Developing a Platform for Mobile Learning Using mLearn

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***Abstract*—This paper presents preliminary findings of a research study surrounding the development of an integrated architecture for a mobile learning platform. The study builds on prior design specification architecture for *mLearn* already appearing in the literature. In this development stage, the findings indicate that the use of the *mLearn* architecture and its approach when applied to a workplace-learning environment suggests benefits to learning. The results are in harmony with experimental expectations.**

Keywords—Mobile learning, mLearn, mobile services, electronic mobile learning, e-learning

I. Background and Prior Work

The rapid evolution of mobile learning (also known as m-learning or mLearning) allows the incorporation of new capabilities into mobile devices to enrich the learning process. Users can implement mobile learning as a method for lifelong learning to utilize their time in an efficient manner. Mobile learning also has the potential of bringing benefits to schools in support of classroom teaching including group learning. This new approach could change the way people learn in the future [1,2].

Mobile learning extends e-learning to mobile handheld devices such as with tablets and smart phones. The earlier study focused on the design and a suggested development of a mobile learning platform called *mLearn* [3]. The platform allows users within a learning situation to participate in electronic learning sessions where they have the ability to share content and to interact with other users in synchronous and asynchronous modes. The prior study showed the ways in which the *mLearn* platform used extensible mark-up language (XML) content over a hypertext transfer protocol (HTTP) with the Java 2 platform micro edition (J2ME) on the client [4,5]. This integration allowed the delivery of rich multimedia and interactive content to a wide range of mobile devices using different operating system platforms, enabling the *mLearn* platform to have a wide and continuous deployment in the future.

The *mLearn* platform uses three short message service (SMS) delivery methods: Push, Pull and wireless application protocol (WAP) Push. The last method combines both SMS and web browsing over the HTTP protocol in one service. The prior study recommended the use of SMS methods in several learning contexts that require short and in-time content delivery where one could use the Push and the WAP Push methods to send multicasting messages to a group of mobile learners with a common interest or involved in a common assignment. In addition, one could use J2ME on the client for large volume of content delivery involving a learning object such as course content, training material or online tests. The *mLearn* platform supports several learning approaches useable in mobile learning including exposition, exploration, construction and communication [6,7]. Because of the lack of availability on mobile handsets, the former study did not include the construction approach as an appropriate learning model for mobile learning because it involved interactive, high-speed, large memory, large-screen devices.

Many applications intended for mobile learning situations support different learning approaches, each having its own strengths and weaknesses [4,5,6,7]. As the power of mobile devices increases, more design options for developing mobile applications become available and user expectations increase. In the prior study, the team investigated several approaches and used them for structuring and developing computer-aided and multimedia-based learning applications. The reason for deciding on the three approaches is that they meet the current resource limitations of mobile handsets and that they support the computer-aided learning method as described by Kerres [6] and by Meisenberger [7].

The team had used only three (exposition, exploration and communication) approaches for the *mLearn* mobile learning models. The exposition is a computer-based training (CBT) approach requiring a learning path that presents learning objects asynchronously. These mobile learning objects are generally similar to those used for e-learning on a PC. Limitations include the amount of information devices can hold or displayed. Additionally, with mobile learning the user should be able to suspend the learning session and resume it

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whenever desired. Hence, this approach requires the structure of the content for a learning object to be in small and homogeneous learning elements. The prior work also showed that with the exploration approach, the learner does not need to go over a learning path and can explore available learning content of interest, thereby giving the learner greater motivation and control. The communication learning approach allows learners and instructors to communicate asynchronously and synchronously via mobile devices. With mobile learning, these methods could support different learning scenarios that supplement the classroom face-to-face delivery, including the problem-based learning (PBL) model. Such methods are chatting, e-mail and video and audio conferencing. The literature shows [7] that one useful method used for communication in mobile learning situations is the multimedia forum that involves audio and video entries instead of text, since text is difficult to enter on a mobile device.

