An Architecture of a Cloud-Based Virtual Learning Environment

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Abstract

In recent years, the use of e-learning in the higher education sector in Saudi Arabia has increased, as it offers many advantages compared to traditional learning; for example, by enabling students to access e-resources anywhere and at any time. Each individual university has its own e-learning system (tools) that receive significant financial investment. However, there is no integration between these systems. The cloud computing can be used in this area as it offers the advantages of facilitating knowledge-sharing and providing different platforms. In this paper, an architecture of a Virtual Learning Environment that supports different e-learning platforms is proposed; the proposed system is based on cloud computing, as it offers many advantages to universities, educators and students. This research aims to show that how cloud computing may be used to support educational domains. Cloud computing is likely to have considerable impact on education in the future and to address .many challenges facing the sector

Keywords: E-learning; Virtual Learning Environment; Cloud computing

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1. Introduction

The use of Virtual Learning Environments has increased in recent years in Saudi Arabia. It is a rapidly developing area, especially in education, as many universities have invested in VLEs to further develop the courses they offer. In this type of learning, instructors and learners live in different places [1]. As instructors and learners do not meet face-to-face, they do not engage with each other in a classroom environment; however, they meet in a virtual location called a Virtual Learning Environment. Students are taught without having an instructor in the classroom. Instead, material is designed by tutors and presented it in a virtual space [2]. VLE are also known as Learning Management Systems (LMS).

However, there are some major limitations to the current VLE systems used at Saudi universities. Universities sometimes pay too much to buy VLE systems. In addition, each university has a separate e-learning system that offers no integration with the VLE systems used in other universities; therefore, there is a need for further integration between the VLEs used at Saudi universities. This paper suggests using cloud computing to resolve this issue, which offers a number of advantages that could help address these limitations. Cloud computing technology offers services and allows users to make demands and provide the services they require. It has grown over the past few years around the globe to provide services and tools to users. The main concept of cloud computing is to provide access to platforms and applications via remote servers. In more detail, cloud computing technology allows access to businesses without having to install applications on a device [3]. It is important to understand the basic concepts of cloud computing. The greatest important advantage of cloud computing is that it enables access to advanced technology and infrastructure without the need for a significant financial outlay. Furthermore, it facilitates the sharing of knowledge and resources between academic institutions [4]. The rest of this paper is organized as follows: Section 2 presents literature review of Virtual Learning Environments, and Section 3 discusses cloud computing in depth. Section 4 presents the proposal architecture, and the conclusions are presented in Section 5.

2. Virtual Learning Environment

Many researchers have defined their own view of VLE. The UK's Joint Information System Committee [5] has defined VLE as "an electronic system that can provide online interactions of various kinds that take place between learners and tutors, including online learning". According to [6], the VLE is a software system that can be used to deliver online education via web-based content, such as, chats ,automated tests and discussion forums. The low cost is not the only reason to use VLEs; they can also be modified to address the teaching needs of a particular course. Several types of open source software can be used to develop VLEs. One of the most common is the Moodle system.

VLEs offer many advantages that have been described in the literature. With increasing numbers of students in higher education around the world, VLEs can support universities to cut the practical pressures of finding sufficient physical resources and space for them. Students can study their course modules at anytime and anywhere, unlike in traditional learning environments [7]. Regarding fixed time and space constraints; some learners prefer not to have a fixed time or place for learning, and VLEs can be appropriate for their learning style. Learning and teaching using VLEs is extra economic than old-style learning, as students are able to study from home without expenditure money on transportation to university. VLEs can deliver education to people who have experienced barriers, such as students who have singular requirements or a disability. In addition, learners who have family commitments or individuals with financial difficulties may find it easier to participate in the learning environment using a VLE [8].

Educators have the ability to manage courses in a VLE system, for example, by sending announcements to students, issuing assignments and uploading course material [2]. VLEs can offer student services, such as discussion boards, document-sharing and access to off-line lectures or notes. VLEs can link course contributors to reach both effective collaboration and communication. Finally, students and lecturers may appreciate the suitability of the online sending of resources and materials [9].

