

## Case Study

### DESIGNING AND IMPLEMENTING M-LEARNING MODEL

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#### ABSTRACT

Mobile phones have been one of the most widespread in world market because of the high penetration of mobile phones market. On the other hand, this makes investment in learning systems one of the most successful investments. However, with M-Learning, the mobile user can study his/here lessons from anywhere and anytime using his/her mobile phone, unlike other learning services that depend on the location of the user.

Moreover, the M-learning system should be designed in a way that it provides easy access to courses and course material.

M-Learning is depending on mobile technologies and their support infrastructure. In these days, 2.5G, 3G and 3.5G mobile technologies are used as a platform for deploying of communication, e-content and mobile services.

The purpose of this research is to design and implement a model M-Learning system. The proposed system takes care of security, interoperability, and user friendly. The proposed M-Learning system will base on XML Web Services as a component model.

**Key Words:** M-Learning, e-content, mobile technologies.

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#### INTRODUCTION

Wireless learning is not a learning strategy; it is a delivery strategy. In the same way, mobile learning or m-learning are also delivery strategies. These delivery strategies support a range of instructional strategies and designs<sup>1</sup>. The m-learning strategies presented here focus on ways to use mobile devices.

M-learning is the exciting art of using mobile technologies to enhance the learning experience. Mobile phones, PDAs, Pocket PCs and the Internet can be blended to engage and motivate learners, any time and anywhere [<http://www.m-learning.org/>]. Learners send text (SMS) or picture (MMS) messages from their phones to the web-based media Board to contribute to both personal and collaborative web sites. Create engaging information sheets with a quiz on the back. Learners send a simple text message with the answer and get an instant reply.

Before picturing the new proposed approach, it is important to ask the essential questions. What gap in skill and knowledge are we trying to fill? What are the options? What are the costs? How do the benefits and limitations of these options compare? Is our learning intervention part of a larger solution such as a documentation system, learning management system, order entry system, or data collection solution? The following sections will give skills needed to evaluate m-learning as a delivery strategy.

There are pros and cons for each option. A multidimensional framework developed by Goh and Kinshuk<sup>2</sup> suggests that the pros and cons for e-learning and m-learning fall into four dimensions: content, device, connectivity and collaboration. Limitations such as screen size, resolution, input/output modes, navigation and bandwidth require content be optimized for each device. In addition, a plan must be put in place to update that content on disconnected devices. Connectivity affects tracking. If knowing who is using the systems matters, mobile and fixed-line systems will deliver immediate results. On the other hand, disconnected use systems will require additional technology to upload information on how and what is being used.

Collaboration is defined as "The ability for the learner to send messages to fellow students, contact the facilitator and query experts is a clear strength of fixed-line systems"<sup>1</sup>. Collaboration can include instant messaging, participation in a threaded discussion and embedded e-mail. The degree of collaboration available to mobile wireless users will be dependent on the device.

There are one and a half billion cell phones in operation around the world and a large percentage of them are in the hands of students<sup>3</sup>.

Mobile learning devices can be connected to a wireless network or they can work in disconnected mode. In a disconnected mode, the device must have content downloaded in advance so not all mobile devices are wireless. Likewise, not all wireless devices are mobile; many people consider a laptop PC with WiFi cards too weighty to be really mobile. Examples of common mobile devices (Not all educationally practical) are Mobile Pocket PCs, Laptops, Smart phones, Tablet PCs and Personal communication devices such as pagers<sup>1</sup>.

The interest in this technology is being driven by the rapid growth of wireless and mobile devices. As Harvey Singh (2003), CEO of NavoWave, points out<sup>4</sup>:

- More than 50 percent of jobs are mobile-away from a physical office.
- In the United States, an average worker spends only two days in formal training programs.
- To date, over 500 million Web-enabled mobile phones have been shipped to customers.
- Multipurpose hand-held devices, such as PDAs and cell phones, will outsell laptop and desktop computers combined by 2005.
- The enterprise market for mobile computing is estimated at \$30 billion.

