Chapter 9
Collaborative Learning on Decentralized Ubiquitous Environments

Jorge Luis Victória Barbosa
University of Vale do Rio dos Sinos (UNISINOS), Brazil

Sandro José Rigo
University of Vale do Rio dos Sinos (UNISINOS), Brazil

Débora Nice Ferrari Barbosa
FEEVALE University, Brazil

Jezer Machado de Oliveira
University of Vale do Rio dos Sinos (UNISINOS), Brazil

Solon Andrade Rabello Junior
University of Vale do Rio dos Sinos (UNISINOS), Brazil

ABSTRACT

The application of technologies in the improvement of education strategies is called Ubiquitous Learning. This chapter discusses the collaborative learning and proposes the integration between two models dedicated to support ubiquitous learning environments, called Global and CoolEdu. CoolEdu is a generic collaboration model for decentralized environments. Global is an infrastructure designed to create ubiquitous learning environments. Global provides software agents that perform tasks common to ubiquitous learning processes. By extending these agents or adding new ones, a system can be specialized to support ubiquitous learning environments. The CoolEdu/Global integration created a collaborative and decentralized ubiquitous learning environment. The resulting environment was evaluated through a simulated scenario dedicated to explore its functionalities. The results showed the potential of deploying the environment in real situations.

DOI: 10.4018/978-1-5225-1709-2.ch009

INTRODUCTION

Over recent years, studies of mobility and distributed computational systems have been stimulated by the proliferation of portable electronic devices (for example, smartphones, tablet PCs and notebooks) and by use of wireless communication technologies (such as, WiFi, 3G and bluetooth). This mobile and distributed paradigm is called Mobile Computing (Satyanarayanan, Bahl, Cáceres, & Davies, 2009). Additionally, improvements in and proliferation of Location Systems (Hightower & Borriello, 2001; Hightower, LaMarca, & Smith, 2006) have stimulated adoption of solutions that take the user's precise location into account for provision of Location-based Services (Vaughan-Nichols, 2009; Dey, Hightower, Lara, & Davis, 2010).

Adoption of these technologies in combination with a proliferation of sensors has made it possible to provide computational services in specific contexts – Context-aware Computing (Baldauf, Dustdar, & Rosenberg, 2007; Dey, 2001; Knappmeyer, Kiani, Reetz, Baker, & Tonjes, 2013). This idea is based on perception of characteristics related to users and their surroundings. These characteristics are normally referred to as context, namely, any information that can be used to describe the circumstances concerning an entity. An application can then modify its behavior based on perceived context. This process, by which software modifies itself according to sensor data, is known as Adaptation (Lopes, Souza, Geyer, Costa, Barbosa, Gusmão, & Yamin, 2012). Integration of these technologies through generic software infrastructures (Costa, Yamin, & Geyer, 2008) has led to the emergence of continuous computing support, anytime and anywhere – Ubiquitous Computing (Satyanarayanan, 2001; Weiser, 1991).

Ubiquitous Computing is a computational model that aims to pro-actively serve the needs of users, acting in an invisible manner (Weiser, 1991). The goal is to achieve continuous integration between technology and the environment, helping users in their daily tasks. In this model, applications are available regardless of place and time and access to the computing environment is continuous, irrespective of the device or the physical location of the user.

Education, as well as other areas of knowledge such as Accessibility (Tavares, Barbosa, Costa, Yamin, & Real, 2014) and Health (Vianna & Barbosa, 2014), makes use of this new technological reality to improve its practices and approaches. The application of these technologies in improving education strategies gave rise to a research front called Ubiquitous Learning (Barbosa, Hahn, Barbosa, & Saccol, 2011; Wagner, Barbosa, & Barbosa, 2014; Ogata, Yin, El-Bishouty, & Yano, 2010; Rogers, Price, Randell, Frase, Weal, & Fitzpatrick, 2005; Yang, 2006).

Ubiquitous Learning refers to learning supported by the use of mobile and wireless communication technologies, sensors and location/tracking mechanisms, which work together to integrate learners with their environment. Ubiquitous learning environments connect virtual and real objects, people and events, in order to support a continuous, contextual and meaningful learning. A ubiquitous learning system can use embedded devices that communicate mutually to explore the context, and dynamically build models of their environments. It is considered that while the learners move with their mobile device, the system dynamically supports their learning by communicating with embedded computers in the environment. The opportunities made available by the context can be used to improve the learning experience.

There are several proposals for ubiquitous learning environments, such as LOCAL (Barbosa, Hahn, Barbosa, & Saccol, 2011), JAPELAS (Yin, Ogata, Tabata, & Yano, 2010) and GlobalEdu (Barbosa, Barbosa & Wagner, 2012), as well as the works proposed by (Chen & Li, 2010; Yang, 2006; Zhang, Jin, & Lin, 2005). Most proposals for ubiquitous learning environments use centralized structures (Yang, 2006). However, this approach is not adequate for the ubiquitous computing definition presented by