Because VLEs are an important practical and inexpensive new product for higher education, many Saudi universities have developed their own VLEs, such as Blackboard, Moodle, and D2L. However, over 30 universities use VLEs, each with their own spearheaded system, which means paying individually for both the tools and license. The greatest drawback is the lack of integration between these VLEs, as sharing course content would save time and effort.

Each university has its own data center with servers, a storage space, network devices and other equipment. In additional to the system administrators required to control all the servers, there is a need to integrate these VLEs between different universities. Increased collaboration between them would be beneficial to all institutions involved, especially to those that cannot afford technical support staff to maintain their systems. Therefore, collaboration between institutions in the use of the different techniques would be very helpful. Many institutions do not have enough staff to maintain their systems and to provide the necessary technical support. There is a need for an architecture with multiple features, such as integrity, availability and scalability. The core business of Saudi universities is to provide education to students. They are shifting away from considering IT operations to spending time and effort on IT infrastructure. Cloud computing is a new trend in computing technology that can help address these issues.

3.Cloud computing

Depending on user requirements, cloud computing proposals a range of services, and allows users to provide some services and to formulate their own demands. In recent years, the use of cloud computing has grown around the world. The main concept of cloud computing is to provide access to devices, platforms and applications via a remote server. Over the past few years, the environment of the internet has continued to move from a static to a extremely dynamic environment that permits users to run software applications and collaborate to share information and create new facilities online. Cloud computing has improved in use due to the large number of features it offers, and many business models rely on cloud computing to deliver their services to customers [5].

There are several definitions of cloud computing; the most suitable and commonly used one is that of the National Institute of Standards and Technology [9], "Cloud computing is 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. This cloud model is composed of five essential characteristics, three service models, and four deployment models". Another definition for cloud computing is presented by [10], "A style of computing in which massively scalable IT related capabilities are provided as a service using Internet technologies to multiple external customers".

Cloud computing is a new technological trend in which a unique data center offers many service and tools to users [3]. Some of the features and advantages of cloud computing are described below. Cloud computing has ability to reduce institutions' expenditure as they need not individually build their own separate data centers but can share them instead. Virtualization is the main concept of cloud computing, as there are many issues involved in the use of physical servers. Cloud computing can resolve any issues that arise with physical servers by creating a virtual environment. If there is a problem with the fixed data center, data will be automatically moved to another environment. Data in the cloud does not need to be centralized to be consistent but is instead distributed, and users do not have to worry about their data if a failure occurs on any server [11].

Cloud computing includes three main service layers, which are software as a service, platform as a service and infrastructure as a service. Software as a Service (SaaS) refers to the software and applications that people can access over a web browser. Service providers control these applications without any cost control for the end user, for example Gmail and Hotmail. Platform as a Service (PaaS) refers to the environment that supports the applications and runs on the cloud. Infrastructure as a Service (IaaS) is located in basic environment of the cloud and includes hardware and resources for example, physical servers, storage and networks [12].

Many companies provide cloud services around the world, for example Google Apps, Microsoft Live@edu for education and Amazon web services for education [13]. The main IT vendors, such as Microsoft, Google, IBM, Yahoo and Amazon, are still building up their cloud. Cloud computing services are particularly used in higher education across the developed world and in Saudi Arabia to make learning, teaching and research easier without the need to acquire and maintain hardware and software, such as Office 365 and Microsoft Augr.

Other advantages of the cloud presented by [14] are cost-effectiveness, flexibility, easy availability and data safety. Cloud computing can be used to run applications, systems, and IT infrastructure and reduces the need for staff and financial resources. Flexibility means that a user can start on a insignificant scale by buying one node before adding additional resources later. Cloud computing also offers increased data safety in the case of natural disasters or other factors. This approach is very problematic to achieve in a traditional off-site backup. High availability refers to cloud computing providers having improved resources to provide additional time than any other organization.

