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Cloud based Education as a Service framework for EFFAT University

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Abstract
Cloud Computing has emerged to a great extent in a decade and has been quite a persuasive and attractive paradigm that has innovated and revolutionized the IT Services globally. Business giants have practically moved to cloud for both its effectiveness and efficiency. Beside Corporate Sector, it has also influenced the education sector and there have been a number of services and solutions emerged which has extended the performance of this sector. Thus, this study discuss and compare the technical analysis of cloud computing includes the service levels as well as purpose a cloud based education as a service framework for EFFAT University based on the survey feedback of EFFAT University.

Keywords**:** Cloud Computing; education sector; service framework

1. Introduction

Cloud services are gaining high repute for their robust and fast performance. Currently, the big tech-giants like Google, Amazon, Microsoft, Oracle etc. have all setup their own cloud services – a global network which allows its users to roam their data and applications anywhere around the globe. The Service Level Agreement (SLA) is a contract between a service provider and user that defines the level of service between the service provider and the user [1]. This feature of cloud establishes a sense of commitment and delegation of responsibility between the user and the cloud.

Cloud computing is not only has its fame in the corporate sector but has also influenced the Education sector and there have been a number of services and solutions emerged which has extended the performance of this sector. Globally renowned institutes all across the globe have moved their computing to cloud based services. Massachusetts Institute of Technology (MIT) – a world renowned technology institute has its own Drupal based cloud for its students where students can create their own sites and participate in the community [2, 3].

The vision of mobile cloud computing (MCC) is an autonomous digital environment in which different mobile devices obtain their computation, storage, services and other resources autonomously and efficiently anytime and anywhere [4]. E-Learning using cloud computing supports students from rural parts of the world who will get an opportunity to learn from world class professors [5]. Besides that, student may experience and ubiquitous learning in higher education due to the impact of wireless and cloud applications [6]. In addition, using cloud computing in higher education is an alternative strategy to improve agility in the current financial crisis especially in university [7]. The implementation of cloud computing service can deliver teaching of programming languages while keeping a proper track of activities and also handling factors like plagiarism [8].

In Kingdom of Saudi Arabia, the educational institutions are moving their data from local systems to cloud services which reflects the establishment of cloud computing is extensively used in Saudi education sector [9-11]. In Effat University, the cloud services are already used by both the faculty and the students but there has been no mechanism defined the feedback of the user's experience regarding the cloud services. Therefore, this study identify the service level of different cloud computing system and a survey is conducted within the faculty members and the students of Effat University to study the cloud services user's experience especially for their academic activities.

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2. Methodology

There are 66 participants involved in this survey study, 61 are students and 5 are faculty members. The participants required to complete the research-specific questionnaire. After the survey, the collected data was analyzed and interpreted accordingly.

This study propose the Cloud-based Services for the Proposed Education as a Service Framework in order to provide educational flexibilities to the faculty and the students so that they can have a convenient and innovative experience of both teaching and learning. Figure 1 shows the proposed system architecture diagram.

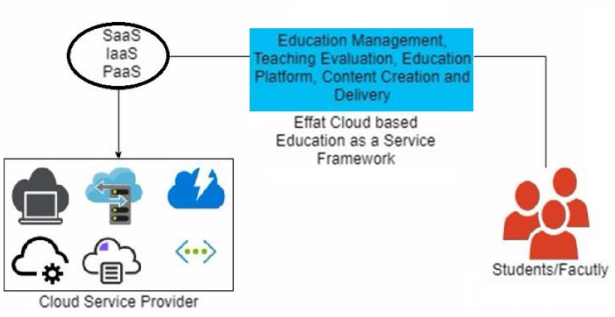

Figure 1: System Architecture Diagram

2.1 Content Creation

The first objective is to facilitate the faculty members to create contents for the delivery of education through cloud platform. In this regard, it is suggested to setup an open source LMS, based on Moodle which would allow a complete control and a robust delivery mechanism.

