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Using the cloud to develop applications supporting geo-collaborative Situated Learning

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HIGHLIGHTS

- A general architecture for developing geo-collaborative applications is proposed.
- Two applications developed following this architecture are shown.
- A framework which supports the development of applications was developed and tested.
- The benefits of using this architecture and the framework are shown.

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ABSTRACT

Situated Learning stresses the importance of the context in which learning takes place. It has been therefore frequently associated with informal learning or learning outside the classroom. Cloud technologies can play an important role supporting this type of learning, since it requires ubiquitous computing support, connectivity and access to data across various scenarios: on the field, in the classroom, at home, etc. In this paper we first present the situated learning theory and how we can take advantage of services offered by Cloud Computing to implement computer applications implementing learning activities based on this theory, providing pertinent geographical information and discussion boards. Next we propose a software architecture schema which can be used as a basis for integrating existing cloud services into new applications supporting learning activities. Then we present two examples developed with this approach with its viability and advantages. These are discussed in the concluding chapter.

1. Introduction

The Situated Learning theory states that learning requires theoretical concepts learned in the classroom to be linked to practical situations in authentic contexts where they can be applied [1,2]. The way in which humans learn implies practicing the concepts acquired in theory [3]. Moreover, teaching and learning activities involving conceptual knowledge (learned inside a classroom), and practical implementation (in real situations) are not only complementary, but also feedback each other in a process of ongoing and increasing interaction.

Recent advancements in mobile, wireless and positioning technologies, combined with contextual computing, provide an opportunity for curricular development that may take advantage of these devices for supporting different aspects of learning and teaching [4]. Mobile and wireless technologies allow interaction with the real world in new ways because computational power and interaction are available outside the classrooms limits. Mobile technologies combined with content access virtually anywhere and anytime, allow learners to gain new learning experiences in a variety of situations beside the classroom itself [5,6].

Nowadays, new learning situations have been proposed that are marked by a continuity of learning experiences across different learning contexts. Students, individually or in groups, carry out learning activities whenever they want in a variety of situations and that they switch from one scenario to another easily and quickly. In these learning situations, learners are able to examine the physical world by capturing sensor and geo-positional data and conducting scientific inquiries and analyses in new ways that incorporate many of the important characteristics suggested by situated learning.

In the literature, we can see a growing number of applications developed to support collaborative learning according to the

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situated learning theory, which also make use of geo-referenced information. These applications have in common implemented communication mechanisms that allow learners interact with one another and at times with the teacher in synchronous or asynchronous ways in order to work collaboratively across various learning situations; in locations and devices. However, these applications are seldom related to the concepts of Cloud Computing, nor take advantages of what this paradigm can offer. Cloud Computing is about ubiquity, reliability, scalability and lowering costs, which matches the requirements for applications in which users will be using a variety of devices, in different settings and scenarios.

We understand Cloud Services as the functionalities that Cloud Computing may offer to its users which may be accessible using an internet website or by using an API, thus including the services as part of a new application. According to our previous experience developing applications for supporting learning activities and analyzing others' experiences through the literature, we see a real opportunity to take advantage of the available services in the cloud and systematically use them for developing applications supporting learning activities. We especially consider those, which make intensive use of geographical information and include the discussion as an important part of the learning activity. Applications with these characteristics can often be associated to the Situated Learning theory [3]. These functionalities, geo-location and discussions, are implemented as Cloud Services by various service providers: for example, geo-location is provided by Goggle Maps, Openlayer and Mapserver. Discussion forums are implemented through various microblogging sites like Twitter and Facebook, which have been successfully used for supporting discussions in learning scenarios. Therefore we think that developers of applications supporting learning activities based on the Situated Learning theory can take advantages of services provided by the cloud in order to implement them with less effort and more reliability, since cloud services have been developed to serve a large number of users and are in most cases very stable. There is another advantage regarding the usability of the applications which incorporate services from the cloud: most users already know how to interact with them since they have already used them in other contexts.

