOSTING

Before starting developing the prototype we had to register the domain name and secure host. A domain name is an identification label for getting authority or control over internet. Domain name are nothing but host names that identify the Internet Protocol (IP) resources such as web sites. Domain names are mainly used by Individual Internet host computers as host identifiers or hostnames. Without the use of the domain name, anytime a user wished to visit the site they would be forced to enter in the IP address for the site like 69.163.237.21, which is not easily recalled from memory. There are billions of IP addresses currently in use, and most machines have a human readable name which makes the task of finding the sites much easier. There are many billions of DNS requests made each day and IP addresses can change daily; add that to the equation and we see why a domain name is largely beneficial. To use an analogy – think of a domain name as a license to have a website but where does the website exist? Where exactly do you put your website? Along with a domain name, in order for a site to be seen there must also be a host for the content a user wishes to display on their site. There are a variety of different types of hosting available on the Internet and the prices for each range greatly. Uniform Resource Locators (URLs) are nothing but components that appear in host names for internet resources like websites. The domain name resolves to an Internet Protocol-IP address, based on that IP address a route is determined using the host routing table that specifies the route from an end user to that of the IP address which returns the website to the browser.

4.2 TECHNOLOGIES USED

As we discussed earlier in this chapter, the technologies used are jQuery mobile, Asp.net with C# and MySql as database. The proposed model includes a student panel and faculty panel. In the student panel, the students can register themselves and gain the access to the learning

contents of their choice. They can actively participate and interact with the other users and faculty. They can take any assessment tests and can involve in a discussion on a particular topic. This end was developed using a open source scripting language, 'jQuery Mobile', a unified user interface design across all mobile device platforms. Asp.net with c# was used to write the code behind. MySql was used to store the details of the registered users and their details like username, password etc. At the faculty end the registered faculty can add the course, course content, can assess the students by taking tests, and help the students by involving in the discussion. This was developed using asp.net and MySql was used to create the database to store the data like the faculty details, course contents. Let us look at these technologies briefly.

4.2.1 JQuery Mobile: Touch-Optimized Web Framework for Smart phones

JQuery Mobile is a unified user interface design across all mobile device platforms. It is lightweight, flexible and has easily themeable design. The mantra behind jQuery mobile is “write less and do more”. Instead of writing unique apps for each mobile device or OS, the jQuery mobile framework will allow you to design a single highly branded and customized web application that will work on all popular smart phone and tablet platforms [29]. It works across almost all popular mobile operating systems like iOS, Android, BlackBerry, Bada, Windows Phone, Palm WebOS, Symbian, MeeGO and many more.

Using jQuery reduces the task of developing same application for different operating systems saving money and most importantly time. The applications developed using jQuery Mobile have the same look and feel across different mobile devices. I used jQuery mobile to build a dynamic touch interface that will adapt flexibly over a wide range of devices irrespective of the operating system and size the device have. The following figure 14 shows the range of

browsers that support jQuery. The following figure is a yahoo's graded browser support chart with 3 different grade levels: A-grade browsers get the full experience of JavaScript, CSS etc, where as C-grade browsers get no java script or CSS. jQuery Mobile is working on all A grade browsers and hence ensures that the developed application as best as it possibly can.

Platform	Version	Native	Opera Mobile				Opera Mini		Fennec		Ozone	Netfront	Phonegap
			8.5	8.65	9.5	10.0	4.0	5.0	1.0	1.1	0.9	4.0	0.9
iOS	v2.2.1	A											A
	v3.1.3, v3.2	A						A					A
	v4.0	A						A					A
Symbian S60	v3.1, v3.2	C	C	C		B	C	B			C	C	
	v5.0	A	C	C		A	C	A					A
Symbian UIQ	v3.0, v3.1			C							C		
	v3.2				C						C		
Symbian Platform	3.0	A											
BlackBerry OS	v4.5	C					C	C					
	v4.6, v4.7	C					C	B					C
	v5.0	A					C	A					A
	v6.0	A						A					A
Android	v1.5, v1.6	A											A
	v2.1	A											A
	v2.2	A				A		C		A			A
Windows Mobile	v6.1	C	C	C	C	B	C	B				C	
	v6.5.1	C	C	C	C	A	C	A					
	v7.0	C				A	C	A					
webOS	1.4.1	A											A
bada	1.0	A											
Maemo	5.0	B				B			C	B			
MeeGo	1.1	A				A				A			

Figure 14: Range of browsers that jQuery mobile supports

jQuery's mobile strategy is simply summarized as delivering top-of-the-line javaScript in a unified user interface that works across the most-used smart phone web browsers and tablets. The difference with this approach is the wide variety of mobile platforms it supports. JQuery

Mobile is built on a foundation of clean, semantic HTML to ensure compatibility with pretty much web-enabled device. In devices that interpret CSS and JavaScript, jQuery Mobile applies progressive enhancement techniques to unobtrusively transform the semantic page into a rich, interactive experience that leverages the power of jQuery and CSS [29].

4.2.1.1 Key Features of jQuery Mobile:

- *Built on jQuery core* for familiar and consistent jQuery syntax and minimal learning curve
- *Compatible with all major mobile platforms* - iOS, Android, Blackberry, Palm WebOS, Nokia/Symbian, Windows Mobile, bada, MeeGo with baseline support for all devices that understand HTML
- *Lightweight size* (12k compressed for all mobile functionality) and minimal image dependencies for speed.
- *HTML5 Markup-driven configuration* of pages and behavior for fast development and minimal required scripting.
- *Progressive enhancement* approach brings core content and functionality to all mobile, tablet and desktop platforms and a rich, installed application-like experience on newer mobile platforms.
- *Automatic initialization* by using HTML5 data-role attributes in the HTML markup to act as the trigger to automatically initialize all jQuery Mobile widgets found on a page.
- *Accessibility* features such as WAI-ARIA are also included to ensure that the pages work for screen readers (e.g. VoiceOver in iOS) and other assistive technologies.
- *New events* streamline the process of supporting touch, mouse, and cursor focus-based user input methods with a simple API.
- *New plug-in* enhance native controls with touch-optimized, themable controls.

- *Powerful theming framework* and *Theme Roller* application make highly-branded experiences easy to build.

4.2.1.2 *Supported platforms in alpha 3*

In the new alpha 3 release, the following platforms and browsers have a solid jQuery Mobile experience with pages fully functional and rendering as designed.