Faculty or Academic Manager's would be able to setup their classes on the LMS and where they can setup a week-wise or lecture-wise schedule of delivery. Faculty can place their lecture notes, presentations, learning material and much more to facilitate the students. Similarly, they can put assessment activities like Quizzes, Assignments, Practical Activities i.e. Programming simulations etc.

Faculty can also develop interactive learning resource using SCORM package which would allow them to develop tracking mechanism for students and can also setup activities based on these tracking. For example: a SCORM presentation would allow a teacher to setup a quiz once a learner has spent a reasonable time on slides rather than skipping them.

2.2 Content Delivery

The next objective is to setup the mechanism that would help to deliver the contents and in this regard the Moodle based LMS would be helpful because it provides both the content creation and content delivery facilities. The faculty or academic manager will be able to allocate students to the class, which would allow students to access the set content.

Students will access the resources like lecture notes, presentations and even the assessment material. They will also submit their assessment work and quizzes right on the LMS which would create a bounded learning mechanism where everything is going systematically and can be audited.

Faculty can also upload the recorded lectures in form of A/V files or as a link to some external repository i.e. You tube etc or cloud storage. This would help the students to access these resources.

2.3 Education Management

The next objective of the proposed framework is to provide a mechanism for Education Management and here to, the Moodle based LMS will play its role. There are plugins available to integrate renowned services like Turnitin and Blackboard with the Moodle. Hence, once the student will submit their assessment work, it will be automatically tested for plagiarism and the report will be available for faculty to view right along with the submitted work.

Faculty members can directly assess the work on the LMS as it provides a complete interface that would allow them to provide inline comments, formative feedback and finally the summative feedback. Each assessment will be graded and the grades will be reflected in students' individual grade books.

2.4 Education Platform

The next objective is to provide the educational platform to support the learning and in this regard, various cloud-based services will be clubbed to offer a platform both to the students and the faculty. For example, if the faculty member gives an assignment to setup a webserver and make it accessible over the internet, the Compute service of the cloud computing which provides access to a Virtual Machine, will help the student to install and setup a webserver and make it accessible through the internet.

Similarly, cloud storage would allow both the faculty and students to place big files under their respective accounts and access this resource right from the LMS. This provision establishes a direct linkage between the services.

Online classes and online discussions is a highly desired feature by the survey responders and in this regard, the proposed framework provides the provision to setup online classes and discussion forums using other cloud services. For example: Skype for business allows a faculty member to setup a conference right from the LMS for selected class/students.

Additionally, Office 365 will be available and integrated with the LMS which would provide a number of cloud based services to all users. These services will help faculty and students to have an excellent cloud experience where they can perform various tasks with device independence as all these services will be

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accessible through the browser. This service includes MS Word, Excel, PowerPoint, One Note, Outlook etc.

2.5 Teaching Evaluation

Teaching evaluation is the final objective of the proposed framework that would allow the management to analyze the faculty performance. In this regard, the LMS will provide the feedback mechanism which would allow the students to submit their feedback regarding the faculty and the contents delivered. Also, the management can evaluate the performance through various reporting like class grade book, attendance logs etc.

3. Result and discussion

Table 1 tabulated the survey result. Based on the responses feedback from the survey, most of the participants (72.73%) are not aware of the cloud based educational services. About 56.06% of the respondents using any Cloud based Education as a Service at Effat University. About 36.36 % of the participants are interested of new services to be introduced. About 95.45% of the respondents believe that the Cloud based Education Services will be helpful and beneficial to students and faculty at Effat University.