There are benefits and limitations of m-learning for the two primary delivery strategies: the use of mobile devices to delivery performance support and the use of mobile devices to teach through communication<sup>1,2</sup>. The benefits of m-learning as communication stem from learners and experts constructing knowledge in an authentic context.

### M-LEARNING LIMITATIONS

Qingyang done his study at Stanford University's Language lab<sup>5</sup>, he provides some insights into the fragmented experience of learning with mobile device. The study warned that "Learning requires concentration and reflection. However, being on-the-go (Riding a train, sitting in a cafe, walking down the street) is fraught with distractions. Students are in situations that place unpredictable but important demands on their attention. This leaves the mobile learner with a highly distracted, highly fragmented experience. The learning application must be designed with this in mind".

Experts<sup>6</sup> have suggested that "some employees are unsure about evaluating their personal learning experiences. The lack of external feedback can cause learners to question their goals and achievements." Therefore, using m-learning delivery devices and strategies for self-directed learning compounds this challenge.

Mobile and wireless devices have limitations due to screen size and ability to access information designed for traditional web-based viewing, if the mobile devices are accessing information from websites<sup>7</sup>.

One of the biggest limitations and drawbacks for using a mobile wireless e-learning solution is cost. Recommending m-learning or wireless learning means devices for each learner, paying for wireless service, budgeting for maintenance and upgrades and supporting for resolve technical problems.

Due to security challenge of mobile devices size and portability, they are easy to lose, subject to damage and more likely to be stolen than desktop systems. In a Computer World article, Muir<sup>8</sup> estimates that "Probably fewer than 10 percent of mobile devices used by major organizations have serious protection for stored data".

### THE PROPOSED MODEL STRUCTURE

Due to the widespread of mobile phones in world market, specially in Saudi market with the high technology and penetration, 98% of student segment in KAU have mobiles with 3.5 G. Appendix (A) contains the questionnaire assessment for this segment of KAU (182 students).

Consequently, our proposed M-Learning can be grouped into three delivery strategies: m-learning as e-learning, performance support and communication<sup>1,2</sup>. The first strategy is the least modern, but probably the easiest to execute and most frequently used. The last two strategies are more modern, but less frequently used. None of these delivery strategies is designed to be a stand-alone learning solution. They might be blended into larger programs to extend learning to the work site.

#### 3.1. M-Learning as E-Learning:

The first approach can be expressed as math equation, m-learning=e-learning. The internet access will be via wireless devices, it follows that e-learning simply becomes m-learning. In this most simplistic view, e-learning and m-learning are the same; just the devices differ. In either case it is the same course, taken on the same PC notebook and there is little need to rethink strategies because the device (The PC) remains constant; only the network connection changes.

Figure (1) depicts the following assumed technical basic gathering of this scenario. Course 1 operates an e-Learning (LMS) system on Server 1. Contents on Server1 should be modified within a content transaction with Server 2 by means of the mobile client 1. Course 2 operates an e-Learning (LMS) system on Server 2. At the place of the meeting of wireless 1, 2 and 3, a mobile client 2, which access contents on Server 2, is used.

Altogether 10 different communication ways are possible between these five systems ( $\binom{5}{2} = 10$ ) fro which five can occur via wireless network technologies.

Therefore, mobility can be conceptualized in different ways, i.e., mobility of the user, mobility of the device

