Chapter 4
Towards a Small-Scale Model for Ubiquitous Learning

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ABSTRACT

The ever-increasing use of mobile devices allied to the widespread adoption of wireless network technology has greatly stimulated mobile and ubiquitous computing research. The adoption of mobile technology enables improvement to several application areas, such as education. New pedagogical opportunities can be created through the use of location systems and context-aware computing technology to track each learner's location and customize his/her learning process. In this chapter, the authors discuss a ubiquitous learning model called LOCAL (Location and Context Aware Learning). LOCAL was created to explore those aforementioned pedagogical opportunities, leveraging location technology and context management in order to support ubiquitous learning and facilitate collaboration among learners. This model was conceived for small-scale learning spaces, but can be extended in order to be applied to a large-scale environment. Initial results were obtained in a real scenario, attesting the viability of the approach.

INTRODUCTION

In recent years, there has been a continued research effort in the field of mobility in distributed computer systems. This is mainly due the widespread availability of portable electronic devices (such as mobile phones, handheld computers and netbooks) and of interconnection technologies based on wireless communication (like bluetooth and Wi-Fi). This mobile and distributed paradigm is called *Mobile Computing* (Satyanarayanan, 1996; Satyanarayanan et al., 2009; Diaz, Merino & Rivas, 2009). Moreover, the diffusion of wireless communication technologies enables mobile devices to provide computational services in specific contexts (*Context-aware Computing* (Abowd, et

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al., 1999; Baldauf, Dustdar & Rosenberg, 2007; Hoareau & Satoh, 2009)). Adaptation related research brought the possibility of continuous computational support, anytime, anywhere (*Ubiquitous Computing* (Satyanarayanan, 2001; Weiser, 1991)). In turn, *Location Systems* (Hightower & Borriello, 2001) are enabling the use of this kind of computing in accordance with the physical location of users.

Location, as was shown by Hightower and Gaetano (2001), is an important topic related to mobile and ubiquitous computing. Hightower, LaMarca and Smith (2006) demonstrate that the precision obtainable in today's location methods (such as A-GPS and cellphone antenna triangulation) already allows for the implementation of commercial applications. Moreover, the widespread adoption of wireless hotspots suggests that in the near future this precision will only grow, giving way to *Location Based Services* (Vaughan-Nichols, 2009; Dey et al., 2010).

Based on today's technology, we can imagine a scenario where society would be permeated by mobile devices, always connected to a communication network, and with precise location data always available. The data would be used in order to provide customized services, depending on the physical location, context and the needs of each particular application. In this scenario, ubiquitous computing would be greatly stimulated, as precise location methods would always be available. This will cause a significant impact in education (*Ubiquitous Learning* (Barbosa et al., 2006; Ogata & Yano, 2009)).

To take advantage of ubiquitous computing, a new educational model should finally arise. This model should allow the construction of learning programs related to dynamic information obtainable from the learners' own physical context, establishing links between contexts and pedagogical goals and resources. This will be a key element to facilitate collaboration among learners with related interests. Towards this scenario, several approaches are being researched, like (Ogata & Yano, 2009; Barbosa, Geyer & Barbosa, 2005; Yau et al., 2003).

In 2002, a university at south of Brazil called Unisinos has proposed a new pedagogical approach to undergraduate courses. This approach is called *Undergraduate Course of Reference* (nicknamed *GRefe*) (Barbosa et al., 2007). GRefes are based on: (1) Learning Programs: a new kind of academic structure oriented to stimulate the integration between thematic course areas; (2) Learning Projects: long duration activities used to amalgamate the knowledge created in the different thematic areas. The GRefes form a strongly-tied, interdisciplinary community where both teachers and learners are encouraged to use the mobile computing infrastructure in their daily activities. We are always seeking for new ways to better explore this infrastructure in the pedagogical processes. As such, the *Mobile Computing Lab* (nicknamed *MobiLab*) at Unisinos has been working on research topics related to the area of ubiquitous computing. One of our main goals was to investigate how mobile devices and location technology could be used to improve learning processes. The high point of this work was the creation of a mobile and ubiquitous learning model powered by mobile computing and location technology, capable of customizing learning and teaching processes by employing contextual information obtained from the environment. This model is called LOCAL (*Location and Context Aware Learning*), and is being tested at our university to support ubiquitous learning. In this sense, we hope to explore pedagogical opportunities through a new technological configuration and a model fine-tuned to support the specific necessities of ubiquitous learning environments.

The chapter is organized in four sections. The second section presents previous work in the area of mobile technology used to create and/or identify pedagogical applications, and how it relates to our work. The third approaches the LOCAL model. The next section shows preliminary test results involving the application of LOCAL in