

Chapter 8

A Cloud-Based Learning Platform: STEM Learning Experiences with New Tools

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ABSTRACT

A wide range of innovative Web 2.0 tools can be used for STEM education; however, learning orchestration issues arise in terms of management, adaption, and intervention. These issues can be solved through the manipulation of the tools' Web application programming interfaces (APIs) in order to orchestrate the learning experience. In this chapter, the authors present a learning platform that is capable of orchestrating learning activities through Web interoperability with Web 2.0 tools. This interoperability is realized through advanced Semantic Web technologies such as JSON-LD and Hydra, and a specialized architecture to automatically recognize, process, and use the tools' Web APIs. Finally, an evaluation of the architecture in a Massive Open Online Course is presented which reveals satisfactory usability and emotional evaluation results.

INTRODUCTION

In a research report by the New Media Consortium titled “Technology Outlook for STEM+Education 2012-2017”, Johnson, Adams, Cummins and Estrada (2012) show technologies that will impact STEM in the upcoming years. With over 30 different technologies analyzed, the results of the referred study ranked cloud computing within the top short-term adoption technologies.

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Furthermore, parallel reports from the New Media Consortium regarding higher education and K-12 in 2012 also ranked cloud computing within the top short-term adoption technologies. Research community has also focused on this type of technology for education, such as the comprehensive review by Chao (2012). Interestingly, mobile apps, social networking, and collaborative environments were also ranked for short-term adoption in the STEM report, which indicates the major role that

collaborative and mobile applications are playing in educational settings.

This aforementioned STEM report also describes the identified trends, which are summarized in three areas. The first area is that teaching paradigms in all educational sectors are continually shifting to include models of online learning, new technologies, and collaboration. Second, the impact of massively open online courses (MOOCs) in STEM areas is highly evident by an increasing number of new MOOCs offered in the very fields. Third, the abundance of resources (in the forms of content, applications, and services) that are easily accessible through the Internet challenges the educators' role.

Moreover, the challenges identified in the STEM report raise issues, such as digital media literacy, which is one of the essential skills that continue to gain importance. In education, this is a relevant challenge from the perspective of the inclusion of multiple tools and apps that are already available, which can be used for STEM education, although this new tools could present digital literacy issues for both teachers and learners. Furthermore, the STEM report cites the following: "Cloud-based collaboration tools allow STEM students to engage problems as teams, to interact and brainstorm solutions easily, and to craft reports and presentations; often, the very same tools can be used to support both global and local collaboration." Cloud-based tools (CBTs), also known as Web 2.0 tools, are usually highly interactive tools with collaborative features. These CBTs use cloud computing to scale their tools to hundreds of thousands of users, and they have added interoperability features through opening the application program interfaces (APIs) to enable consumers to use their technology, as well as to compose new and innovative systems, which includes the creation of new educational experiences. In this sense, Hernández, Schmitz, Mikroyannidis, Delgado, and Chao (2013) emphasize in the perspective that including interoperability features enables a wide range of possibilities to

provide new learning experiences through orchestrated services, the authors also claim that a new paradigm is presented, where a monolithic architectural approach is evolved to a flexible, heterogeneous and distributed architectural setting intended for education environments. The perspective presented by Hernández et al. (2013) asserts that the change of paradigm enabled by cloud computing also maximizes innovation possibilities in the following way:

...allowing interoperability of the best and most appropriate cloud services based on learning needs, freeing up from a vendor specific approaches and limits, transforming the cloud education environment into a digital educational ecosystem of services and resources available for the practitioners, in contrast to a large amount of software services that are difficult to manage and organize for a learning setting.

The aforementioned CBTs can form a flexible cloud-based learning platform (CBLP), which manages to orchestrate learning activities and tools for educational experience, and thereby automate many of the common tasks that the teacher and learner face when using the CBTs for a course assignment. The CBLP is also known as a cloud education environment (CEE) (Hernández, Linares, Mikroyannidis, & Schmitz, 2013). This chapter examines the current CBTs from an educational perspective, and raises the need of a CBLP that is flexible in terms of the integration of multiple CBTs and their corresponding mechanisms for orchestration. Consequently interoperability is key for the proposed approach. Thus, the background section gives a short review of Web interoperability in educational systems. This research presents a proposal of a highly flexible Web interoperability by using advanced Semantic Web technologies that are both simple and robust to use (Hernández & Güetl, 2015). These technologies provide a simple way to define a CBT API specification that is machine processable (i.e. it can be used by

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