Chapter 11
Cloud Computing for Teaching and Learning: Design Strategies

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ABSTRACT

Cloud-based courses are now in widespread use by universities and other educational institutions. The cloud-based approach to course delivery is now used to provide scalable, granular educational content and training to millions of students asynchronously and synchronously in an innovative, effective manner. In the case of universities, more variables are under their control, such as student enrollment and student use of course elements. For universities with a focus on STEM-related programs, courses are offered to multiple categories of students with a mix of face-to-face and distance learning approaches, and the courses are often also open to the general public under different contracts. These universities typically aim to offer specially designed programs to companies and the general public who have diverse requirements and challenges. Aided by advances in cloud computing platforms, STEM focused-educational programs are increasingly adopting cloud-based learning systems to meet the diverse needs of their students. In this chapter, we discuss the motivation behind leveraging the cloud for STEM based higher education. We use the case study approach and examine two cases. The first is a large private university with 18,000 students and the second is a for-profit private educational company offering courses mainly to the general public. We examine best practices that are involved in developing such systems, progressive delivery mechanisms for course presentations, setting up the required cloud infrastructure and the operational use of the entire system. The aim is to give researchers and developers deeper insights into the development of successful private cloud-based STEM-based educational offerings.

DOI: 10.4018/978-1-4666-9924-3.ch011

INTRODUCTION

Higher education is being transformed by the introduction of information technology, changes in attitudes towards college-based education and the deployment of new business models in education (Gentzoglanis, 2012). STEM education is particularly important in creating a workforce that will enable the United States to be competitive into the 21st century.

The term "STEM" refers to the collection of academic disciplines of *S*cience, *T*echnology, Engineering, and *M*athematics. The term also relates to educational policy and curriculum choices from k-12 through college that aim to improve competitiveness in science and technology development. STEM education and policy impact workforce development, the economy, national security and immigration policy.

Cloud computing is a form of distributed computing systems that accomplishes sharing of heterogeneous computational resources, including hardware, data and software among multiple end users. However, it has distinct adoption requirements for organizations (Pastore, 2014). Cloud computing has evolved to become a dynamic and scalable computing and storage platform that is suited to the demands and needs of online students, including adult learners. This is because cloud-computing seems much easier to adopt and use due to its relatively affordable costs and wide availability and accessibility on the Internet.

This chapter seeks to discuss the increasing widespread use of cloud computing in STEM-related educational environments providing details on the benefits and challenges related to its use.

Traditional college education has been of the in-class, university-based variety, where face-to-face meetings have been the norm. However, over the last decade in particular, there has been an explosion in online education, with the majority of colleges across the United States now offering degree programs that can be partially or fully completed online.

Many colleges have done this out of competitive necessity and in order to compete globally for students, similar to their peers. Indeed, colleges move programs online no longer competitive advantage, but to survive in a globalized, hypercompetitive environment. As more and more articles appear casting doubt on the economic value of a college education, pressure is being brought to bear on the higher education supply chain and the cost reductions that are afforded by online educational programs.

Educational institutions deploy cloud computing support to advanced digital learning, thus we can expect serious transformations of the curriculum from the traditional mode of delivery. For too long we have tried to understand digital learning by classifying courses as either online, hybrid or face-to-face. The aim of using new cloud-based models is to achieve functional convergence of the physical and virtual campus, which ultimately will lead to few distinctions between face-to-face and online courses.

This is motivated by the recognition that because of individual circumstances, one mode may have advantages for a given student at a given time. Students could engage in a course remotely, in a face-to-face environment or they can chose to participate in a converged combination of the two. If the discipline lends itself to cloud computing-supported multiple delivery options, educational institutions try to provide their students as many opportunities as possible to engage the course materials while preserving the personalized interactions between the instructor and the students.

Private Educational Providers and MOOCs

In tandem with these pressures, private non-traditional providers have also entered the online educational market, offering even greater varieties of specialized web-based training formats. A well-known example of a non-traditional educational provider is Phoenix University, with 112