- Apple iOS (3.1-4.2): tested on iPhone, iPod Touch, iPad
- Android (1.6-2.3): all devices, tested on the HTC Incredible, Motorola Droid, Google G1 and Nook Color
- Blackberry 6: tested on Torch and Style
- Palm WebOS (1.4): tested on Pre, Pixi
- Opera Mobile (10.1): Android
- Opera Mini (5.02): iOS, Android
- Firefox Mobile (beta): Android

4.2.1.3 *Target platform additions for beta*

Next jQuery team is targeting to support to Blackberry 5, Nokia/Symbian, and Windows Phone 7 for the upcoming beta release. Since jQuery Mobile is built on the jQuery core, all pages should also work great on most recent versions of desktop browsers too - Firefox, Chrome, Safari, Internet Explorer, Opera, etc.

jQuery Mobile makes it easy to develop user interfaces for mobile web applications. The interface configuration is markup-driven. It can create the entire app interface in HTML without using JavaScript. New custom events, to detect the devices and touch specific actions like tap,

tap-and-hold, swipe, and orientation change are provide with jQuery Mobile. It uses themes to make it easy to customize the look and feel of the application. Basic jQuery mobile page structure is shown in figure 15.

```
<Code />

<!DOCTYPE html>
<html>
  <head>
    <title>Page Title</title>
    <link rel="stylesheet" href="http://code.jquery.com/mobile/1.0a1/jquery.
    <script src="http://code.jquery.com/jquery-1.4.3.min.js"></script>
    <script src="http://code.jquery.com/mobile/1.0a1/jquery.mobile-1.0a1.min
  </head>
  <body>

  <div data-role="page">

    <div data-role="header">
      <h1>Page Title</h1>
    </div>

    <div data-role="content">
      <p>Page content goes here.</p>
    </div>

    <div data-role="footer">
      <h4>Page Footer</h4>
    </div>
  </div>

</body>
</html>
```

Figure 15: JQuery mobile basic page structure

To use jQuery mobile, we need to include:

- ✓ The jQuery Mobile CSS file (jquery.mobile-1.0a1.min.css)
- ✓ The jQuery library (jquery-1.4.3.min.js)

- ✓ The jQuery Mobile library (jquery.mobile-1.0a1.min.js)

4.2.2 Asp.net

ASP.NET is a unified Web development model that includes the services necessary for you to build enterprise-class Web applications with a minimum of coding. ASP.NET is part of the .NET Framework, and when coding ASP.NET applications you have access to classes in the .NET Framework. You can code your applications in any language compatible with the common language runtime (CLR), including Microsoft Visual Basic, C#, JScript .NET, and J#. These languages enable you to develop ASP.NET applications that benefit from the common language runtime, type safety, inheritance, and so on.

ASP.NET includes:

- A page and controls framework
- The ASP.NET compiler
- Security infrastructure
- State-management facilities
- Application configuration
- Health monitoring and performance features
- Debugging support
- An XML Web services framework
- Extensible hosting environment and application life cycle management

4.2.3 MySQL:

MySQL is a relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases. It is named after developer Michael Widenius' daughter, My. The SQL phrase stands for Structured Query Language. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. Free-software-open source projects that require a full-featured database management system often use MySQL. For commercial use, several paid editions are available, and offer additional functionality. Applications which use MySQL databases include: Joomla, WordPress, MyBB, phpBB, Drupal and other software built on the LAMP software stack. MySQL is also used in many high-profile, large-scale World Wide Web products, including Wikipedia, facebook.

4.2.3.1 *How does MySql Works*

MySQL is a powerful Relational Database Management System (RDBMS) which we will use to learn the basic principles of database and data manipulation using Structured Query Language (SQL) statements. SQL is a database language that is used to retrieve, insert, delete and update stored data. This is achieved by constructing conditional statements that conform to a specific syntax. MySQL is a database server program and as such is installed on one machine, but can 'serve' the database to a variety of locations. The MySQL Server is installed on a Server and can be accessed directly via various client interfaces, which send SQL statements to the server and then display the results to a user. Some of these are:

A Local Client: A program on the same machine as the server. An example of this is the command line MySQL client software we will be using in the rest of the MySQL workshops (although there are other programs including graphical interfaces).

A Scripting Language: Can pass SQL queries to the server and display the result.

A Remote Client: A programmer on a different machine that can connect to the server and run SQL statements.

Remote Login - You may be able to connect to the Server Machine to run one of its local clients.

We used the database tables to store the details like usernames, passwords, emails of the registered users, and instructors. Tables are further created to store the course contents. The data can be dynamically added and deleted. Stored procedures are written to dynamically insert and delete and update data.

4.3 DEVELOPMENT

For developing the prototype initially the paper prototype was designed. The requirements were gathered and analyzed based on Evolutionary Prototyping (EP). EP allows a continuous refinement of the system and is based on an acknowledgement that designers don't understand all the requirements and will build on those well understood requirements while adding features as they understand the requirements more. Initially all the features that are needed to include in the system are designed and analyzed based on the existing systems and a model was proposed. The proposed model can be seen in the figures 16 and 17. The proposed environment includes mainly two portals: Students and Instructors. The users can register and can access information of his/her choice of interest and can interact with the instructors and the

registered users through a discussion forum. The users can also have the provision to assess their skills but taking the exams in the lessons. Additional features like announcements and assignments tabs are also provide.

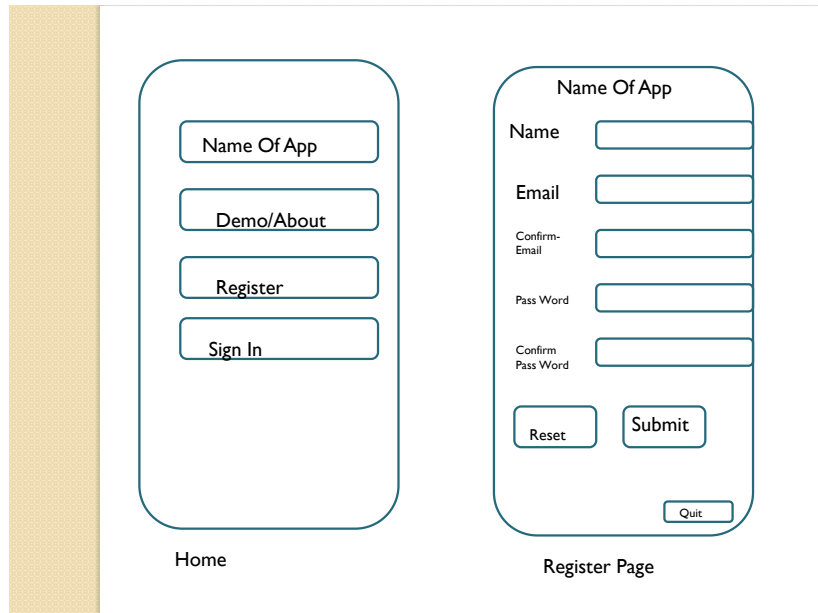


Figure 16: AME proposed model-Login and Register layout.