The prior study also proposed the dissemination architecture of the *mLearn* platform using the J2ME platform and XML messaging as shown in Fig. 1. It allowed for rich content delivery into mobile devices by incorporating different types of media. In this case, the end user mobile device communicates with the web service directly over a GPRS/3G network for exchanging the actual XML content. The learning objects (e.g., course content, training material, interactive tests) for *mLearn* appear in XML, which is an open and international standard. Hence, one could assemble and implement different types of learning content. A dedicated website would become part of the architecture with authorized users who deliver the learning objects

Mobile learning through *mLearn* would normally be initiated when the client issues a request for a learning object. Fig. 1 showed the process of the client interacting with the server using XML over HTTP. The server side components are primarily Java servlets. The process begins when the Java J2ME client creates a request object that contains information such as a destination servlet or servlet operations with the associated parameters. Once the request object is populated, then the client sends the request to the HTTP connection manager, a web service component that acts as a client-side proxy for the server by assembling and disassembling the XML messages. The HTTP connection manager passes the request to the server as an XML message and listens for a response. At the server side, the XML message would be first received by the dispatcher servlet that takes the message and de-serializes it into a request object. The dispatcher servlet then passes the request object to the appropriate servlet responsible for dealing with the user's content request, generating a response object by accessing the data store via a layer of data access objects and finally sending the response object back to the client through the HTTP connection manager. The client's HTTP connection manager de-serializes the XML response into an appropriate response object and passes it back to the calling object.

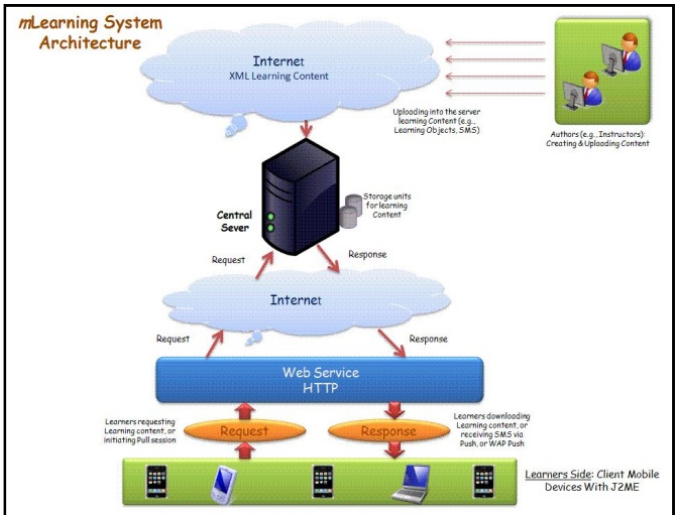

Fig. 1. *mLearn* Learning Environment

The prior study had proposed the design of an integrated high-level architecture for a mobile learning platform called *mLearn* that allowed the delivery of multimedia content over a HTTP protocol. Overall, the *mLearn* design suggested that the focused delivery and exchange of educational content would allow learning interaction at any time and at any place. Therefore, the *mLearn* platform would become an asset to active learners whether in an academic, government, business, or industrial setting.

The prior activities with *mLearn* lead naturally to the development phase, which is the subject of this work. The project team deployed *mLearn* to local telecommunications companies in Beta form. Full deployment of *mLearn* would occur only after extensive testing and after commercial and public acceptance of the product.

II. Pilot Results Using mLearn

A. Brief Project Background

In 2011, Qatar Petroleum (QP) and Qatar University (QU) agreed to collaborate on an m-learning project to take place during the first two quarters of 2012. During that time the project team has developed new m-learning content using *mLearn* for training purposes in the company's energy and industry sector. The curriculum developers from Qatar Petroleum's Corporate Training Department English Division worked with the m-learning content development team that satisfied (a) QU's academic requirements, and (b) actual training needs of the client; in this case a Shift Handover Log Entry Module for the trainees of QP and its affiliates.

The main target groups for this pilot were Qatari national trainees studying Technical and Further Education (TAFE) Certificate 3 at QP in preparation for their future careers as field operators and maintenance technicians in the energy industry. For these positions, it became essential that the operators and technicians write clear and accurate entries in the shift handover logbook to communicate with the next

shift; additionally, it was important to provide an accurate company record of shift activities. These trainees completed the "Operations and Maintenance Technical Report Writing Courses" before participating in the m-learning pilot so the m-learning application acted as consolidation training and a reinforcement of the guidelines for writing shift handover log entries.