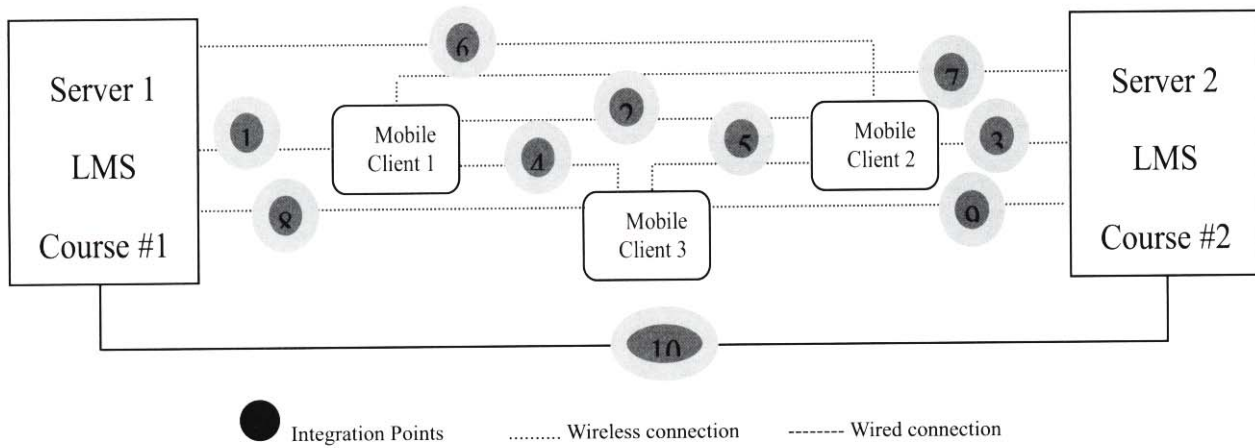


Fig. 1: Technical components in an ad hoc M-Learning integration scenario.

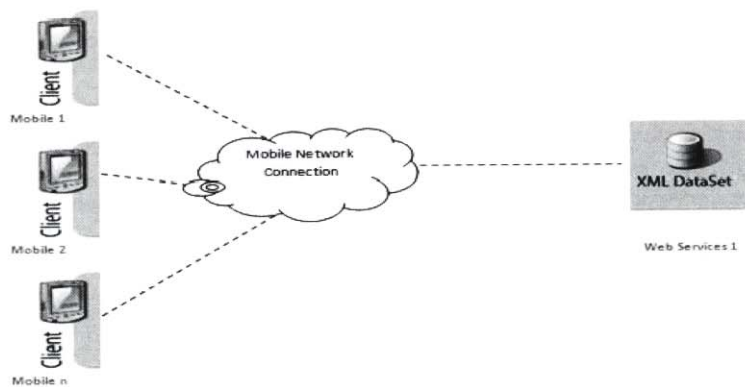


Fig. 2: All E-learning Web services run on one Machine.

and mobility of services<sup>9</sup>. Consequently, they believe that the important basic components of m-learning are identity, learner, activity, facility and collaboration.

**3.2. The Proposed System Architecture based on web services:**

Figure (2) illustrate the proposed architecture for Mobile E-learning system. The system has two parts: server side and client side. The server side has one or more web services for manipulation E-learning contents. The client side is a software installed on each Mobile machine for requesting, submitting, and viewing e-content.

**3.2.1 Scalability**

The critical factor for a distributed e-learning application is the ability to grow with the number of users, the amount of data and the required functionality. The e-learning application should be small and fast when the demands are minimal, but it should be able to handle additional without sacrificing performance or reliability. Web service provides a number of features that enhance e-learning application scalability one of them is Flexible Deployment

**3.2.2 Flexible Deployment**

As the load on an e-learning application grows, web service's location independence makes it easy to distrib-

ute web services over other computers, offering an easier and less expensive route to scalability. Redeployment is easiest for stateless services or for those that do not share their state with other services. For web services such as these, it is possible to run multiple copies on different machines. The learner load can be evenly distributed among the machines, or criteria like machine capacity or even current load can be take into consideration.

With Web services, it is easy to change the way clients connect to web services and web services connect to each other. The same web services can be dynamically redeployed, without any rework or even recompilation. All that is necessary is to update the registry, file system, or database where the location of each web service is stored. Figure (3) shows an example for redeployment the e-learning web service on several server machines.

