Abstract

The diversity of mobile devices and their limitations have raised many challenges for the actual deployment of mobile learning across institutions. The main objective of this work is to present a solution that encourages institutions to adopt mobile learning as a tool to support the learning process. We present a generic framework for interoperability with existing VLEs that provides a compact and an easy to use implementation of their learning activities on Java enabled mobile devices. In this paper, we discuss the design and the prototype of the proposed interoperability framework. The results and the feedback of the prototype evaluation with tutors are reported. The reported results and comments cover the system’s usability and its value for both tutors and students.

1. Introduction

Besides the known limitations of mobile devices, many concerns are raised regarding the administration overhead and cost of operating a mobile learning environment [3]. These concerns stood as a barrier against large scale deployment of mobile learning. Thus, a mobile learning environment should make use of in hand technologies, target devices naturally owned by learners and deliver content that is of most use to learners [2, 3].

The above insights convey our motivation to build a framework that provides generic interoperability with existing Virtual Learning Environments (VLEs) to support learning. VLEs are widely used in educational institutions which encourages large scale use. We will start our discussion by a background of existing related work and the different techniques used to provide grounding for our approach. This is followed by a close look at the infrastructure of the system and how it works. A prototype of the system using Moodle as an example VLE is presented. Moodle is used because it is an open source VLE that is extensively used at the University of Glamorgan by foundation students. Finally, we will report on some interesting results of an evaluation carried out with 8 users from the University teaching staff.

2. Background

Most of the existing attempts to build mobile learning environments adopt server side solutions that target built-in internet browsers on the mobile device [9, 10]. These are server side techniques because they require almost no setup on the client side. The first technique used was to access the VLE directly from the built-in browser on a PDA [9]. Results of such technique showed a poor use of the system as it provides a limited view of an online learning system. Moreover, it assumes that students have PDAs or it obligates the institution to provide students with PDAs. Then an improvement to the above technique customizes the content using XSL and XSLT technologies. By using these technologies, the content display can be customized to a certain extent to suit different devices. Thus, XSLT and XSL were used to switch among several representations of XML on different devices according to a repository of profiles on the server [1, 9]. Again, this technique targets the built-in browser of a mobile device. This type of adaptation depends on predefined static profiles stored on the server side. Alternatively, WAP was used to provide a specialized learning experience for mobile learners [5]. However, WAP is known to be an expensive and a hard to use technology [2].

A client side approach uses intelligent agents on the device to retrieve content and customize it according to the hosting mobile device and learner profile [4]. This client side agent could be a specialized mobile learning application with special content tailored and stored on the target device [8]. This client side approach is capable of taking learner’s preference in consideration but with the disadvantage of extra processing on the mobile device and a smaller range of target users [5]. Proxies were often used as a mediator to customize content before delivered to a mobile client [10]. In this paper, we present a hybrid solution mixing client side and server side approaches to bring together their benefits.
3. The Interoperability Framework

A key challenge in our proposed system is producing a generic design for interoperability between VLEs and a wide range of mobile devices. The framework should be easily installed and maintained by institutions with minimal staff time and cost. These values have guided us to adopt the following guidelines in the framework design:

- Using a J2ME mobile client instead of the built-in mobile browser.
- Using web services to establish a communication channel between the client and the server side.
- Generating granular representations of learning content on the server side to suit the requirements of the wireless technologies.
- Providing the server full control over the content display and delivery to the mobile client.

3.1. Granular Generation of Content

Our granules represent meaningful encapsulations of information where their display, content and size can be adjusted through several control variables. These variables reflect granule sizes, order in the sequence of generated granules, multimedia content information, content display information. As shown in figure 1, there are two databases used by the system: the remote VLE database and the local database of the framework. The framework retrieves data directly from the target VLE database and encapsulates it into granules according to a set of control variables stored in the local database. The direct access to the VLE databases helps to avoid redundancy or inconsistency of information.

In this work, we focus on extending supplementary learning content published on the web and managed by VLEs rather than static or uploaded learning documents. Supplementary learning content or activities include news, grades, events, messages, assignments, workshops, quizzes, revisions, discussions, tips, lessons or any dynamic activity that requires interaction from a student. This type of learning could be very valuable on mobile devices. Moreover, it can be easily done on the move where a mobile device is always available, for example, while traveling or sitting outdoors on campus or anywhere where a desktop computer with an internet connection is not available.

3.2. J2ME

Almost all mobile devices come with a pre-installed java virtual machine which makes J2ME an attractive...
choice for development on mobile devices [7]. A lightweight Java application can provide a user-friendly interface while keeping the communication process compact and efficient. Meaning that, only required data is retrieved and it is displayed according to the control parameters encapsulated in the granules set on the server. As we have discussed, the client’s menu items, the type of content displayed and how it should be displayed is decided on the server side with values from the database. This gives the framework full control over the client from the server side. Moreover, it makes it easier to upgrade the client or change display of items or contents without any intervention from the mobile user.

3.3. Web Services

XML-RPC is used for communication between the mobile client and the server side of the mobile learning environment. The technologies used on the server side are Java, JSP/Servlets/Beans, Tomcat Engine 5.5, MySQL 5 database and Apache XML-RPC server. The server side of the system is easily hosted and maintained as a regular web application.

Using web services gives the user the freedom of using any of the mobile internet technologies. Moreover, it ensures system’s scalability and reusability by providing a standardized means of communication that could be extended by other clients in the future.

3. The Prototype

In the University of Glamorgan, foundation year students, who come from various disciplines, rely extensively on Moodle throughout their studies. There is one member of staff responsible for administrating Moodle; however, there are at least 10 tutors involved in each course and they interact with the students through Moodle. Even though, the prototype is interacting with Moodle, our design is scalable and it can be extended to support other commonly used VLEs.

4.1. Scenarios Using the Client

The MobiGlam J2ME client can be used by tutors or students. All users are required to login with their regular Moodle account information. The server side framework authenticates and recognizes the user. According to the user type and permissions, the server side provides different views and menu options to the client. As shown in figure 2a, the menu is showing the following functionalities: participants, preferences, chat, news, messages, grades and more activities.

The Participants functionality allows the user to find any participating tutor or student in the same course either by browsing or searching (see figure 2b). Users can add
participants to contact list, message them or see their profile. Additionally, tutors are allowed to view the grades of students through their profile. Managing a contact list and messages sent and received by each user is provided through the Messages functionality, which is also provided by Moodle (see figure 2c). Alternatively, Chat gives a very basic implementation of a live one-one chat between users who are online at the same time.

News provides the student with latest news posted for a specific course. Additionally, tutors can use the client to add more news which can be posted as SMS to all students in the course. Grades show the grade categories for each student in the selected course (see figure 3a). Also, the student is allowed to navigate further to view details of each grade category.

The Activities option in the main menu will take the user to more specific learning activities for this course like assignments, lessons, quizzes, workshops, forums and events. This view differs for each course according to the learning activities created by the tutor on Moodle (see figure 3b). Moreover, alerts can be scheduled for Events that are marked on the calendar of the course in Moodle.

Forums are an additional way of discussion among course participants beside messaging and chatting. Quizzes are currently the most interactive implementation we have of a learning activity because the student can fully take a quiz on the device as designed by the tutor on Moodle.

5. System Evaluation

An initial evaluation of the prototype was carried out with 8 participants. The participants were interviewed individually where they were asked some introductory questions to collect information about their background and to record their initial impression of the technology prior to using the system. Then, they were asked to go through the application and give feedback as they were using it.

5.1. Pre-Use Impression

Meanwhile, when asked if they would consider a mobile learning application in their teaching, all participants strongly agreed and showed enthusiasm to the idea giving the following reasons:

- It will be possible to access information anytime and anywhere.
- It is a self paced type of information access.
- Mobile technology is evolving rapidly and we should make the best use of it.
- Mobile technology is interesting and engaging for the students.