In addition to trainees, the pilot also included QP employees and developers. The twenty-seven learners taking part in the pilot were from companies such as QP, RasGas, Shell GTL, Qatargas, and Oryx. The m-learning team conducted pilots in 2012 at the Dukhan Learning Centre (May 22), the QP Ras Laffan Training Centre (May 23), and the QP Ras Abu Aboud Training Centre (May 24). The one-hour pilot consisted of a one-hour pre-test (ten minutes), individual use of an m-learning application (forty minutes), a post-test (ten minutes) and an evaluation of the m-learning pilot under discussion. The exposition part in the m-learning application acted as the instructor; the learners only had guidance in ways to use the device and open the application. The exploration part followed the exposition and most learners finished the entire content in the time provided. Fig. 2 shows a typical learning session.

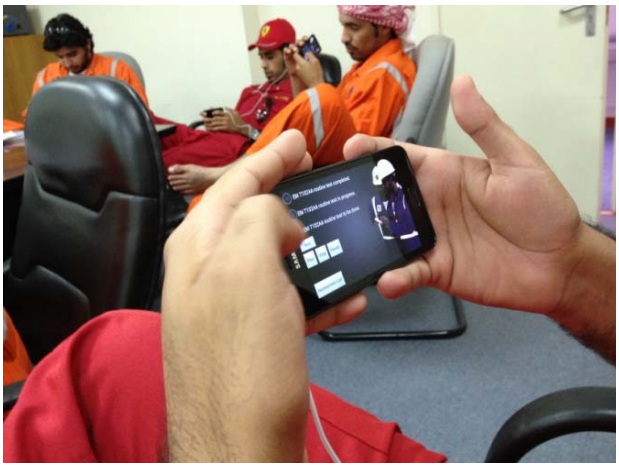

Fig. 2. Learners engaged in the *mLearn* project

B. *Test Results from the Pilot Sessions*

The results from the *mLearn* project generated some promising outcomes. Appendix A shows the results from the three pilot sessions conducted in May of 2012. In all except a few cases, the post-test results were greater than the pre-test results. Averages for all twenty-seven learners for the three pilot cases show that the pre-test results were 62.7%, the post-test results were 78.9%, and the net percent difference was +16.2%. Fig. 3 illustrates this outcome.

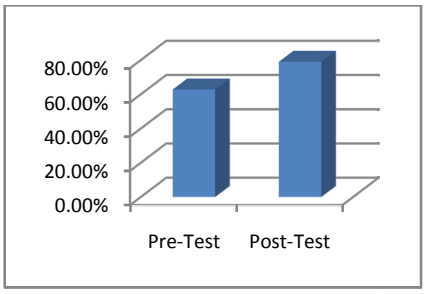

Fig. 3. Overall results from pilot studies

The learner feedback from the pilot studies was also encouraging. The evaluation questionnaire had eleven questions assembled in five (hardware, application lesson slides, assessment activities and overall) categories. The evaluation results appear in Table 1.

TABLE 1. EVALUATION RESULTS FROM PILOT STUDIES

#	Question	Results
1	How easy was it to use the Samsung Galaxy S II?	Extremely easy=71%, Very easy=6%, Somewhat easy=23%, Difficult=0%
2	Is it more convenient to have information and content in mobile phone or in books?	Mobile only=41%, Mostly mobile=41%, Mostly books=18%
3	How easy did you find the navigation through the mobile course?	Extremely=59%, Very=41%, Somewhat=0%
4	Did you find the Lesson Slides easy to understand?	Definitely=53%, Yes=41%, Somewhat=6%
5	Did the Lesson Slides help you to memorize the content?	Extremely helpful=53%, Quite helpful=41%, Somewhat helpful=6%, Not helpful=0%
6	Did you find the Assessment Activities easy to understand?	Definitely=53%, Yes=47%, Somewhat=0%
7	Did you find the Assessment Activities engaging, that is, did they hold your interest?	Definitely=47%, Yes=53%, Somewhat=0%
8	How did you find the overall quality of the presentation (fonts, audio)?	Excellent=41%, Good=41%, Fair=12%, Poor=6%
9	Do you feel that the m-Learning application helped you learn?	Definitely=50%, Yes=50%, A Little=0%
10	Would you take another mobile learning course if it were available and relevant to your learning needs?	Definitely=71%, Probably=29%, Maybe=0%
11	Would you recommend mobile learning as a method of study to others?	Definitely=53%, Yes=41%, Maybe=6%

A sample of learner comments from the questionnaires includes the following.