**3.3. M-Learning Framework**

The most basic component of learning is the delivery of the contents<sup>9-12</sup>. Parsons, et al.<sup>9</sup> presented a frame work of the M-Learning model structure. The model includes 4 M-Learning requirements<sup>9</sup>; learning objectives, learning experience, M-Learning contexts and generic mobile environment design issues. Moreover, the feasibility of mobile learning can be justified from the perspective of devices and market trends<sup>13</sup>.

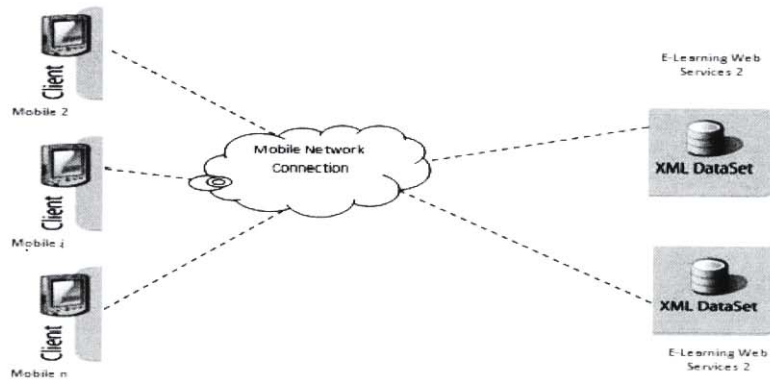


Fig. 3: ReDeployment of E-learning web services on several machines

The learning objectives of the proposed model contain:

1. individual learning (Improved skills and new skills)
2. Collective learning (Social skills and team skills).  
The learning experience includes organized contents, outcome and feedback, goals and objectives, representation or story, individual and team development and social interaction. The mobile learning illustrates identity, learner, activity, facility and collaboration. Finally, the generic mobile environment design issues include user role and profile, mobility, mobile interface design, media types and communication support.

Figure (4) represents new paradigm of the collaborative flow between mobility suite of design model and e-Learning model. The representation and organization of contents (e. g. learning objects) should provide an easy access to the contents.

The proposed model is based on component based software due to many advantages (Encapsulation, complexity management and reuse)<sup>14</sup>. The component has a logical and physical (Implementation) aspect. The logical representation of a component is modeled using UML subsystem, which can be thought of as the design view of a component<sup>14</sup>.

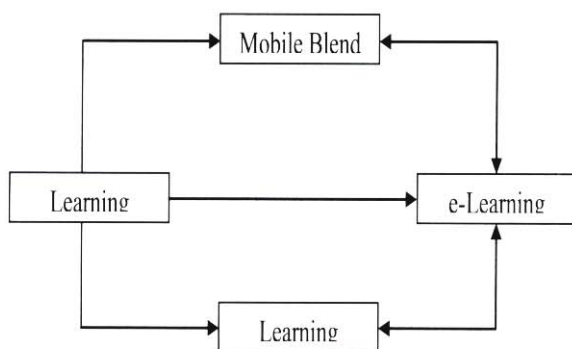


Fig. 4: New paradigm of the collaborative flow between mobility model and e-Learning model.

Mobile learning consists of main elements<sup>15</sup>, it includes:

1. Mobile Technology
2. Mobile Devices
3. Wireless Protocols
4. Wireless Language (Like Wireless Markup Language WML)
5. Wireless Applications. (Figure 5) shows these elements.

**3.4. Mobile Enterprise Scenario:**

Sending a message out in the delivery to collect the content is a common practice of every learning process. The proposed model is a solution that allows one to take the mobile device out in the field, fill in the prepared form and send it to the server for processing. This includes:

1. Mobile Server Manager is an application that allows:
  - Learning design.
  - Learning object.
  - E-learning to prepare the courses form, determines questions and set the type of answers for the questions.
2. Mobile Client is a mobile device application that presents the content form to the student, allows him to fill in the answers and sends them to the server for processing.



Fig 5: Elements of M-Learning.