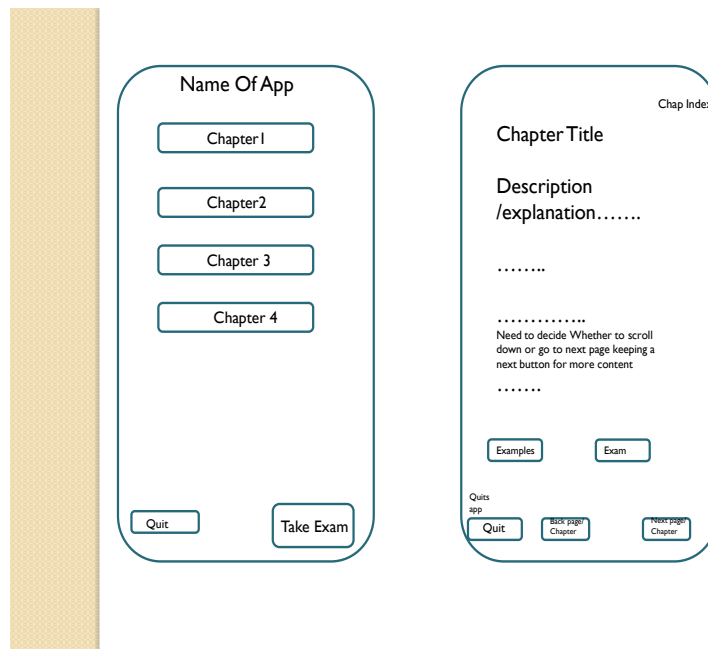


Figure 17: AME proposed model-Tutorial Layout

The instructors can host the lessons and can make changes to them dynamically which will be displayed at the user end. Using the proposed environment the student can access the information through their mobile devices from anywhere and at anyplace. The initially designed prototype was reviewed by Dr. Cheryl Seals. Once the proposed prototype was accepted, we worked analyzing the tools to be used for developing the proposed model. After going through many technologies that support mobile environment, we have finalized and used jQuery mobile as our major technology for developing the prototype.

4.3.1 Student Portal:

As discussed earlier the model includes a user portal that can be accessed through a mobile device. From this section students can register themselves and gain access to the content through their mobile devices. The developed model screenshots are shown in the following figures. Figure 18 is the basic student registration page, where students can register themselves from their mobile devices with a username, email and password.

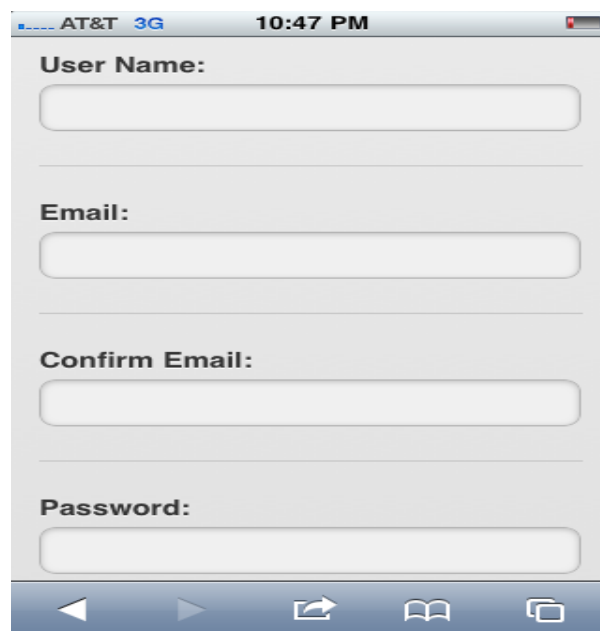
The image shows a mobile application interface for registration. At the top, the status bar displays 'AT&T 3G' and '10:47 PM'. Below this, the registration form consists of four vertically stacked input fields, each with a label above it: 'User Name:', 'Email:', 'Confirm Email:', and 'Password:'. Each label is in bold black text. The input fields are white with rounded corners and a light gray border. At the bottom of the screen, there is a blue navigation bar with five white icons: a left-pointing arrow, a right-pointing arrow, a square with a right-pointing arrow, an open book, and a square with a right-pointing arrow.

Figure 18: AME Registration Page

Once the registration is done, the user can login with the username and password created. Once he logs in, he will be directed to a main menu that includes ‘My Courses’, ‘Add Course’ and ‘My Account’ links. Main menu screenshot is shown in figure 19. Link to ‘My Courses’ directs to the list of courses the student opted for. For the first time user no courses exist and he can add courses form the ‘Add Courses’ tab. ‘My Account’ contains basic information about the use and the user will have a chance to edit his personal information.

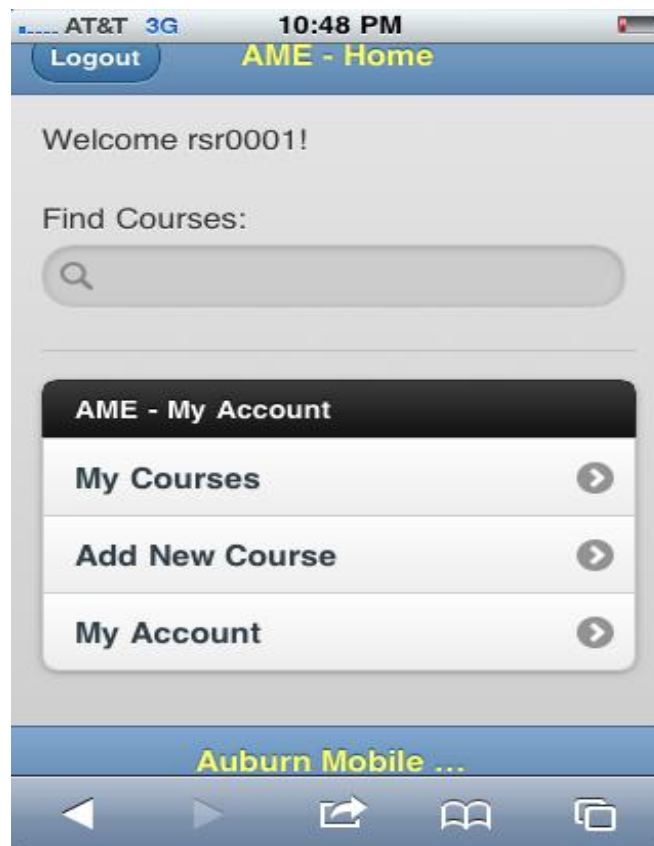


Figure 19: AME Tutorial Main Menu

When user tries to add a new course from ‘Add New Course’ tab he will be directed to the list of courses that are sorted by department, course name and faculty. The student can add a course by going through any link and select the course of his/her choice by clicking add course button. Figure 20 shows add new course page.

