A New Mobile Learning Adaptation Model

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Abstract—This paper introduces a new model for m-Learning context adaptation due to the need of utilizing mobile technology in education. Mobile learning; m-Learning for short; in considered to be one of the hottest topics in the educational community, many researches had been done to conceptualize this new form of learning. We are presenting a promising design for a model to adapt the learning content in mobile learning applications in order to match the learner context, preferences and the educational objectives. Moreover, the proposed model will support the student learning context which is a result of the mobility of m-learning scenarios such as user location, movement, duration of stay, noise level and availability of resources. Our model covers mainly context dimension, user dimension, device dimension, and connectivity dimension.

Index terms—m-Learning, Mobile learning content, Adaptation, computer based training (CBT).

I. INTRODUCTION

The last four decades added a great enhancement to the learning process through introducing a new medium to interact and communicate between the learners and the tutors. In the seventies, distance learning (d-learning) began to include audio and video [16]. In the late eighties computer based training (CBT) came out to support the learning process by using computers and some special designed programs that use video, audio, and computer graphics [16]. In the late nineties, where the new technology of the internet started to be used worldwide, there was emergence of the e-learning to describe a new way of managing the learning process and delivering the learning materials via Internet. In the past few years e-learning has grown very fast, and many universities and organizations adopted such form of learning [19]. Now, with the speedy of mobile technology it seems e-learning is getting ready to make another shift to the era of mobile learning [4]. Many mobile devices combine telephone, wireless internet connection and many of the personal computer capabilities. These devices can enhance the teaching technique and help the educational community to achieve the idea of learning anytime and anywhere [5].

E-Learning can be defined as the utilization of internet, intranet, software, and any other e-media to combine the power of all the new technologies in order to enhance the learning process. E-Learning introduces a different way of learning that can help students in many ways [19]. Students can access a large amount of information, study in their self-base, be more confident, communicate with fellow classmates, and they will be released from the traditional classrooms’ stress. However, e-learning is not intended to replace the class room learning. It could be used alone or in conjunction with more than one traditional learning methods; in this case the term blended learning is used [14].

E-Learning platform provides several services. Some of these services are common and have grown since computers were first used in education, the other services can vary from one platform to another. One of the most important services for any e-learning platform is the learning content and content presentation.

E-Learning content is a digital content that is used by tutors to present the teaching materials to students. Much effort has been devoted for the reuse of the teaching material, and the result was introducing the term Learning Objects (LO) [15], which are defined as “Any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning.” [17]. E-learning content has a lifecycle which includes a number of phases. The content pass through these phases before the learner can interact with it. Each phase has a specific purpose that enhances the learning content in some way. E-Learning lifecycle content includes analysis, design, authoring, assembly, transport, storage, delivery, interaction and monitoring [13].

Mobile learning; m-learning for short; has many definitions revolve in how people can learn or stay connected with their learning environments that include their classmates, instructors and instructional resources through mobile devices [18]. M-Learning had been added to the online learning category, which mean a new supporting technique for the education. "Formal Learning now can be broadly divided into three categories based on the context of occurrence-Regular Class room learning, distance learning and online learning [16]. Distance learning can be within a class room environment or with online access and it can be a combination of both. On the other hand, online learning can include e-learning and mobile learning as shown in figure 1" [6].

The significant developments in mobile technology and the new mobile devices that can deliver web or internet-based learning materials led to a natural flowering of e-learning to mobile learning [6]. There is a large similarity between e-learning and mobile learning. E-Learning can be defined as learning supported by digital "electronic" tools and media. Milrad defined m-Learning as "e-Learning that uses mobile devices and wireless transmission [5]. It's clear that mobile learning is a subset of e-learning [16]. M-learning extends the benefits of e-learning (e.g. access to information, learning anytime anywhere) to a much wider range of teaching and learning contexts. With mobile learning, students get a new degree of freedom; they can choose when and how they want to consume learning contents [7]. However, just as the relationship between e-Learning and the traditional learning methods, mobile learning can not replace the traditional
classrooms. Mobile learning is a supported teaching technique that can be presented with conjunction of other teaching methods.

Generally, mobile learning should include tools that enable learners to access the learning content that can be stored on mobile device or can be accessed via internet [1]. Learning materials were developed in large sections which may not be appropriate for m-learning. Many guidelines have been proposed to help in reorganizing learning content to fit the limitation of the small devices [4]. There is a common agreement that mobile content must be designed in the form of learning objects or granules to allow for the reusability and flexibility in learning materials development and delivery [13]. m-Learning content must contain visually information and effective graphical strategies that can help the student in learning via small screens by reducing the amount of reading required. Moreover, the mobility of m-learning scenarios defines a new relation between the learning and the student context [12]. This relationship should be taken into consideration when designing the mobile learning content. Mobile learning content must be developed to support the students in any context [2]. Also, mobile learning must be able to support different learning styles in different ways and motivate the students who may lose their motivation because of being far from the traditional class rooms.

A. Statement of Problem

There are many problems and issues should be taken in the consideration when we want to relocate services that are provided by an e-learning platform into services provided in a mobile learning platform. One of the most important issues is the content design. Most of today's e-learning content has been designed for larger screens, 15 inch or more, how could this content be squeezed in a way that fit the mobile devices screen and doesn't limit the student interaction with the content. Moreover, the mobile learning has its interesting aspect from the idea of learning any time anywhere, and in the own student base. But on the other hand this aspect inherits a problem that was described in [8] and to recognize the essential role of mobility and communication in the process of learning. In this research paper we introduce a model to design the mobile learning content in a way that match the user's preferences and context.

