Chapter 1
Implementing a Hybrid Cloud Infrastructure to Facilitate ICT in Education: Design and Evaluation

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ABSTRACT

In this chapter, the authors present the methodology and the results of their effort towards the introduction of cloud services as a means to simplify the adoption of ICT in education using Free/Open Source Software. A hybrid cloud infrastructure is established in order to provide Linux and optionally MS-Windows desktop environments with the Software as a Service cloud model. Legacy and modern school PCs function as stateless devices. To achieve this, their "Sch-scripts" application performs an unattended installation of the Linux Terminal Server Project software to a school computer that also hosts centrally maintained virtual machines. Classroom management is accomplished using their "Epoptes" application. Administration is only required in the school server while the educational software is provided with the Software as a Service model either in online form or through repositories that automate software installation. Four-hundred-twenty schools have already implemented this architecture and 117 responded to the evaluation survey. The statistical analysis of these answers confirms the design principles, which include minimal cost, as well as reusability of obsolete equipment, ease of administration, centralized management, patches and educational software provisioning, classroom management, and above all, facilitation of the educational procedure.

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INTRODUCTION

The importance and prevalence of Information and Communication Technologies (ICT) in education is universally recognized, because of their potential to create more comprehensive educational material that ameliorates the academic development of children (Kalaš, 2010). Despite this fact, ICT introduction did not meet their initial, since 90s, expectations (Watson, 2006). Since early 2000s many national and international studies (Kozma, 2003; OECD, 2006; Pelgrum, 2001) depict the fact that there is a serious gap between the theoretical enhancement that will result by exploiting ICT in education and the actual application of ICT in a classroom.

Some of the obstacles mentioned above, are mainly technical issues related to the schools' networking, computing and building infrastructures. In Greece for example, computers are part of a local area network and are communicating using the client – server computational model, which requires administration of all components (all the clients and the server). Due to the technological evolution and the software and hardware prerequisites of educational software, many school labs' computers need to be replaced. Unfortunately, the goal of procuring and maintaining computer labs to satisfy the requirements was impractical due to limited resources. To make things worse, in order to achieve a 1:1 student to computer ratio more computers are needed, not to mention that the lack of technical personnel to support the ICT infrastructure impairs all the aforementioned issues (Kondilis et al., 2007). In 2006, a new computational model, the thin client model (Becta, 2004; Nieh et al., 2005), was introduced, taking advantage of the Linux Terminal Server Project (LTSP) package (Balneaves, 2009) and the Ubuntu (http://www.ubuntu.com) operating system (O/S), aiming to replicate successful references of other countries (Braaten et al., 2002; Reinholdtsen, 2002; Carter et al., 2008). Old PCs could be reutilized and students had accepted thin client performance as well as Ubuntu's application environment, but there were still technical issues with regards to the installation, everyday usage and administration (Kondilis et al., 2008).

The rest of the paper is structured as follows: Section 2 presents the cloud computing model and its services. In Section 3 we analyze the conditions that we concluded as crucial in order to ensure the ICT exploitation in education. Explanations of how the proposed architecture conforms to the previous requirements along with the technical issues of the customization procedure and a comparison with corresponding proprietary software techniques are quoted in Section 4. The diffusion of the solution is being presented in Section 5, followed by the statistical analysis of a survey that was answered by the schools that adopted the solution, in Section 6. Section 7 discusses our future plans. Section 8 summarizes and concludes the paper.

CLOUD COMPUTING AND ITS SERVICES

Recently, available computing resources are cheaper and more powerful than ever before, resulting in the emergence of a new computing model called cloud computing, one of the hottest topics in ICT today (Zhang et al., 2010; Sultan, 2010; Grossman, 2009; Vouk, 2008), while it is also considered to be the next stage in the evolution of the Internet. IT vendors spend billions of dollars to create infrastructures that provide cloud solutions and therefore creating more research opportunities on this field. Strange though it may seem, there is not a standard definition of the cloud, as its services are being utilized by various computing models and the term "cloud computing" is used to imprint several diverse things. Current ICT trends are about data center consolidation, server virtualization, using thin client devices (such as an Internet browser), whilst broadband