In this work, we propose an architecture and present a framework based on it to design and implement learning activities which harness the opportunities offered by the cloud. For this, we start from the requirements of the Situated Learning theory and explore the role of Cloud Services in supporting new forms of technology-enhanced learning activities fulfilling these requirements. This work considers the features of the common understanding of Cloud Computing, transferring the abstracted features to other prominent internet services like, e.g., Twitter and Facebook (which we see as specific instances of Cloud Services in the context of this paper). We argue that in the context of learning scenarios a wider definition of Cloud Services is need to encompass possibly relevant new developments. Furthermore, this paper presents an architecture that allows the flexible usage of services that belong to this extended definition of Cloud Services. We describe two examples of learning scenarios that build upon the presented architecture to demonstrate how these services facilitate innovative aspects of technology-enhanced learning scenarios. Then, we present a framework developed in order to ease the development of applications taking advantage from Cloud Services and we describe how to use it. Finally, an outlook for future development of this understanding of Cloud Services is presented.

2. Related work

In this section we will review the relevant literature for this work. Firstly we will present relevant work on using Cloud Computing in general, and what we defined as Cloud for educational purposes, as described in the previous section. Secondly, we review the literature about computer applications implementing geo-collaboration supporting learning activities that fall under the Situated Learning theory umbrella. Thirdly we will review the literature about microblogging used to support discussions within learning activities, understanding that microblogging services as a kind of Cloud Services.

2.1. Cloud Computing for learning

The potential of Cloud Computing for improving efficiency, cost and convenience for the educational sector is being recognized by a number US educational establishments [7], e.g.: (1) The University of California (UC) at Berkeley, found cloud computing to be attractive to use in one of their courses which focused exclusively on developing and deploying SaaS applications. Using Amazon Web Services, UC Berkeley was able to move its course from locally owned infrastructure to the cloud. One of the main reasons was quoted as being the ability to acquire a huge amount of servers (needed for this course) in a matter of a few minutes [8]; (2) researchers at the Medical College of Wisconsin Biotechnology and Bioengineering Center in Milwaukee are making protein research more accessible to scientists worldwide, thanks largely to renting processing time on Google's cloud-based servers. With cloud computing making the analysis less expensive and more accessible, it meant that many more users can set up and customize their own systems and researchers can analyze their data in greater depth than was previously attainable [9]; (3) faced with budget cuts the Washington State University's School of Electrical Engineering and Computer Science (EECS) selected a cloud platform (namely vSphere 4) from VMware (a leading provider of virtualization technology) to support a move to cloud computing. The EECS claims cloud computing has actually enabled it to expand the services it offers to faculty and students rather than cut them back [10].

Cloud computing is also finding its way in British academia, a number of UK higher education institutions, e.g., Leeds Metropolitan University, the University of Glamorgan, the University of Aberdeen, the University of Westminster, the London University's School of Oriental and African Studies (SOAS) and the Royal College of Art (RCA) have adopted Google Apps. Popular demand from students (many of whom were already abandoning the unreliable in-house email systems) and cost were said to be the main factors behind this move [11].

According to Alabbadi [11], Cloud Computing is being widely deployed, with its dynamic scalability and usage of virtualized resources, in many organizations for several applications. It is envisioned that, in the near future, cloud computing will have a significant impact on the educational and learning environment, enabling their own users (i.e., learners, instructors, and administrators) to perform their tasks effectively with less cost by utilizing the available cloud-based applications offered by the Cloud Service providers. Alabbadi [11] analyzed the use of cloud computing in the educational and learning arena, to be called Education and Learning as a Service'' (ELaaS), emphasizing its possible benefits, and offerings. This research indicates that it is essential for an educational and learning organization, with its budget restrictions and sustainability challenges, to use the cloud formation best suited for a particular IT activity.

de la Varga proposes a classification of already existing and popular Cloud Services many providers offer for free, according to their possible usage in education [12]. According to this classification, in the category of collaboration we have GoogleDrive, Dropbox, Slideshare among others. In the category of communication we have skype and Blogger. Twitter and Moodle fall in the category of interaction, while Gimp and Campstudio in the category of creation.

Cloud Computing has already made its way into the learning scenario, mostly by providing services and infrastructure. It is then natural to go one step further and see the cloud as providers for various services and data which can be integrated in a new application supporting learning activities.