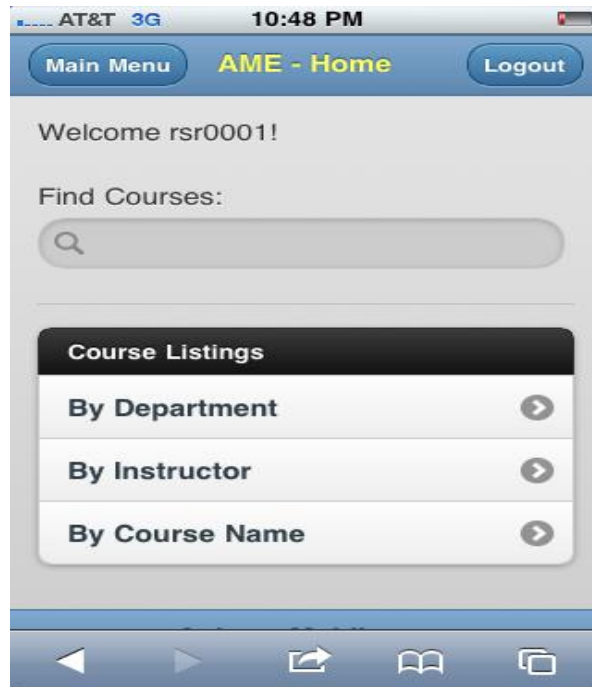


Figure 20: Add New Course

Once the course is added, he will be directed to 'My Courses' tab and the user can add any number of courses available. List of all the courses that are opted by the student are shown in My Courses tab and student can select any one course from the list to gain access to the information. Figure 21 show the list of courses added by the demo user. Once user selects a particular course to browse through the course contents, he/she will be directed to the main page of the course contents that includes Announcements, Lessons, Assignments, Exams, Course Outline and Discussion Forum. Figure 22 gives the basic idea of course main page layout. Announcements tabs includes information about an announcement or any other important information that instructor wanted to convey and the list of announcements are prioritized with the most recent announcement first. Lessons contain all the knowledgeable information in the course. Lessons can be grouped into chapters and chapters can be further divided into different subsections.



Figure 21: List of Courses

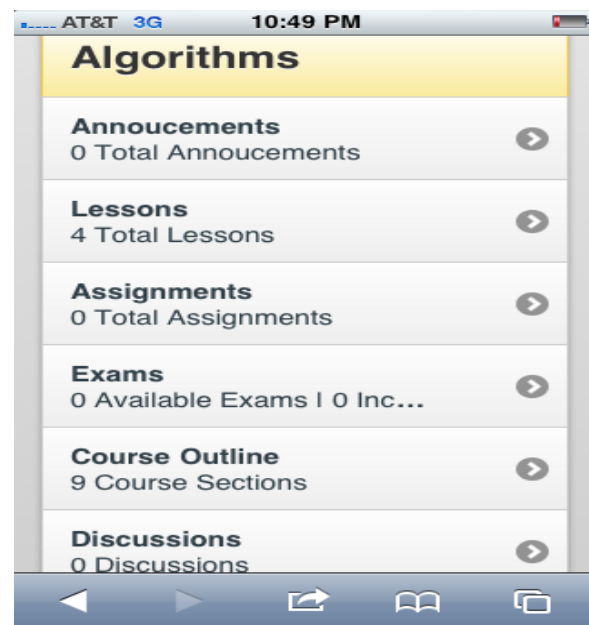


Figure 22: Course Main Page

All these are dynamically uploaded from the faculty portal. The faculty had to just add the appropriate chapter name and subsections and they are categorized accordingly in the tree structure. Assignments contains the list of assignments to be done and contains the information

like description of the assignment, when and where to be submitted. Exams tab contains the list of exams that are available for the course that can be taken through mobile devices. These exams are shown only if they are present. These can be made available by the instructor within the time stamp of his/her choice. Once the time expires the student will not be able to take the exam. Exams comprises either choose the correct option type or a textual answer type questions or both. Images can also be uploaded if required. Questions are to be answered one at a time and can move on to the next by clicking next button. If the student cannot complete the exam in right time, it logs him out of the exam and credit will be given to only those he answered. Once all the questions are answered, the student can review the exam before finally submitting. After the student submits the exam, the marks scored will be given right away. If the exam includes textual answers, partial credit is given for choose the correct option type questions and the total credit is given once the instructor grades the textual answer questions. Course outline is the list of lessons/chapters available for that particular course. This gives the user a chance to look at the topics what he is searching for. The last tab is discussion tab and this involves the discussion of any particular topic related to the course. The student can create a discussion and all the other registered users who opted for that particular course and instructor can join the discussion. This gives the users and instructors to communicate and interact with each other.

4.3.2 Instructor Portal:

The next section in our proposed model is instructor's portal where the registered instructor can post the content, so that the students can access the content from their mobile devices. Once the instructor logs in, he/she can view his/her courses or can add a new course. In each course, to host the content, he can add lessons, edit or delete them. For adding the lessons in a hierarchal manner, a course out line was designed so that the instructor can add any topic at

any chapter or subsection directly. Exams can be added to lessons or courses so that the students can take them from their mobile devices. If required, a time frame can be given. Exams include choose the right answer and text field type of questions. Choose the correct option type of questions will be automatically graded and the text field type of questions will be shown up on the instructor panel with student name who took it, and the instructor can grade it. Other feature like announcements, assignments, e-mail sections are added. As discussed earlier student portal includes a discussion forum, the discussion can be seen by the instructor and the instructor can participate if required.

CHAPTER 5: RESULTS AND DISCUSSION

As stated in chapter 1, the primary objectives of this study were to address the following concerns:

1. Investigate mobile educational tools currently available to facilitate and supplement traditional classroom learning.
2. Investigate the affordances and constraints involved in developing the mobile educational application that can support the educators as well as the learners in a capacity that is easy to use, meets all the requirements needed and is engaging for the learners.
3. Design and develop a web based mobile application that can be accessible across different mobile platforms and can provide the educators and learners the ability to use the mobile system that is interactive, easy for educators to post their content, easy for the learner to access the content and accessible anytime and anywhere.
4. Determine if the developed prototype is better when compared to the currently existing mobile environments.

To address these concerns, a series of studies were conducted in spring 2011. The existing educational tools were studied and discussed in the earlier chapters. Their affordances, constraints, the challenges involved and the requirements for the mobile learning are studied and discussed. A web based mobile application that is user friendly, interactive was developed using 'jQuery' mobile. The results from these studies provided information about how students

perceive the developed environment and if the proposed environment is best suited for mobile education.

5.1 RESULTS OF USABILITY- AME MOBILE ENVIRONMENT

Based on the survey information obtained from the study participants, many already have the knowledge of accessing smart phone or tablet PC's. All the study participants were college graduates so it was not a surprise that many have the idea about today's mobile devices. There were about 35 participants and 86.7% have a mobile device like Ipod, Ipad, tablet PC or a smart phone. Approximately 93.3% of the participants have the knowledge of accessing information from these mobile devices. About 86.2% participants believe that the education should involve mobile teaching tools also as a method to supplement traditional classroom or PC environments. When asked about, if they want to access course information though mobile devices, 96.7% of the participants are willing to use it. Figure 23 shows the percentage of participants who are willing to use mobile environments to lessons if it was available for them.

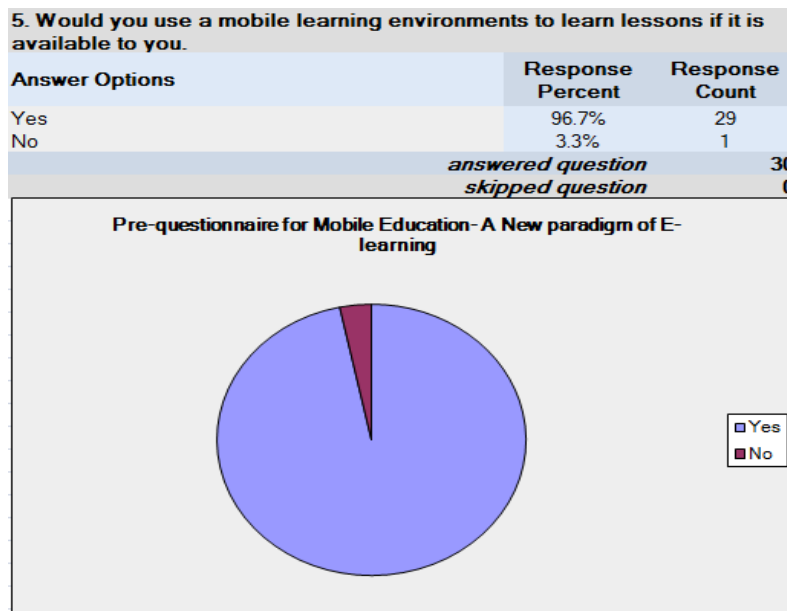


Figure 23: Percentage of participants interested in mobile education

Figure 24 represents that 86.2% of participants believe that online mobile environments will improve access to course contents. Table 2 represents the summary of data reported by the student participants. Overall their responses denote that most of them are not novice mobile users and we consider the group to be experienced mobile users. These results indicate that the students believe that mobile learning must be used in addition with traditional classroom environments and they believe that it improves access to educational information and will use the environment if it is available to them.

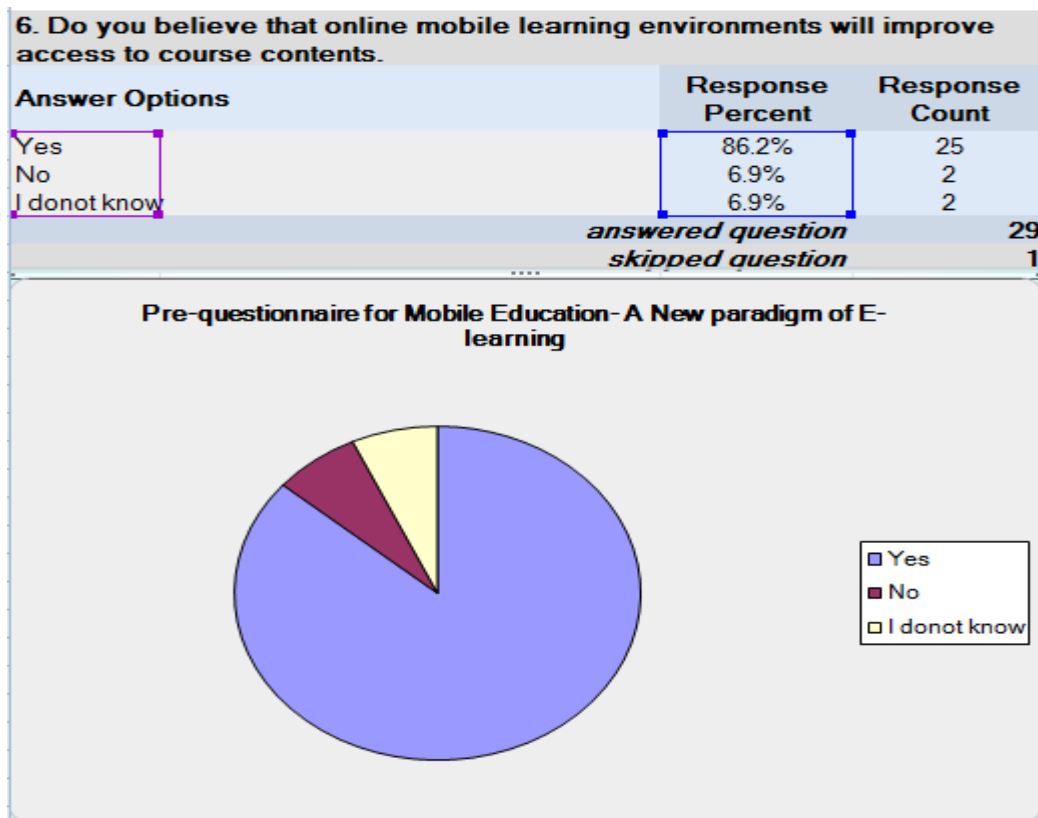


Figure 24: Student perception to mobile educational environments

Question	Response
Do you have any mobile devices like ipad, smart phone	Yes-86.7% , No-13.3%
Do you know how to access online information though mobile devices	Yes-93.3%, No-6.7%
Do you use mobile devices to access educational information	Yes- 86.7%, No-13.3%
Do you believe education should involve mobile teaching tools also	Yes-83.3%, No-13.3%, I don't know-3.3%
Would you use mobile learning environments if available	Yes-96.7% ,No-3.3%
Do you believe online mobile learning environments will improve access to class materials	Yes-86.2%, No-6.9%, I don't know-6.9%

Table 2: Pre-Questionnaire Results

The above results indicate the need of developing a mobile educational environment. And hence a mobile learning environment was developed. The study can be considered successful if the students who wanted to use the developed mobile environment as a supplement to access their course materials. We will now see the user's reaction to the developed application.

	1	2	3	4	5	6	7	Average
Terrible/Wonderful	0	0	0	1	5	8	15	6.28
Difficult/Easy	0	0	1	1	0	9	18	6.45
Frustrating/Satisfying	0	0	1	1	6	9	12	6.03
Dull/Simulating	0	0	1	2	8	15	3	5.59
Rigid/Flexible	0	0	0	1	5	17	6	5.97

*Data was collected on a seven point scale 1 being the lowest and 7 being the highest

Table 3: Post Questionnaire satisfaction Results

Table 3 shows that the participants responded well to the developed mobile learning environment (AME Tutor). On a scale of 1-7, the average rating in each of the satisfaction categories is nearly 6. Their response to the system was better than expected by the researchers.

