ORIGINAL ARTICLE

Context-aware adaptive and personalized mobile learning delivery supported by UoLmP

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Abstract   Over the last decade, several research initiatives have investigated the potentials of the educational paradigm shift from the traditional one-size-fits-all teaching approaches to adaptive and personalized learning. On the other hand, mobile devices are recognized as an emerging technology to facilitate teaching and learning strategies that exploit individual learners' context. This has led to an increased interest on context-aware adaptive and personalized mobile learning systems aiming to provide learning experiences delivered via mobile devices and tailored to learner's personal characteristics and situation. To this end, in this paper we present a context-aware adaptive and personalized mobile learning system, namely the Units of Learning mobile Player (UoLmP), which aims to support semi-automatic adaptation of learning activities, that is: (a) adaptations to the interconnection of the learning activities (namely, the learning flow) and (b) adaptations to the educational resources, tools and services that support the learning activities. Initial evaluation results from the use of UoLmP provide evidence that UoLmP can successfully adapt the learning flow of an educational scenario and the delivery of educational resources, tools and services that support the learning activities. Finally, these adaptations can facilitate students to complete successfully the learning activities of an educational scenario.

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1. Introduction

Over the last decade there is a growing interest on adaptive and personalized learning by many researchers in Technology-enhanced Learning (TeL) (Martins et al., 2008; Brusilovsky and Millán, 2007). This has led to several research initiatives world-wide that investigate the potential of the educational paradigm shift from the traditional one-size-fits-all teaching approaches to adaptive and personalized learning (Tseng et al., 2008; Brusilovsky and Henze, 2007). The key benefits of this approach are that learners are provided with adaptive

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and personalized learning experiences that are tailored to their particular educational needs and personal characteristics toward maximizing their satisfaction, learning speed and learning effectiveness.

Moreover, the widespread ownership of mobile devices and the growth of mobile communications industry has provided a number of services such as instant interpersonal and group communication, location-aware information delivery and personalized assistance based on users' preferences and needs, as well as ubiquitous communication and interaction with smart devices and objects (Mascolo, 2010; Satyanarayanan, 2010).

Mobile devices are recognized as an emerging technology with the potential to facilitate teaching and learning strategies that exploit individual learners' context (Jeng et al., 2010). More precisely, mobile devices can (a) engage students in experiential and situated learning without place, time and device restrictions, (b) enable students to continue learning activities, initiated inside the traditional classroom, outside the classroom through their constant and contextual interaction and communication with their classmates and/or their tutors, (c) support on-demand access to educational resources regardless of students' commitments, (d) allow for new skills or knowledge to be immediately applied and (e) extend traditional teacher-led classroom scenario with informal learning activities performed outside the classroom.

This has led to an increased interest on context-aware adaptive and personalized mobile learning systems that aim to provide learning experiences delivered via mobile devices and tailored to the educational needs, the personal characteristics and the particular circumstances of the individual learner or a group of interconnected learners (Liu and Hwang, 2009; Hwang et al., 2008). The key benefits of these systems are that: (a) learners are provided with personalized learning experiences in real-world situations and (b) learners' behavior is detected and recorded for providing them with adaptive feedback and support (scaffolding).

Within this context, in previous work reported in Gómez et al. (2012) we aimed to address delivering context-aware adaptive and personalized mobile learning by proposing a mobile system for delivering context-aware pedagogical strategy-enhanced educational scenarios via mobile devices.

In this paper, we present initial evaluation results from the use of this system, namely Units of Learning mobile Player (UoLmP), by delivering a context-aware and adaptive educational scenario. The evaluation results provide evidence that UoLmP can successfully adapt the learning flow of the educational scenario, as well as the educational resources and the delivery of the tools and services that support the learning activities of the educational scenario.

2. Background

Mobile learning has been defined as: the process of learning and teaching that occurs with the use of mobile devices providing flexible on-demand access (without time and device constraints) to educational resources, experts, peers and services from any place (Sharples and Roschelle, 2010; Traxler, 2009).

The main benefits of mobile learning for education and learning are reported as follows (Satyanarayanan, 2010; Lam et al., 2010): (a) enables on-demand access to learning resources and services, as well as instant delivery of notifications and reminders, (b) offers new opportunities for learning that

extend beyond the traditional teacher-led classroom-based activities, (c) encourage learners to participate more actively in the learning process by engaging them to authentic and situated learning embedded in real-life context and (d) supports on-demand access, communication and exchange of knowledge with experts, peers and communities of practice.

Adaptivity and personalization in mobile learning systems refer to the process of enabling the system to fit its behavior and functionalities to the educational needs (such as learning goals and interests), the personal characteristics (such as learning styles and different prior knowledge) and the particular circumstances (such as the current location and movements in the environment) of the individual learner or the group of interconnected learners (Wu et al., 2008). Adaptivity deals with taking learners' situation, educational needs and personal characteristics into consideration in generating appropriately designed learning experiences, whereas personalization is a more general term and deals with the customization of the system features, including also issues which can be adapted and specified by learners themselves, such as the system interface, the preferred language, or other issues which make the system more personal (Martin and Carro, 2009). As a result, there are two main issues in the design of context-aware adaptive and personalized mobile learning systems, namely, the learner's contextual information that influence adaptations, and the type of adaptations that can be performed based on retrieved learner's contextual information (Graf and Kinshuk, 2008).

2.1. Learner's contextual information

There are a number of research works that attempt to model learners' contextual information during the learning process (Das et al., 2010; Economides, 2009; Hong and Cho, 2008). A commonly used definition of context in computer science is: "any information that can be used to characterize the situation of an entity" (Dey, 2001), where the term "entity" is defined as anything relevant (namely, a person, a place or an object) participating in the interaction between a user and a system, and the term "information" is defined as any particular element or detailed piece of data that allows for the description of any condition or state of the participating entities (Dey, 2001). In the field of TeL, context has been defined as: "the current situation of a person related to a learning activity" (Luckin, 2010).

In previous works as reported in Zervas et al. (2011), existing efforts have been studied for modeling learner's contextual information in mobile learning systems and a context model has been considered, which can be used in mobile learning systems for personalization and adaptation. More specifically, this context model has been developed based on previous work by Siadaty et al. (2008), who considered that context can be divided into (a) the learning context and (b) the mobile context. The learning context is defined by the learners, the educational resources, the learning activities and the specific pedagogical strategy, whereas the mobile context is defined by the learning context captured with regard to its delivery medium (i.e. the mobile devices). Christopoulou (2008) has proposed to model mobile context according to five (5) dimensions, namely user temporal information, place, artifact, time and physical conditions. Our context model combines and further elaborates the dimensions and their specific elements of both categories (i.e.,