3. Mobile Web-Service is a server application that accepts the filled-in forms. The following scheme shows the whole Mobile workflow; (Figure 6).

Also, the proposed model has been designed to be a search engine that enables many kinds of potential students to search for study units from institutions providing higher education. The architecture of the proposed model consists of three main components: knowledge base, search/delivery engine and authoring interface (Figure7).

Figure (8) shows an internal structural view of the CourseCatalog subsystem as well as external dependencies (IDatabase, ITransaction and IPersistence).

Figure (9) illustrates sequence diagram and showing how the subsystem implements the ICourse Catalog. get Courses() operation.

**3.5. M Learning Architecture:**

It is suggested that the proposed model be implemented as a client/server application. Being a client-side application, overhead of required server-side or online connection is avoided and additionally provides better management of the LO creation process. This at the same time allows uniform machine processing, easier access and delivery to other learners. The proposed model will be to facilitate content submission process by guiding authors through the procedure.

The proposed model is described by the list of “Action verbs” listed below in sequence of their execution. The process is shown in detail in the following:

1. Validate: Both authors and learners will be validated at this stage. Validating content involves verifying the file structure and the embedded links by parsing through the document. At the same time, the proposed model will extract additional metadata regarding the file structure.

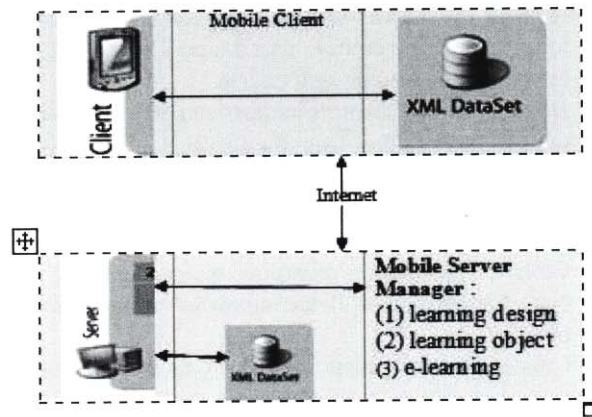


Fig. 6: Mobile Enterprise Scenario.

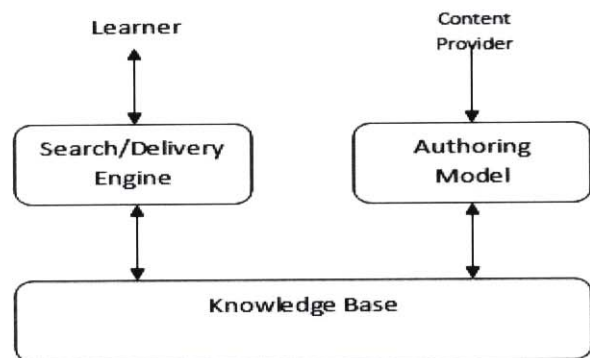


Fig 7: The Architecture of the Proposed Model.

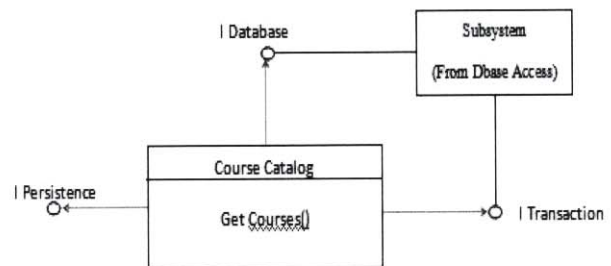


Fig. 8: Internal Structure View of the Course Catalog Subsystem.

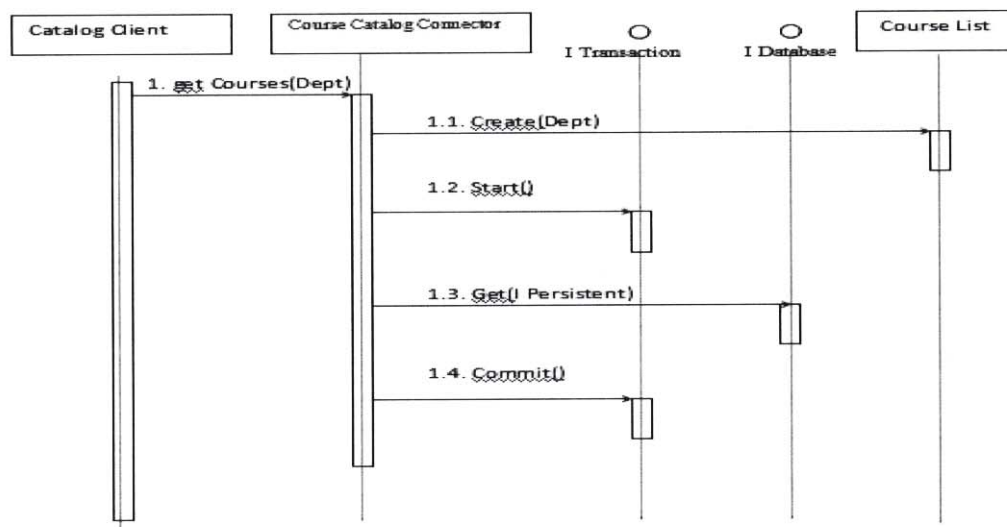


Fig. 9: The Course Catalog Subsystem's Implementation of Course Catalog.get Courses().

2. Identify the learner level and language of the content: Prepare the courses names and identify the related languages with each course.
3. Download: The learners/authors can download contents of their studies from the server.
4. Upload: The learners/authors can upload home work, assignment and media contents to their teachers at server.
5. Collect: Information regarding the content and the contributing author(s) are collected using a form out.
6. Create XML Metadata Record: A first-cut metadata record will be compiled from the returns of the Form. The Learning Object Metadata standard will be used in the proposed model.
7. Get Assignment: The contributing student(s) will be prompted to upload their assignment to the server. Assignment is expected to be in either html (Default) or non-html format.
8. Update Metadata Record: The Metadata Record of the content will be updated based on the additional manifest info obtained at the Validation stage.
9. Encapsulate and Zip: The content and its metadata will be packaged and zipped into a learning-object (LO) file ready for uploading to content server. The zip file will also contain the LO support files.

#### 4. The Proposed Model Testing

In section 3.2 the proposed model architecture is presented based on web services. The system has two parts server side and client side. As explained in software testing process<sup>16</sup> has two distinct goals:

1. To demonstrate the students and authors that the proposed model meets its requirements.
2. To discovers faults or defects in the proposed model where the behavior of the system is incorrect or does not confirm to its specification.

Consequently, the testing policies may be based on experience of the system usage, therefore three distinct aspects are needed:

1. All model processes, methods and functions that are accessed within client should be tested.
2. Integration of processes, methods and functions that are accessed through the same screens must be tested.
3. Where the students/authors input are provided (At any where any time), all processes, methods and functions that are be tested.

Figure (10) shows the running of the prototype of our proposed mobile system, taken into consideration the layout solution architecture.

#### CONCLUSION

This paper defined m-learning and explained why it is considered a delivery strategy-not a learning strategy. Also, the paper described the benefits and limitations of m-learning and described new approach to m-learning.

This paper has explored and acknowledged the technical, educational and financial challenges Mobile devices are a growing part of the technical infrastructure of large and small enterprises see Appendix (A). Due to the convergence of wireless data and computing will give us true anywhere, anytime and any device access to information. These devices are enabling enterprise contents for learning, distribution and student service and they will provide the e-contents on which training can ride. These devices are changing how work and learning are done. The leadership of training and development must monitor and align with the line-of-business functions considering mobile devices in order to take advantage of this new delivery mode. The strategies presenting in this paper are a starting point for generating ideas for formal and informal mobile learning.

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