We anticipated that the response would be closer to 5. The researchers felt that their exclusion of a tutorial for the system might actually affect the percentage of users that would satisfactorily navigate the site. The tutorial was intentionally left out of the study to gauge how intuitive the site would be without directions. Based on user response, the site proved to be very intuitive, even for novice users. Rating amongst the highest averages were that of ease of use, satisfying to use, and how wonderful the application to use; which are key to engaging students as well as prolonged use of the system after deployment.

Rating weight	Strongly Disagree	2	3	4	5	6	Strongly Agree	NA	Average
The system enables me to accomplish the tasks quickly	0	0	0	1	3	5	19	1	6.50
Using the system will make it easier to access the course content	0	0	1	0	1	14	11	0	6.17
I feel comfortable using the system	0	0	0	1	2	17	8	1	6.14
The system gives error messages that clearly Tell me how to fix the problems	0	0	0	2	1	13	12	0	6.25
The organization of the information on the system screen is clear	0	0	1	0	3	16	8	0	6.07
The interface of the system is visually appealing	0	0	0	2	4	12	10	0	6.07
Layout/Colors of the interface is visually appealing	0	0	0	0	10	12	5	0	5.81
Overall, I am satisfied with this system	0	0	0	2	1	16	8	0	6.11

*Data was collected using a 7 point scale; 1 being the lowest and 7 being the highest.

Table 4: Post Questionnaire usefulness Results

Table 4 represents how the users viewed the system in respect to how useful it would be in accessing the course content. Judging by how users rated the system we can see that the most feel as if the system would assist them in improving the access to the course contents. This is a key factor, as the users see the usefulness in the system, they will be more inclined to use the system as it helps them in their daily tasks. With the average rating in excess of 6 in each area, it is clear that the users find the system useful which will likely translate to students wanting to use the system in their classrooms. The highest rating 6.5 for ‘the system enables me to accomplish my tasks quickly’, 6.17 for ‘using the system will make it easier to access the course content’ and 6.14 for ‘I feel comfortable using the system’ are key factors to the success of the system. If the students do not find the system easy and comfortable, they will avoid using the system. We wanted the students to feel that the system worked for them and not against them, it seems that the students received the system well.

Question	Yes, I completed all my required tasks	I only completed some tasks			I could not complete all the tasks			Average
		2	3	4	5	6	Strongly Agree	
Were you able to successfully complete the set of tasks?	81.5%	18.5%			0%			
Based on you experience, would you use AME tutor to access the course materials	0	1	1	3	4	7	13	5.86
This environment provide broader access than currently available course delivery option	0	1	1	3	7	12	5	5.48
I will recommend the tool to others	0	1	2	0	4	12	10	5.86

Table 5: Post Questionnaire Combined results

Table 5 is a representation of different set of questions and the participant's responses respectively. The first question is in regards to whether they successfully completed the set of tasks that were given to them. This list of tasks can be found in Appendix D. Over 80% responded that they could. This supports one of the goals of the research which was to build a mobile learning environment that was intuitive, user friendly and easy to use and learn. The second question was, if they are willing to use the newly developed mobile environment and about 75% of the participants are willing to use the application. The next question was if the developed environment will provide the broader access than currently available tools and when rated on a scale of 1-7, the average response was 5.48, that is nearly 80% of the participants agree that the environments provides better access than other currently developed environments.

5.2 STUDY PARTICIPANTS COMMENTS

Some of the participants made specific comments, in regard to the system, in the comment section of the post questionnaire; below are the few participants comments.

Anonymous participant 1, "I have seen these kinds of environments before, but none of them were intended to use through mobile devices. Good work."

Anonymous participant 2, "I application has very interactive content, simple and easy to use. It's really cool."

Anonymous participant 3, "Using the application will help me accessing the contents anytime at anyplace"

Anonymous participant 4, "The site functions very well but needs more visual elements."

Anonymous participant 5, "More features needed to be included like audio, video, live chat to make it more interactive."

CHAPTER 6: FUTURE WORK AND CONCLUSION

6.1 FUTURE WORK

As the project is still in its infancy, extensive future work needs to be done before it can robustly be tested and used by schools systems and students. To date limited understanding has been achieved on how mobile learning could be implemented in basic education. Though our project results demonstrated, how easy and convenient it is to access the course contents through the mobile devices, there are many other issues to be addressed in the future. One of the issues to be addressed is keyboard limitations. The user may not have accessibility for all the symbols he needed. This issue can be addressed by developing plug-ins for the mobile browsers that include the required input or developing a virtual keyboard. Other features like Audio, Video, live chat can also be implemented to make the application more interactive and more accessible. Though two-way communication is possible with discussion forum, by implementing web-based chat room, the goal of two-way communication can be completely achieved. Adding Audio and video are the additional features that make it more interesting for the students to interact and keeps them engaged.

Mobile devices have been demonstrated to add new possibilities to educational experience. But some of the additions include capturing, collaborating and presenting data. As the devices expand in their capabilities and research deepens, educators should be able to more accurately grasp the degree to which mobile learning can enhance the learning experience.

6.2. CONCLUSIONS

The advantages of mobile learning are obvious to all. In this research, we intended to provide an idea for the learner- centered education by using the mobile devices. For this we have developed a graphical user mobile environment that provides a new way of learning mode and adaptive to learner's learning style. With the development of mobile educational environments, it would be easy and convenient for the students to carry out course contents in anytime and anywhere, so that it provided more opportunities to study course contents in extra-curricular time and that apparently improves effect of interest of learning. Learning through mobile devices in addition to traditional teaching mode increases the utilization of knowledge such as course contents, reference materials and discussions. It is implemented with low cost. Information Technologies like network communications, mobile computing etc. can combine good learning theories and improve the complicated computer education process. As mobile phones and other mobile communications devices spread continuously, the true value of mobile learning will be verified in the educational practice. Learners will break restrictions of time and space away. Although there are some shortcomings, such as the integration of learning, lack of effective Governance, lack of learning platform. However, we believe that with the continuous progress of science and technology, combination of wireless technology and education, it will promote development of mobile learning. It has an invaluable effect for the promotion of lifelong learning and enhancement of the quality of the people.

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APPENDIX A

AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMANSUBJECTS RESEARCH PROTOCOL REVIEW FORM

For information or help contact THE OFFICE OF HUMAN SUBJECTS RESEARCH, 307 Samford Hall, Auburn University
Phone: 334-844-5966 e-mail: hsubjec@auburn.edu Web Address: <http://www.auburn.edu/research/vpr/ohs/>

Complete this form using Adobe Acrobat Writer (versions 5.0 and greater). Hand written copies not accepted.