Table 1. Survey Questionnaire Responses

Questions	Yes	No	No Response
Do you have any experience of using Cloud Services?	48	18	0
Are you using any Cloud based Education as a Service at Effat University?	37	29	0
Are you interested that Effat University should provide Cloud based Education as a Service?	24	5	37
Do you think Cloud based Education Services will be helpful and beneficial to students and faculty at Effat University?	63	3	0
To provide cloud based Education Services, do you think a framework is needed?	54	12	0
Are you satisfied with the proposed services?	57	9	0
Do you have any prior experience of using any of these services (even in personal capacity)?	44	22	0
Do you think these services will bring value to your learning experience?	54	12	0
In your opinion, will this Cloud based Education as a Service model will be helpful and effective?	59	7	0

About 86.36% of the respondents satisfied with the proposed services. Some participants use these services with a very limited scope as 33% of the respondents do not have any prior experience of using any of these services. An education framework would be answer to their queries as supported by 81.82% respondents and same percentage of participant think these services will bring value to their learning experience. About 89.39% of the respondents agreed that the Cloud based Education as a Service model will be helpful and effective. Therefore, the proposed model will be an effective solution.

3.1 Technical Analysis of CSPs

The concept of cloud computing has been around since 60s but the first commercial model of Cloud service was developed in 2002 by Amazon and formally launched in 2006 termed as "Elastic Compute Cloud (EC2)" which allows individuals and organizations to rent computers to run their applications and fulfil their computation needs and today Amazon Web Services is the most renowned cloud service provider [11]. However, beside AWS, there are number of other cloud providers including Google, Microsoft and IBM etc. which are also competing in this race of cloud services. This section will cover the general information about these cloud service providers and comparing their scope of services.

Amazon Web Services

Amazon Web Service (AWS) is the considered to be the oldest CSP that is providing cloud services solutions. The top renowned AWS cloud products are:

a. Compute: Under the compute service, AWS allows its customers to acquire virtual machines according to their requirements for running their applications with the flexibility to extend or shrink the resources according to their needs. The commonly used product line under compute is called as Elastic Compute Cloud or Amazon EC2

b. Storage: Under the storage service, AWS allows its customers to acquire virtual storage space that is required for their data in form of files and applications data. Just similar to compute, the storage is also elastic and it is entirely up to the discretion of the user to extend or shrink their storage requirement. The commonly used storage product in AWS is termed as Simple Storage Service (Amazon S3)

c. Database: Under the database and specially the relational database, AWS provides an excellent storage solution termed as Relational Database Service (Amazon RDS) which supports top of the line RDBMS solutions like Oracle, MS SQL, MySQL etc. All these solutions are also scalable as per the needs of the clients.

d. Networking & Content Delivery: Under the networking and content delivery, AWS provides a range

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of network services that businesses and individuals require for their computation needs. These services include DNS, Load Balancing, and Virtual Private Cloud etc. The most commonly used service is termed as Route 53 which is related to DNS and highly used by organizations and individuals who are managing Web services.

Beside these renowned and most commonly used services, following list of services are also available under the AWS services portfolio:

Google Cloud

Google as we all know it as a Giant, is also offering its cloud services however, its appearance in this sector was after AWS. The service profile of Google Cloud includes major services like:

a. Compute: Under the compute service, Google provides the flexibility to its customers for using VMs for their application deployments. This too, gives the flexibility to extend and shrink the resources as and when desired and it is billed accordingly.

b. Storage and Databases: Under the storage and databases, Google provides the similar like storage and database services as provided by AWS. This includes disk storage and relational database(s) as well.

c. Networking: Under the networking, Google provide network related services including DNS, Load Balancing, Firewall etc. to facilitate its customers.

Microsoft Azure

Microsoft Azure is another leading cloud service provider that is actually providing cloud services to a large number of organizations and individuals. The top utilized services offered by Azure are not any different from AWS and Google. It is also providing almost all the benchmarked services like Compute, Network, Database, Storage, Analytics etc

IBM Cloud

IBM Cloud is also in the race of cloud services yet it is not enjoying a strong position as compared to AWS, Azure and Google but still it has a good repute and credibility which is why it is also in the list of top 10 cloud service providers. The services model offered by IBM Cloud is also similar to same of AWS and Google etc.

