

Chapter 10

Design and Implementation of Multiplatform Mobile–Learning Environment as an Extension of SCORM 2004 Specifications

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ABSTRACT

A learner-adaptive self-learning environment has been developed in which both mobile phones and personal computers can be used as client terminals. The learner-adaptive function has been implemented using SCORM 2004 specifications. The specifications were extended to enable offline learning using mobile phones. Because the application-programming environment of mobile phones varies from carrier to carrier, a common content format was specified for the learning content and content-execution mechanisms were developed for each carrier's environment to maximize content-platform interoperability. The latest learning results achieved by using mobile phones were synchronized with the latest ones on the server-side sequencing engine so that the learner-adaptive function was available from personal computers as well. The system can provide adaptive courses such that the results of a pre-test taken on mobile phones can modify the lecture content on personal computers, fitting them to each learner's level of knowledge and understanding. The functionality and usability of the system was evaluated through two trial experiments, the first of which involved adult learners and the second with small children and their parents.

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INTRODUCTION

Mobile learning is becoming increasingly popular due to the rapid growth in the use of personal mobile devices and wireless networks (Leuhn & Chan, 2003). There are three main types of mobile learning:

- Distribution of learning materials, such as test questions, to mobile terminals (Thornton & Houser, 2004),
- Utilization of mobile devices for mentoring and scaffolding purposes (Stone, 2004; Wang et al., 2003), and
- Collaborative learning in a wireless environment (Cortez et al., 2004; Ogata & Yano, 2004).

Although personal digital assistants (PDA) are available (Shih et al., 2005) that have functionality as rich as that of personal computers, mobile phones are more popular as easy-to-use mobile terminals equipped with both voice-communication and Internet functions (Thornton & Houser, 2004).

This chapter discusses a self-learning environment in which mobile phones and personal computers are used to complement each other (Nakabayashi et al., 2007a; Nakabayashi et al., 2007b). The design goals of the system were:

1. To provide a standard-based mobile-learning infrastructure independent of device characteristics (often differing from mobile phone to mobile phone or from carrier to carrier) exploiting existing e-learning standards (Fallon & Brown, 2003; Nakabayashi, 2004),
2. To enable offline learning using mobile phones,
3. To implement learner-adaptive functionality with which learning materials and the learner's status are shared from mobile phones and personal computers and his/

her status is reflected in the next learning activity from both environments, and

4. To exploit the advanced facilities of mobile phones such as cameras or contactless smart-card readers.

To achieve these goals, the system we developed uses a Sharable Content Object Reference Model (SCORM 2004, Advanced Distributed Learning Initiative, 2006) compliant learning management system (LMS) (Nakabayashi et al., 2006), content browsers, and a SCORM 2004 sequencing engine on mobile phones; there are protocol transformation servers between the LMS and the mobile phones. The content browser on the mobile phones is capable of displaying downloaded content offline. The SCORM 2004 sequencing engine on the mobile phones enables learner-adaptive functionality during offline learning. The learner's learning results on the browser are later sent to a protocol transformation server, which modifies the data format so that it is compliant with SCORM 2004 learner-tracking information. It is then forwarded to the SCORM 2004 compliant LMS. The LMS manages the tracking information on both mobile phones and personal computers. Based on the tracking information, the next learning activity is selected adaptively by the SCORM 2004's sequencing functionality. The learning-material format has partly been extended from the SCORM 2004 specifications to support mobile learning.

We bore several educational settings in mind in designing the system. The main educational setting was conventional self-learning where learners take a pre-test or post-test to check their knowledge on a certain subject using mobile phones while commuting on trains or buses. They then later use a PC-based environment in their offices or homes to strengthen their knowledge with the new content possibly tailored based on their previous test results. Another educational setting is that utilizing input devices for mobile phones to provide an "authentic" or "situated"

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