1. PROPOSED START DATE of STUDY: Jun 17, 2011
- PROPOSED REVIEW CATEGORY (Check one): FULL BOARD EXPEDITED EXEMPT
2. PROJECT TITLE: Mobile Education-A New paradigm of E-Learning
3. Raja Shekar Reddy Erri CSSE (334) 728-1296 rze0001@auburn.edu

PRINCIPAL INVESTIGATOR	TITLE	DEPT	PHONE	AU E-MAIL
Chelby Center for Engineering Technology Suite 3101	(334) 524-8085		raj.auburn@gmail.com	
MAILING ADDRESS	FAX	ALTERNATE E-MAIL		
4. SOURCE OF FUNDING SUPPORT: Not Applicable Internal External Agency: _____ Pending Received
5. LIST ANY CONTRACTORS, SUB-CONTRACTORS, OTHER ENTITIES OR IRBs ASSOCIATED WITH THIS PROJECT:

6. GENERAL RESEARCH PROJECT CHARACTERISTICS

6A. Mandatory CITI Training	6B. Research Methodology																
<p>Names of key personnel who have completed CITI: Raja Shekar Reddy Erri Dr. Cheryl Seals</p> <p>CITI group completed for this study: <input checked="" type="checkbox"/> Social/Behavioral <input type="checkbox"/> Biomedical</p> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px auto; width: 80%;"> PLEASE ATTACH ALL CITI CERTIFICATES FOR EACH KEY PERSONNEL </div>	<p>Please check all descriptors that best apply to the research methodology.</p> <p>Data Source(s): <input checked="" type="checkbox"/> New Data <input type="checkbox"/> Existing Data</p> <p>Will data be recorded so that participants can be directly or indirectly identified? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Data collection will involve the use of:</p> <table border="0" style="width: 100%;"> <tr> <td><input type="checkbox"/> Educational Tests (cognitive diagnostic, aptitude, etc.)</td> <td><input type="checkbox"/> Interview / Observation</td> </tr> <tr> <td><input checked="" type="checkbox"/> Surveys / Questionnaires</td> <td><input type="checkbox"/> Physical / Physiological Measures or Specimen (see Section 6E.)</td> </tr> <tr> <td><input checked="" type="checkbox"/> Internet / electronic</td> <td><input type="checkbox"/> Private records or files</td> </tr> <tr> <td><input type="checkbox"/> Audio / Video / Photos</td> <td></td> </tr> </table>	<input type="checkbox"/> Educational Tests (cognitive diagnostic, aptitude, etc.)	<input type="checkbox"/> Interview / Observation	<input checked="" type="checkbox"/> Surveys / Questionnaires	<input type="checkbox"/> Physical / Physiological Measures or Specimen (see Section 6E.)	<input checked="" type="checkbox"/> Internet / electronic	<input type="checkbox"/> Private records or files	<input type="checkbox"/> Audio / Video / Photos									
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<input checked="" type="checkbox"/> Internet / electronic	<input type="checkbox"/> Private records or files																
<input type="checkbox"/> Audio / Video / Photos																	
6C. Participant Information	6D. Risks to Participants																
<p>Please check all descriptors that apply to the participant population.</p> <p><input checked="" type="checkbox"/> Males <input checked="" type="checkbox"/> Females <input checked="" type="checkbox"/> AU students</p> <p>Vulnerable Populations</p> <table border="0" style="width: 100%;"> <tr> <td><input type="checkbox"/> Pregnant Women/Fetuses</td> <td><input type="checkbox"/> Children and/or Adolescents (under age 19 in AL)</td> </tr> <tr> <td><input type="checkbox"/> Prisoners</td> <td></td> </tr> </table> <p>Persons with:</p> <table border="0" style="width: 100%;"> <tr> <td><input type="checkbox"/> Economic Disadvantages</td> <td><input type="checkbox"/> Physical Disabilities</td> </tr> <tr> <td><input type="checkbox"/> Educational Disadvantages</td> <td><input type="checkbox"/> Intellectual Disabilities</td> </tr> </table> <p>Do you plan to compensate your participants? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>	<input type="checkbox"/> Pregnant Women/Fetuses	<input type="checkbox"/> Children and/or Adolescents (under age 19 in AL)	<input type="checkbox"/> Prisoners		<input type="checkbox"/> Economic Disadvantages	<input type="checkbox"/> Physical Disabilities	<input type="checkbox"/> Educational Disadvantages	<input type="checkbox"/> Intellectual Disabilities	<p>Please identify all risks that participants might encounter in this research.</p> <table border="0" style="width: 100%;"> <tr> <td><input checked="" type="checkbox"/> Breach of Confidentiality*</td> <td><input type="checkbox"/> Coercion</td> </tr> <tr> <td><input type="checkbox"/> Deception</td> <td><input type="checkbox"/> Physical</td> </tr> <tr> <td><input type="checkbox"/> Psychological</td> <td><input type="checkbox"/> Social</td> </tr> <tr> <td><input type="checkbox"/> None</td> <td><input type="checkbox"/> Other _____</td> </tr> </table> <p style="font-size: small;">*Note that if the investigator is using or accessing confidential or identifiable data, breach of confidentiality is always a risk.</p>	<input checked="" type="checkbox"/> Breach of Confidentiality*	<input type="checkbox"/> Coercion	<input type="checkbox"/> Deception	<input type="checkbox"/> Physical	<input type="checkbox"/> Psychological	<input type="checkbox"/> Social	<input type="checkbox"/> None	<input type="checkbox"/> Other _____
<input type="checkbox"/> Pregnant Women/Fetuses	<input type="checkbox"/> Children and/or Adolescents (under age 19 in AL)																
<input type="checkbox"/> Prisoners																	
<input type="checkbox"/> Economic Disadvantages	<input type="checkbox"/> Physical Disabilities																
<input type="checkbox"/> Educational Disadvantages	<input type="checkbox"/> Intellectual Disabilities																
<input checked="" type="checkbox"/> Breach of Confidentiality*	<input type="checkbox"/> Coercion																
<input type="checkbox"/> Deception	<input type="checkbox"/> Physical																
<input type="checkbox"/> Psychological	<input type="checkbox"/> Social																
<input type="checkbox"/> None	<input type="checkbox"/> Other _____																
6E. Institutional Biosafety Approval																	
Do you need IBC Approval for this study? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - BUA # _____ Expiration date _____																	

The Auburn University Institutional Review Board has approved this document for use from 6/17/11 to 6/16/12
Protocol # 11-121 EX 1106

FOR OHSR OFFICE USE ONLY

DATE RECEIVED IN OHSR: 6/9/11 by GB PROTOCOL # 11-121 EX 1106

DATE OF IRB REVIEW: 6/17/11 by CC APPROVAL CATEGORY: 45 CFR 46.101 (b)(2)

DATE OF IRB APPROVAL: _____ by _____ INTERVAL FOR CONTINUING REVIEW: 1 year

COMMENTS: original 3/29/11; CC not approved
1st revs. 5/13/11; CC not approved
2nd revs 5/20/11; CC not approved

APPENDIX B



**AUBURN UNIVERSITY
SAMUEL GINN COLLEGE OF ENGINEERING**

DEPARTMENT OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

**INFORMATION LETTER
for a Research Study Entitled
---Mobile Learning-A New Paradigm of E-Learning---**

You are invited to participate in a research study to explore your past experiences with online mobile educational tools and introduce you to a new prototype mobile educational tool that could be used in educational environments. You will compare and discuss the prototype environment to your past experiences with current mobile educational tools. You must be at least 19 years old to participate in the study. This study is being conducted by Raja Shekar Reddy Erri as a part of his thesis work, under the direction of Dr. Cheryl D.Seals in Auburn University Department of Computer Science and Software Engineering. You were selected as a possible participant because you are college graduate with a career or have knowledge in Java as you have registered for COMP 2210 or Usability related course COMP 6626 or COMP 7620.

