Chapter 75
Open Source Software to Enhance the STEM Learning Environment

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ABSTRACT

This chapter examines the use of Open Source Software (OSS) technologies that can be used to improve the learning of Science, Technology, Engineering, and Mathematics (STEM). Explored are the various methods that can be utilized to improve the percentage of STEM majors in the American educational system with resources such as: Open Source as Alternative (OSALT), virtualization, cloud computing, Linux distributions, open source programming, and open source hardware platforms. Increasing the amount of students that pursue STEM majors is important because the projected job growth in the STEM field compared to non-STEM jobs is 33%. OSALT provides cost-effective alternatives to commercial products such as Microsoft Office Suite and Adobe Photoshop. Second, creating Virtual Machines (VMs) is another avenue to teach complex concepts in computer science, engineering, and Information Technology (IT). Third, cloud computing is an inexpensive way for clients to access information from multiple locations and devices. Fourth, universities can use the Operating System (OS) Linux and its various distributions as replacements for commercial operating systems like Windows in order to reduce IT costs. Lastly, open source programming languages like Python and their associated Integrated Development Environments (IDEs) provide comprehensive facilities for software engineers for application development or testing.

INTRODUCTION

This chapter focuses on the evaluation and integration of OSS technologies to enhance the learning of STEM majors in the classroom. As the STEM majors at various institutions are looking for creative methods to increase their footprint at a fraction of the cost then OSS is vital to continued growth. Technologies reviewed include software languages, IDEs, virtualization, and integrated

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learning management systems (LMS). This chapter will review multiple methods of implementing OSS into curriculum to enhance the learning environment.

OVERVIEW

This chapter will cover the utilization of virtualization, OSS and simulation tools that are also open source. OSS can be defined as software that is made available in source code form. This is important as this source code may fall under the General Public License (GPL) which is a widely used free software license that is managed under the GNU Not Linux (GNU) Project. Virtualization is important as this is an effective method to reproduce system learning environments on the same systems the learner is using reducing the overall hardware footprint and need to for a massive lab. This chapter will also cover various software applications that can be integrated into the university system

STEM Outreach

The new millennium was the dawn of a new era in terms of technological advances. Technology impacts various aspects of our lives. In fact, President Obama believes that the key to enhancing our economy is by fostering education in the STEM areas. Pres. Obama stated recently stated,..".We must create an environment where invention, innovation, and industry can flourish... I am committed to doubling funding for key research agencies to support scientists and entrepreneurs, so that we can preserve America's place as the world leader in innovation, and strengthen U.S. leadership in the 21stcentury's high-tech knowledge-based economy" (Otto, 2012). Thus, federal policies are catering to the growing need for STEM based education that incorporates technology as a way to teach our 21st century youth. Moreover, the projected job growth for STEM careers is estimated to be three times as fast as job growth for non-STEM jobs (Langdon, McKittrick, Beede, Khan, & Doms, 2011). Along with this, the Economics and Statistics Administration states that STEM workers are less likely to experience unemployment than their non-STEM counterparts. Finally, workers with STEM degrees tend to earn higher salaries regardless of if they work in STEM or non-STEM careers. Furthermore, the numerous advances in technology have made our computers smaller, quicker and more accurate. From the premiere of the iPad three years ago, to the surge of smartphones in the market, mobile technology is permanently embedded in our daily lives. In fact, mobile Internet, digital textbooks and cloud computation are three technological advances that can positively change our educational approach.

When thinking about the long term goal of IT related employment it is necessary to view the Forbes 2013 Jobs List to understand the job demands. The number one position is software developer for applications and systems software with 70,872 jobs added since 2010, and overall 7% growth (Smith, 2012b). The number four position listed is computer systems analyst with 26,937 jobs added since 2010, and overall 5% growth (Smith, 2012b). The number six position listed is network and computer system administrators with 18,626 jobs added since 2010, and overall 5% growth (Smith, 2012a). In 2012, the number one position was software engineering with a midlevel pay of $88,142 (Smith, 2012a). The number nine position was computer systems analyst with a midlevel pay of $78,148 (Smith, 2012a).

OSALT and SourceForge

OSALT provides open source alternatives to popular commercial products (OSALT, n.d.). The open source programs LibreOffice, OpenOffice Draw, StarUML and Avidemux respectively are open source alternatives for Adobe Photoshop, Dreamweaver and iTunes. Sourceforge is an open source development Website that provides free

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