B. Related Work

Many researchers [9, 10] introduced new approaches for adapting content in a mobile environment. One approach suggested adapting the delivery of small chunks of complementary learning content to mobile devices using Bayesian belief networks as shown in figure 2. The authors categorize these variables into four main categories: device limitations, connectivity, learner's profile, and content types [3].

A tree organization for the learning objects has been presented in [10], where each object in the tree have a certain goal (level) and specific features which are compared with the learner's contexts and preference. The sequence of objects is dynamically changed according to the learner contexts and preference. This model enables the learner to participate in customizing his own course.

TABLE I. DEVICE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Device</th>
<th>Resolution and screen size</th>
<th>Operating System</th>
<th>Data entry</th>
<th>Browser</th>
<th>Wireless capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm Tungsten T</td>
<td>XGA 100 resolution 2.5&quot; display</td>
<td>Palm OS 5.0</td>
<td>Touch-sensitive Graffiti writing</td>
<td>None</td>
<td>Bluetooth</td>
</tr>
<tr>
<td>HP iPAQ hx5700</td>
<td>640 x 480 resolution 4&quot; display</td>
<td>Windows Mobile 2003</td>
<td>Soft on screen keyboard</td>
<td>Pocket Internet Explorer</td>
<td>Wi-Fi, Bluetooth</td>
</tr>
<tr>
<td>Dell Axim X5</td>
<td>240x320</td>
<td>Windows Mobile 2003</td>
<td>Touch slide-out qwerty keyboard</td>
<td>Mobile Internet Explorer</td>
<td>Wi-Fi, Bluetooth, GPRS</td>
</tr>
<tr>
<td>Sony Ericsson V600</td>
<td>176x208 resolution 1.9&quot; display</td>
<td>Sony Ericsson</td>
<td>Multi touch keyboard</td>
<td>Opera Mobile WebKit, GPRS</td>
<td></td>
</tr>
</tbody>
</table>

1. Screen size
2. Text Presentation
3. Media Presentation
4. Connectivity
5. Test
6. Keyboard
7. Media
8. CPU speed
9. Interactive Media
10. Interactive Text
11. Audacity Level
12. Time of Year
13. Acceptable content
14. AS

Figure 2. A potential model showing dependences among adaptation attributes. Shaded nodes are decision nodes and un shaded ones are evidence nodes. Dotted lines represent possible variations.

The reusability of existing learning content has been proved to be an efficient way for universities to provide students with mobile learning services. An example on how we can get benefit from an existing e-learning content is presented in [7]. It proposed a practicable and easy to use procedure to facilitate traditional e-learning content to users of mobile. Callum and Kinshuk [11] presented a case study on the functionalities and capabilities of different devices as shown in Table 1. It aims to create an awareness of the actual difficulties that are inherited when
interacting via mobile devices with discussion forums and other utilities due to technological functionality limitations.

II. THE PROPOSED MODEL

The evolution of information and communication technologies in the last three decades has had an impact in all aspects of human activities. Learning has also been subject of these changes. Current research efforts in the field of mobile learning have been in many cases guided by a learner-centered approach. Context and content adaptivity are crucial components in mobile learning environments. One important challenge is how to design and implement technological tools and methods to support them. In order to tackle this challenge, learners' context should be defined. In this paper, we describe our current efforts regarding how to model context in mobile learning activities. We introduce an environment dependent context model based on four dimensions context that can be used to design and support context in mobile learning environments.

The model will reallocate the e-learning content into wide range of mobile devices; also it will support the mobility of the learner by taking into consideration the learner's context. Our model will base on the guidelines that were introduced in [10]. As shown in figure 3, the author organized the course as a sequence of objects in a tree form. Each object in the tree has a certain goal (level) and specific features.

The learner will sit his contexts as well as his preference. The sequence of objects is determined based on the object's attributes and the learner's contexts. The sequence of objects can be changed dynamically, according to the changes in the user context.

The user context and preferences are not the only issues that should be taken into consideration when designing mobile learning content. The device limitation and the connectivity also play major role in designing mobile learning content. In addition, it is not enough to only change the sequence of objects to fit the different scenarios of mobile learning.

Based on the above statement, content presentation should be changed as well as the sequence of objects. Several dimensions of adaptations need to be considered as shown in Fig. 4. In this new model, we are building a flow diagram to produce a mobile learning context based on a set of dimensions, each dimension has several factors. Our model will consider each factor in order to make the context adequate to the limitations of mobile functionalities and also to present the content in the adapted m-learning platform. We introduce a multidimensional model that consists of the context dimension, the user context dimension, mobile devices dimension and connectivity dimension as shown in figure 4. Figure 3 and figure 4 show the objects structure and the model of M-learning.

Figure 3. Objects structure

Figure 4. The model of M-learning
A NEW MOBILE LEARNING ADAPTATION MODEL

We have introduced a new model for m-learning context adaptation. This model is intended to adapt the learning content in mobile learning applications in order to match the learner context, preferences and the educational objectives. Furthermore, our model will support the student learning mobility and the change in the user context. The presented m-learning model describes several dimensions where each dimension contains several context related to specific specialization. These contexts reflect specific factors in each dimension. Our future work will investigate more in the role and specification of each factor and its effect of the flow process of our model. Also we will compare our model with other comparative research work to produce statistical result.

REFERENCES


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