There are a number of advantages to accepting the use of cloud computing in Saudi Arabia, such as accessing the latest technology with little investment. At the same time, there is no need to build a huge data center and management problems are reduced, removing the burden of acquiring software for each institution from the government's "shoulders". Cloud computing enables access to advanced technology and infrastructure without the need for high expenditure. Cloud computing is one of the new developments in computer technology expected to influence teaching and learning in Saudi Arabia. The architecture proposed in this study is presented in the next section.

4.Proposed architecture

This research proposes An Architecture of a Cloud-Based Virtual Learning Environment as presented in Figure1. This proposal uses the advantages of cloud computing and addresses the limitations of the current VLE system. The proposed architecture is able to easily transfer knowledge and materials between different universities. It consists of the customer, an Internet provider, an Integration component, Third party component, Cloud education and Replication.

1.1. *Customer*

A customer in this section refers to one of the 34 potential user universities distributed throughout the Kingdom of Saudi Arabia. Each user will be able to access the education cloud system via a browser. A username and password will allow them to make a request to access the VLE contents, including new courses made available in the system by other universities.

1.2. *Internet Providers*

STC, Mobily and Zain are the three main Internet providers in Saudi Arabia. These companies provide comprehensive innovative services and solutions, earning customer trust and enriching society. In addition, they offer integrated services for three main sectors: individuals, business, and carriers.

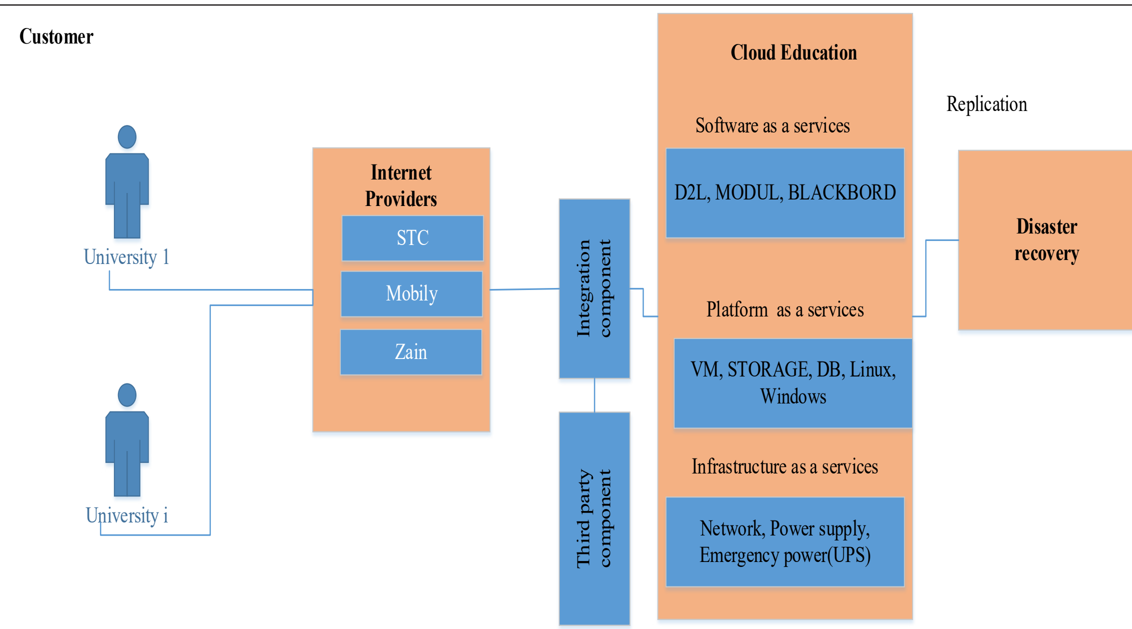

Fig. 1. Architecture of a Cloud-Based Virtual Learning Environment

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1.1. *Cloud education*

Cloud education is a unique entrance point to deal with all the requests coming from different university users to the VLE system. In this paper, Cloud education is defined as a storage system for VLEs. Due to the fact that Riyadh, the capital of Saudi Arabia which is located in the center of the country, it is suggested that cloud education should be built there. Cloud education consists of three layers: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