- *"In my opinion it's an excellent and interesting exercise for us. Thank you. It's a new idea."*
- *"I think students will be excited with this technology and they will learn very fast."*

- *"It was new to me, the first time to see mobile phones used as a method of learning about my job. The program was easy to use, to the point and excellent. I want/wish to see more companies that use this method."*

The development team reviewed and evaluated the project and suggested possible improvements for further work. The team concluded that the system was successful in pulling the learning objects from the server; these objects were successfully developed according to the chosen learning approaches. Additionally, after the application was able to pull the learning objects from the server, it was successful in downloading them on a mobile phone.

To reach its project goals, the team went through many phases. It started by studying current applications that relate to the project. It ran a qualitative analysis to ascertain missing attributes expected from those applications. The team then included many of those attributes in the project. For example, it suggested the inclusion of a forum in which the learner could speak and send a recording as a text message in the context of a forum; the project also allowed learners to interact with instructors and with fellow learners.

After the team went through the design, implementation, testing, and evaluation phases of the developed system, it sought to obtain a wider scope of project within the parameters of its goals. It then analyzed and attempted to elicit the functional requirements and constraints of a more advanced system. It followed the same approach it used to take the system from a descriptive environment to a functional one, based on the same methods and functions used such as android development tools, Java, a MySQL database server, and an apache web server. With this background, the team was able to recommend new features that could be developed, implemented, and added to the *mLearn* application in the future for increased performance.

The project team also suggested the exploration of applications useful in other industrial and educational fields. The design of *mLearn* was flexible enough to adapt to different real-world practices. Therefore, one could take the project to its maximum limit by adapting to applications conducive to other industries in addition to oil and gas. Furthermore, the project could expand to include additional communication components such as the use of a forum and sending e-mails, and incorporating SMSs. Such features would be beneficial to the overall learning experience and add to the enrichment of the project.

Additionally, the *mLearn* system currently supports pulling learning objects from the server to a mobile phone; these learning objects are already included on the server via the developer. However, if the tool allowed the capability for users to post the learning objects onto the server, this authoring mechanism would provide greater flexibility and better expandability for the system.

III. CONCLUSION

From classroom observations, from pre- and post-pilot test results, and from the responses the learners provided, it is evident that learning in the *mLearn* environment was useful and successful. The learners enjoyed the new format and they responded positively to the notifications they received after each task in the exploration activities.

As the learners had already completed the writing course before this pilot, the experience reinforced their technical writing style in shift handover logs through constructive and informative ranges of activities in the m-learning application. The results also show that follow-up modules are effective in promoting retention in language learning.

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APPENDIX A.

PILOT RESULTS USING MLEARN, 2012 MAY, QATAR

QP Ras Laffan				Dukhan Learning Center				Ras Abu Aboud			
Learner	**Pre-Test**	**Post-Test**	**Net % Diff.**	**Learner**	**Pre-Test**	**Post-Test**	**Net % Diff.**	**Learner**	**Pre-Test**	**Post-Test**	**Net % Diff.**
1	95%	95%	0%	1	55%	70%	+15%	1	40%	90%	+50%
2	70%	95%	+25%	2	70%	70%	0%	2	45%	60%	+15%
3	45%	85%	+40%	3	40%	70%	+30%	3	75%	80%	+5%
4	40%	65%	+25%	4	30%	60%	+30%	4	100%	95%	-5%
				5	70%	100%	+30%	5	75%	80%	+5%
				6	75%	65%	-10%	6	60%	75%	+15%
				7	80%	80%	0%	7	85%	95%	+5%
				8	70%	90%	+20%	8	75%	100%	+25%
				9	45%	50%	+5%	9	70%	70%	0%
				10	30%	50%	+20%	10	70%	95%	+25%
								11	75%	95%	+25%
								12	60%	40%	-20%
								13	75%	80%	+5%