Chapter 23
Strategic Planning for Cloud Computing Adoption in STEM Education:
Finding Best Practice Solutions

Alan S. Weber
Weill Cornell Medical College in Qatar, Qatar

ABSTRACT

This chapter describes effective strategic analysis and implementation methods for the adoption of cloud computing services (infrastructure, platforms, and software) in Science, Technology, Engineering, and Mathematics (STEM) education. The benefits of cloud computing, including lower costs, scalability and virtualization capabilities, have been recognized and adopted by major educational, governmental and research institutions internationally during the last five years. However, the term 'cloud computing' was only recently clarified in 2011 in the NIST's standard definition published by Mell and Grance (2012) as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." Despite the increasing clarity in defining cloud computing, the deployment models can be complex, encompassing hybrid, public, community and private cloud frameworks, all with varying levels of privacy, security, and trust. Data format, integrity, and portability as well as geographical server location represent additional factors that educational institutions must weigh when they consider adopting a cloud solution for their educational needs. The chapter provides advice on how to strategically plan for the use of cloud computing services and how to identify, weigh and assess the various factors in decision-making. Just as with e-learning when it was found at the end of the 1990s that purely online technological approaches were not as effective as pedagogical models (blended learning) which took into account human factors such as student motivation, teacher training, technological illiteracy, etc., the author suggests that a holistic technology adoption process that includes needs assessment and stakeholder engagement will be the most successful.

DOI: 10.4018/978-1-5225-8176-5.ch023

INTRODUCTION

Science, Technology, Engineering, and Mathematics (STEM) education has been the focus of recent interest in the federal government in the last decade, including the White House and U.S. Department of Education. The 2013 *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan* issued by the National Science and Technology Council (Committee on STEM Education) identified five key STEM education investment areas:

- **Improve STEM Instruction:** Prepare 100,000 excellent new K-12 STEM teachers by 2020, and support the existing STEM teacher workforce;
- **Increase and Sustain Youth and Public Engagement in STEM:** Support a 50 percent increase in the number of U.S. youth who have an authentic STEM experience each year prior to completing high school;
- **Enhance STEM Experience of Undergraduate Students:** Graduate one million additional students with degrees in STEM fields over the next 10 years;
- **Better Serve Groups Historically Under-Represented in STEM Fields:** Increase the number of students from groups that have been underrepresented in STEM fields that graduate with STEM degrees in the next 10 years and improve women's participation in areas of STEM where they are significantly underrepresented;
- **Design Graduate Education for Tomorrow's STEM Workforce:** Provide graduate-trained STEM professionals with basic and applied research expertise, options to acquire specialized skills in areas of national importance, mission-critical workforce needs for the CoSTEM agencies, and ancillary skills needed for success in a broad range of careers. (CoSTEM, 2013, pp. vii-viii).

In each of these targeted areas, cloud computing has a role to play, as outlined in the discussion below. In this chapter, selected examples and analysis are used to demonstrate the current capabilities and potential of cloud computing in STEM education. Some of the pitfalls and potential harms and risks associated with using these technologies are also highlighted to provide potential adopters with a balanced view of benefit/risk scenarios. Although there are a number of currently available technology adoption and technology acceptance models, such as Davis, Bagozzi, and Warshaw's Technology Acceptance Model (David et al., 1989; Davis, 1989) later modified with Venkatesh (2000) as TAM2 and again by Venkatesh et al. (2003) as the Unified Theory of Acceptance and Use of Technology (UTAUT)–they are difficult to apply to real world technology adoption scenarios. The UTAUT model, for example, has over 40 variables explaining decision-making and subsequent behavior of new technology adopters. This chapter takes a common sense and practical approach to cloud computing technology adoption by identifying key factors in the process of selecting infrastructure, platforms, and services.

Cloud computing within STEM degree granting institutions is unique, since cloud technologies comprise a set of tools and a domain of knowledge that not only facilitate the production of knowledge in other fields of study, but also represent an area of research and discovery in their own right allied with each STEM discipline; for example, basic and pure sciences (information theory, physics), technology (all aspects of cloud computing), engineering (computer engineering, computer architecture, Internet infrastructure, networking) and mathematics (algorithms, chip logic, etc.). The main STEM educational areas in which cloud computing can have a serious impact are: