Mobile Learning Environments

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INTRODUCTION

Mobile learning requires a methodology for creating mobile learning scenarios and producing learning objects to implement them. It also requires a technology to deliver the learning objects to users via mobile computing devices such as personal digital assistants, smart phones, and tablet computers. This article will describe both the pedagogic methodology and the technology using the European research project *MOBIlearn* as an example.

A key part of the MOBIlearn project is the integration of new technologies in education. It aims at improving access to knowledge for selected target users, giving them ubiquitous access to appropriate learning objects (Taylor, 2003). "The MOBIlearn project intends to develop software that supports the use of mobile devices (smart phones, PDAs, Tablet PCs and laptops with wireless network connection) for various learning scenarios, including non-institutional learning" (MOBIlearn, 2005). The aim of MOBIlearn is therefore "… the creation of a virtual network for the diffusion of knowledge and learning via a mobile environment … to … demonstrate the convergence and merging of learning supported by new technology, knowledge management, and new forms of mobile communication" (MOBILearn, 2002, Annex 1, p. 7).

The pedagogic aim of the system is to provide users with the ability to engage in formal, non-formal, and informal learning in a personal collaborative virtual learning environment. To this end, three scenarios were used as the basis of developing the requirements for the system. These were a formal university course and a related orientation activity, a non-formal health care scenario, and an informal scenario based around museums and galleries. The requirements of the system were captured from three user-developed scenarios. A use case model was produced for each of these scenarios plus a fourth model describing generic or common requirements. These requirements were further documented for the technical developers in a database based on a Volere template (Robertson & Robertson, 2001).

The philosophy behind the MOBIlearn system is that it provides a set of interoperable services. Services should be able to communicate asynchronously using unstable communication channels (MOBIlearn, 2005). At the center of the system is the component providing the portal services including the main portal. This represents the single access point for the user to all the services provided by the MOBIlearn system.

One of the challenges of creating a mobile learning environment that spanned more than one domain was extracting generic requirements applicable to all domains. A corollary to this was identifying requirements that were specific to a domain.

Scenarios

Initially the MOBIlearn requirements were provided by three scenarios:

1. A visit to an art gallery.
2. Access to training and basic medical knowledge in a hospital.
3. Master's in business administration.

Development of these scenarios was essential for deriving both user and technical requirements.

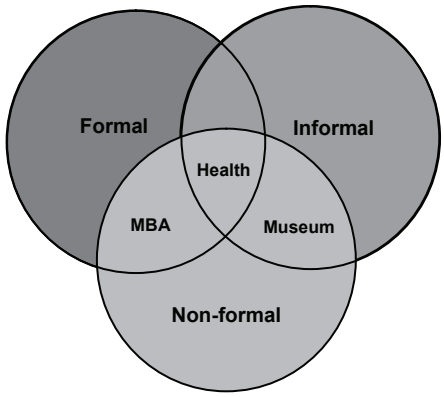
In the MOBIlearn project a series of distributed development teams were established with specific roles or workpackages. One of these workpackages involved the development of requirement specifications to be used by the technical workpackage teams.

Initially these requirements were derived from the user scenarios listed above using the use cases alone, one set for each scenario. The next stage was to amalgamate these into a single specification which could then be handed on to the software developers for the final system. The technical teams then developed a series of services which were required to implement the use cases.

MOBIlearn Pedagogic Design

The pedagogic basis of the system is the learner who interacts with the mobile learning portal to access learning objects and participate in online activities. MOBIlearn provides a tool to facilitate collaboration and teamwork. It expands on systems such as OTIS (Occupational Therapy Internet School) (Beer, Slack, & Armitt, 2005) to provide a framework that can be

Figure 1. Types of learning and their relationship to the scenarios



used in variety of learning situations. It also allows a variety of learning styles.

Learners today want to learn when and where they want, in formal, non-formal, and informal ways (Brand, Petrak, & Zitterbart, 2002; Cook & Smith, 2004).

The types of learning are characterized by the following attributes:

- **Formal**
  - Mandatory participation
  - Objectives and means controlled by educator
- **Non-Formal**
  - Voluntary participation
  - Objectives controlled by learners
  - Means controlled by educator
- **Informal**
  - Grows out of spontaneous situations
  - Objectives and means controlled by learners
  - There may be a facilitator who may provide some content

The second feature of the environment is that it facilitates communities of learners. In the case of the museum scenarios, the learners are operating in an informal environment motivated by their own interests (Cook & Smith, 2004). The methodology gives them the ability to join a virtual community with interests like their own. The learner is under no obligation to formally join (or leave) the community and can participate as much or as little as he or she wishes. This particular scenario has many features in common with the Virtual Museum of Canada (Soren, 2005), but is also designed to be used in a real museum (the Uffizi Gallery in Florence, Italy, being a test site) to give a richer experience than the traditional audio guides.

The health care scenario on the other hand is a non-formal learning environment where a *community of practice* (CoP) is being established. The system is designed to deliver training case studies where a learner assesses a situation and suggests a course of action. This can then be discussed with other learners who will have different levels of experience. Learning has no start or end point, and new members can join (and leave) at any time; however, it may be a condition of employment that staff engage with this continuing development. New case studies can be added, including ones suggested by the learners. This does contradict some of Ellis, Oldridge, and Vasconcelos's (2003) criteria for a community of practice, specifically a voluntary and emergent group. However, if staff engages with the learning environment, a virtual community of practice could develop, meeting other criteria including a mutual source of gain.

Finally there is the MBA scenario, which is based in formal learning where students use the system to access resources, undertake tasks, and discuss topics with fellow students and academics. There is immersion and presence in the online learning environment. This encourages students to build trust and teamwork (Beer et al., 2005). The environment is more constrained and there is a specific enrolment and end point. Although it is theoretically possible to start and end a course at any time, this does not yet happen.

There are features that are common to all three scenarios, for example, there will be some base content. In the case of the museums, this will be information about exhibitions and within that, information about specific exhibits. In the case of health care, there are a series of reference *oblettes* (learning objects) relating to various diseases and situations. For the MBA, there are formal course materials. All scenarios have discussion areas or forums allowing collaborative learning and providing for the foundations for a community of learning and practice to be built.

Development

The development methodology for MOBIlearn was a combination of the *service-oriented approach* (SOA) and prototyping loosely based on Boehm et al.'s (1998) spiral model. Modeling was done using the use-case modeling tool of UML (Rumbaugh, Jacobson, & Booch, 1999). Initially a use case model was produced for each of the scenarios. These were examined for commonality, and a common or generic use case diagram was produced mapping user requirements used in all scenarios (see Figure 2). For each of the use cases, a detailed description was produced based on the template suggested by Cockburn (1998) (see Figure 3).

The use case diagrams were then cross-referenced in the requirements database, which was based on Volere shells (Robertson & Robertson, 2001) (see Figure 4). The database was then passed on to the development teams who grouped requirements according to their functional similarity. This became the basis of the service-oriented architecture described as follows.