- Software as a Service (SaaS)

Software as a Service deals with the applications used in VLEs. A user can access this layer via a web browser. Therefore, SaaS uses the web to deliver applications, which are controlled by Internet provider (STC, Mobily or Zain). Therefore, it is not necessary to install VLE applications on the user's PC. SaaS is one of the three layers of cloud education which is observable for customers (end-users), since actual software applications are retrieved and used. The many applications used in VLEs include Moodle, Blackboard Sakai and D2L.

- Platform as a service (PaaS)

This layer is responsible for offering an operation system and support centre to run the software as a service layer. This layer offers developers the opportunity to run and manage applications without the need for the university user to be aware of the maintenance associated with the infrastructure. To build and run on-premises applications is always complex because technical staff are required to manage and control the applications. By using PaaS, the university does not need to employ technical staff to manage and control the applications.

- Infrastructure as a service (IAAS)

This physical layer is the foundation of cloud education. IaaS is an alternative to building a personal data center and purchasing new devices. It contains hardware devices, such as network devices and a power supply. As a replacement for marketing fresh hardware infrastructure, IaaS providers normally offer virtualized infrastructure as a service. IAAS is held and managed by the Cloud education. This layer is flexible as it can offer highly scalable resources that can be modified depending on requests from users, who only pay the producer for what they consume.

1.2. *Disaster recovery system (DRS)*

Disaster recovery system(DRS) is mainly aimed at the business continuity and acts as a form of security to protect data from risks, natural disasters, cyber-attacks and device failures. DRS works only if the main DR fails. The user will not be able to sense any delay while DR is in operation; it provides replication for all activities that happen in the main data center. DRS can replicate servers and any critical devices at other locations to guarantee the continuity of the business. it is suggested that Disaster recovery system should be built in Jeddah which is noted as the second largest city after the capital.

1.3. *Third party component*

Teaching content prepared by individual universities must be protected by a third party. In this research, it is suggested that a Third Party Component should be responsible for any issues related to intellectual property infringement, such as copyright violation or the mishandling of confidential data. This component utilizes some authentication and encryption mechanisms to ensure access control and confidentiality respectively.

1.4. *Integration component*

The integration component is a very important part of this architecture as it works as middleware, which acts as an intermediate layer between applications. This component consists of a list of policies and conditions that allow communication between different applications. It includes some conditions for those who have permission to access the education cloud. There are different layers of user permission, such as read, write, and download.

Some universities are already known as top universities, for example King Saud University. On the other hand, some universities were only established a few years ago. The use of the integration component will ease communication and integration between newer and older universities. Therefore, this component helps new institutions profit from the experience of older ones. This includes access to the questions bank; sharing of course contents; attendance; and the preparation and delivery of presentations.

Different universities will not need to repeat work done by other universities. In other words, there will be no need to reinvent the wheel. This should help universities share knowledge and tools such as virtual labs, videos, tutorials, discussion rooms and presentations.

5. Conclusion

The trending technology of cloud computing has raised a range of new issues. In recent years, the use of VLEs in higher education in Saudi Arabia has increased because they offer many advantages over traditional learning by giving students access to e-resources anywhere and at any time. Cloud computing frameworks are able to provide an environment that has the ability to share knowledge and support different platforms. This paper first introduced the concept of Virtual Learning Environments and discussed the current status of VLEs at Saudi universities. The literature regarding ideas for cloud computing was then reviewed before proposing an architecture of VLE based on the cloud that supports different eLearning platforms. The proposed system is based on cloud computing because of the multiple advantages it offers to institutions, instructors and students alike. This research aims to show that how cloud computing can be used to support the education sector. In the near future, cloud computing will have a considerable impact on education and solve many issues arising in the sector. There are many resources in Saudi universities that could be shared. Cloud computing is growing rapidly in many areas and it is expected that it should soon have a significant impact on VLE systems.

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