What will be involved if you participate? If you decide to participate in this research study, you will be asked to perform a pre questionnaire before evaluating the prototype. Once the pre questionnaire is completed, the participant will be provided with the links for newly developed mobile educational tool. By clicking on the links the participant will able to see the usability or design feature of the prototype. Then a set of questions relating to overall satisfaction and usability of the prototype will be given to the participant where he/she needs to select an answer from a list of answers for each question. The approximate time for accessing the application will be 5 to 10 minutes and completing the survey will take 10 minutes. An E-mail will be sent to the participant with all the above instructions explained clearly in the mail. By agreeing to participate in this research study you are consenting to allow the use of data collected from you for research purposes.

Are there any risks or discomforts? There are no perceived risks associated with this study

Are there any benefits to yourself or others? Information collected during this study will help us identify how effective and intuitive the prototype environment is and how it rates in comparison to other existing mobile educational tools and also further helps to asses usability features of the application

Will you receive compensation for participating? NO compensation for participation will be given.

Are there any costs? There are no costs associated for participating.

If you change your mind about participating you can withdraw at anytime during the study by simply closing your browser. Once you've submitted anonymous data, it cannot be withdrawn since it will be unidentifiable. You can withdraw from study at any time without penalty. Your decision about whether or not to participate, or to stop participating, will not jeopardize your

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future relation with Auburn University, Department of Computer Science and Software Engineering.

Any data obtained in connection with this study will remain anonymous. The data in this study will be anonymous. Data will be collected through a questionnaire. Your name, email and other identifiers are not collected during the survey and will not be associated with the data provided. Information collected through your participation may be used to publish in professional journal, conference submissions, thesis and dissertations and/or presented at professional meeting.

If you have any questions, we invite you to ask them now. If you have questions later, Raja Shekar Reddy Erri (334) 728-1296, rze0001@tigermail.auburn.edu, Cheryl Seals, (334) 844-6319, sealscd@auburn.edu, will be happy to answer them. You will be provided a copy of this form to keep.

For more information regarding your rights as a research participant you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

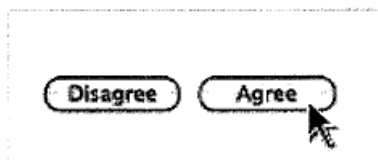
- Add approval statement here -

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. IF YOU WISH TO PARTICIPATE IN THIS SURVEY PLEASE SELECT YOUR CHOICE BELOW

Clicking on the "agree" button below indicates that:

- You have read the above information
- You voluntarily agree to participate
- You are at least 19 years of age

If you do not wish to participate in the research study, please decline by clicking on the "disagree" button.



** Add this statement to your letter!*

Page 2 of 2

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Protocol # 11-121 EX 1106

APPENDIX C

Pre-questionnaire for Mobile Education- A New paradigm of E-learning

1. Do you have any mobile device like Ipad, Ipod, Tablet PC or a smart phone with browser facility?

Yes

No

2. Do you know how to access online information through mobile devices?

Yes

No

3. Do you use mobile devices to access educational information?

Yes

No

4. Do you believe education should involve mobile teaching tools also as method to supplement traditional classroom lessons and PC environments?

Yes

NO

I dont know

5. Would you use a mobile learning environments to learn lessons if it is available to you.

Yes

No

6. Do you believe that online mobile learning environments will improve access to course contents.

Yes

No

I donot know

7. Did you ever use any of the following mobile educational tools to access class materials through mobile devices.

Moodle

blackboard

Logi Campus

Other

8. How often you use your mobile devices to access your class materials

Hourly

Daily

Weekly

APPENDIX D

Prototype Task List

Thank you for choosing to participate in the AME mobile environment study for effectiveness and usability as well as successfully completing the pre questionnaire for this study. Below you will find the task list that you should complete in order, after wards visit <https://www.surveymonkey.com/s/QR7MMVY> to complete the post questionnaire.

AME Task List

1. Visit <http://amecom.comentdev.com/students/default.aspx>
2. Register yourself and login
3. Find the list of courses available and add them
4. Now browse though the course you have added
5. Browse through the course contents, announcements, assignments, exams section.
6. You may take the tests.
7. Browse through the discussion forum and make a new post, reply to the old posts.
8. Delete the posts you made.

That completes the required tasks on the application, please visit <https://www.surveymonkey.com/s/QR7MMVY> to complete the post questionnaire.

APPENDIX E

Post Questionnaire-Mobile Education-A New Paradigm of E-learning

[Exit this survey](#)

1. Please rate the system usability

	Terrible	2	3	4	5	6	Wonderful
overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Please rate the system usability

	Frustrating	2	3	4	5	6	Satisfying
overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Please rate the system usability

	dull	2	3	4	5	6	stimulating
overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Please rate the system usability

	rigid	2	3	4	5	6	flexible
overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. The system enables me to accomplish tasks quickly.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. Using the mobile system will make it easier to access the course content.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. The system is easy to use.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. I feel comfortable using this system.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Please give us your reflections on learning while using the system.

	Difficult	2	3	4	5	6	Easy	N/A
Getting Started	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Learning advanced features	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Time to learn to use the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. The system gives error messages that clearly tell me how to fix problems.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. The organization of information on the system screen is clear.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. The interface of the system is visually appealing.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. Layout/Colors of the interface is visually appealing.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. Overall, I am satisfied with this system.

	Strongly Disagree	2	3	4	5	6	Strongly Agree	N/A
Overall reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. Were you able to successfully complete the set of tasks.

- Yes, I completed all my required tasks
- I only completed some tasks
- I did not complete all the tasks

16. Based on your experience, would you use AME Tutor to access the course materials in the future.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
Reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17. This environment provide broader access than currently available course delivery options.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
Reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. I will recommend the tool to others.

	Strongly Disagree	2	3	4	5	6	Strongly Agree
Reaction to the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>