Oracle Cloud

Oracle cloud is another cloud service available to organizations however; this service is a bit different from the others as it is primarily focuses on the Oracle database and Oracle Application development model. It does provide the features that are common in almost all the Cloud Service Providers but the competitive edge to Oracle Cloud is that it provides a native support to Oracle databases and provides good support towards RDBMS, Big Data and Data Analytics.

Table 2: Service Level CSP Comparison

Service	AWS	Google	Azure	IBM	Oracle
Computer	✓	✓	✓	✓	
Storage	✓	✓	✓	✓	
Databases	✓	✓	✓	✓	✓
Networking and Content Delivery	✓	✓	✓	✓	✓
Machine Learning	✓		✓		
Analytics and Big Data	✓	✓	✓	✓	✓
Security, Identity & Compliance	✓	✓	✓	✓	✓
Mobile Services	✓		✓	✓	
Application Integration	✓	✓	✓	✓	✓
Customer Engagement	✓				
Business Productivity	✓	✓			✓
Desktop & App Streaming	✓				
Internet of Things	✓	✓	✓	✓	
Development	✓	✓	✓	✓	✓
Software	✓	✓	✓	✓	✓
Management	✓	✓	✓	✓	
Cloud AI		✓	✓	✓	

3.2 Cloud-based Services for the Proposed Education as a Service Framework

In the proposed Education as a Service framework, following cloud services are proposed as per the cloud service model.

Software as a Service

This will be the main set of services under the proposed framework involved two different software namely Moodle LMS and Microsoft Office 365 for Education. The Moodle LMS used as the main application that will practically manage the whole framework. It will comprise of following embedded features:

a. Attendance
b. Assignments
c. Feedback

d. Forum
e. eLibrary
f. Blackboard
g. Assessment
h. Reports
i. Online Classes
j. Parental Control

Alongside Moodle, the software application would be Office 365 which will be integrated with Moodle through a public API. Office 365 will provide following features:

a. Word
b. Excel
c. PowerPoint
d. One Drive
e. Skype for Business
f. Lync
g. One Note
h. SharePoint
i. Outlook Email

Platform as a Service

PaaS will be a supportive model for education platform. This will provide the faculty and the students with the virtual environment where they can actually deploy/implement various activities. This would be more effective for IT and engineering students as these features will be more IT centric. This model will include:

- Windows Azure – It will provide a default environment for in-built services within the Microsoft Azure.

- SQL Azure – It will provide services related to Databases.

- Power BI (Business Intelligence) – it will provide a good analytical and reporting tools that would help students especially with the data mining and data reporting tasks.

Infrastructure as a Service

Similar to PaaS, IaaS will also be a supportive model for the proposed framework. This too, will be helpful for the faculty and the students to have an excellent learning experience. Students will be able to create their student accounts on Microsoft Azure which will be free for 1 year. On this account, they will be allowed to setup Virtual Machines and configure network services. They will be provided with the pre-installed Windows or Linux operating system on these virtual machines. Under the network services, they will be able to configure DNS, Load Balancing and other network services to have a hands-on experience.

Why Microsoft Azure and Office 365?

The reason for proposing Microsoft Azure Cloud and Office 365 for Education is because Effat has already acquired Office 365 subscription and since it is a registered University therefore, Microsoft, to promote education, has provided these features to faculty and students free of cost.

Additionally, it has also provided API and plugins for integrating with Moodle hence students and faculty will be able to access all these services right from their Moodle account. A Single-Sign-On SSO can also be setup using OAuth service with Moodle. Office 365 provides wide range of services which are quite familiar to both faculty and students i.e. Word, Excel, PowerPoint, Outlook.

4. Conclusion

This study allows Effat University and other educational institution to implement cloud framework within their institution and provide benchmarked IT services to its students and staff for the better delivery and learning experience. This allows them to benefit by Cloud Computing where they can offer a world of services on a very cheaper price. This solution would be extremely cost effective for the organization.

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