Since MobiGlam works on Java enabled devices, the participants were asked if they own a java enabled device and they all answered positively to this question. However, they were asked if they would be willing to download a java virtual machine to enable Java on their devices and they all answered positively to this question and two participants have given the following comments:

- It is common for an online application to require downloading a specific plug-in to be displayed and used properly, so why not do it for a mobile application.
- It is very easy nowadays to download applications and games on a mobile device.

5.2. General Performance

All participants gave a very positive feedback on the ease of use of the user interface. The following comments were given:

- The menu is very intuitive.
- The system is quite easy to use and it doesn’t require training, so, it will save money for organizations and it will encourage people to use it.
- One participant used a VLE on a PDA browser before and he reported that using this application is much easier and faster than using the browser to access the VLE.

Also, the following recommendations were given to further improve the navigation:

- Adding a Help option in main views to guide users if needed.
- Adding an option to allow the user to go to the main view from anywhere in the application.
- Adding small icons and images to improve the look of the application.

Regarding connectivity used in testing, two participants reported that they prefer to use GPRS as Wi-fi is unstable sometimes and it could be very frustrating to get disconnected all the time. An interesting point raised by one of the participants was that, she doesn’t expect to have that fast response from this new technology and she doesn’t mind to have a slower response from GPRS but with guaranteed stable connection. General comments on the performance were:

- The application is very compact and fast.
- Everything you need is there.

5.3. The Value of Functionalities

The participants were asked about the most beneficial and the least beneficial functionality offered by MobiGlam. Quizzes, SMS notifications, SMS messaging, local scheduled alerts for deadlines and News were
identified as the most beneficial functionalities. Two participants specifically liked quizzes reporting that students usually forget about doing the quizzes and it is easy to do on the move.

The participants suggested the following improvements to the existing functionalities:

- Including a link in grades where the student can see tutor assessment and tutor comment on the work submitted.
- Creating groups in contacts so that a tutor can send one message and it goes to a certain group.
- Allow uploading images or small sized files in assignments.
- Allow the scheduling of alerts in an earlier date than the deadline as specified by the user.

All the participants strongly agreed that MobiGlam is a good complement to a VLE and can be useful in supporting the learning process in the university. They gave the following reasons:

- It provides an instant way of communication which is very helpful, as it is difficult to reach students sometimes for urgent matters, especially that the majority of students don’t check their emails regularly.
- It is useful to find out about tasks, deadlines, and exam times from one’s mobile phone.
- It promotes collaboration and interaction among students and tutors.
- It helps students manage their time and keep track of their deadlines.
- It is more interesting to use than the online system.

Finally, the following general concerns were raised about the application:

- Students will use the system in non-educational communication most of the time.
- Lots of scrolling is required to read text on the small screen device.

6. Summary

Thinking large scale deployment requires us to consider the following issues: cost, resources, stability, reliability, monitoring and evaluation, staff and student attitude towards the system [6]. In this paper, we have presented a new approach towards large scale deployment of mobile learning through generic interoperability with VLEs to extend their functionalities to a J2ME browser. Interoperability with existing VLEs guarantees the availability of resources without any need for redundancy or authoring of specialized content. Our client is server driven which facilitates maintenance, monitoring and evaluation of both the client and the server side application. Moreover, using J2ME widens the range of target mobile devices to include any java enabled phone.

Building a designated client on the mobile helps in providing our users with a friendly interface to promote its functionalities into their everyday learning and teaching.

Finally, we have reported on the results of an evaluation conducted with tutors and lecturers regarding the performance of the application on the mobile device and the value of the functionalities provided. The results of the evaluation are very positive and encouraging with very constructive feedback about enhancing the use of the system. However, the obvious concern of limited display and capabilities of mobile devices raises the need to enhance the mobile browser to achieve the following:

- Personalization for learners.
- Adaptation to devices with different capabilities.

7. References


