

CLOUD BASED E-LEARNING MODEL FOR ETHIOPIAN EMPLOYEES

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ABSTRACT

Many institutions across the world have been trying to upgrade/transform their educational systems to reduce the cost of learning with high comfort. Ethiopian education system is one of them, which is has been facing critical challenges to afford the education extensions & teaching facilities. This problem becomes critical to those who are Employees, disables and females with pregnancy or the learners who cannot join the classes on regular basis with traditional teaching learning processes like regular, summer, extension and distance education. In recent years, few institutions in Ethiopia tried to encounter accessibility barriers by adopting advanced learning & teaching systems but acceptance level of such systems is still not satisfactory and popular. However, it has been observed that there is a strong and urgent need to have better and alternative educational platforms with extensive accessibility. The strategic shift from traditional classroom to e-learning and e-learning to cloud based learning can be a promising change and significant improvement for next generation teaching- learning environment. To achieve this, a Unified Cloud based E-Learning Model (UCELM) was proposed and functionally tested using Cloud Services opens source application.

KEYWORDS

UCELM, Disables, Females, Employees, Cloud Computing, E-learning.

I. INTRODUCTION

The opportunity of higher education has become a great challenge in Ethiopia due to the population growth and the shortage of educational institutions and facilities. Although the government is striving to fill the gap of teaching professionals through hiring the foreign professionals, still both the quality and quantity of education is not achievable.

The studies [1][2] [3] have also been experience that governmental organization and academics institutions have been facing critical challenges for how to upgrade their ICT and E-Learning systems and daily losing their data within on-premise IT infrastructure. Not only this, the limitation of sharing academics resource for online study especially for busier professionals still another issue that setbacks the accessibility and wide extension of education to everybody. Therefore; due to all aforementioned challenges, contextualized alternative teaching method is expected to be a better solution for improvised data storage, long term sustainability, suitability, easy upgradability, resource Sharability and extension of higher education with low cost and better comfort so that Employees and learners can learn anywhere at any time based on their comfort and need. Using cloud computing, higher institutions with voluminous data such as education system would be better beneficial because this technology provide services elastically [4] [5] [6] [7]. Many educational institutions across developed and developing world including Ethiopia have tried to implement the on-premise e-learning systems in order to support learning to extent accessibility of education to a broad spectrum to solve learning demand of learners but unfortunately, the cost for IT infrastructures is not affordable to numerous organizations. Even though the e-learning solves the several challenges and problems of traditional education platform but still there are several problems such as software purchase, frequent system update, cost of maintenance, scalability, flexibilities, integration, and need based contextualization of educational platforms [8] [9] [10]. Today cloud computing has widely proved to be an alternative way out for educational computing, communication and collaboration with better profit margins as it reduces the cost of hardware and software and improves the efficiency of delivery of computing resources via internet. In addition, it helps for energy conservation as research identified that more different data centers have the largest power consumption [11] [12]

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[13]. The central motivation of this research study is to bring remedial solution to solve the problem that is faced by Employees, academics institutions and learners community for ease of access to education with improved facilities like anytime, anywhere over any device alongwith comfort and convenience. This is aimed to the whole country into forefront line of digital education and transformation that lead to significant change of economy and educational quantities & qualities. The main objective of this study is to analyze the current challenges in existing education delivery systems and platforms and designing an alternative cloud based model with better suitability, comfort, convenience and improved facilities for the learners' community.

1.1 The Problem Investigated

The access to academics learning resources, and protecting of data in a traditional IT infrastructures now has become an unsolved problem. The stakeholder being affected mostly are Employees , people with disability, Females with pregnancy and, government officials who are not able to access education to upgrade their knowledge and credentials on regular basis. Not only upgrading the existing e-learning system, maintenance and cost of the software are another big issues that setback the prosperity of academics institutions and individual who want to resolve their learn issues. These strongly affected Employees are private/Govt employees, disables, and females with pregnancy who are not able to afford cost of self-sponsor and others living expense such as; transport cost from far distant to school centers. In related situation, physically challenged groups such as disables and pregnant women are not able to travel and get school far away from their residential places but unfortunately, the current educational systems failed to resolve such problems in Ethiopia. Another big problem is with working employees who are staying away from latest technology that can promote and develop their technical skills through available online training and certification programs [14] [6]. Aforementioned problems are declining the quantity and quality both in terms of educated or trained professionals. In recent years few universities and colleges in Ethiopia have adopted advanced teaching learning systems like e-learning over their owned and managed e-learning servers but acceptance and success level of these systems is not satisfactory and wider popular because the sector has limited research studies that can support for better educational analytics and technology supported modeling in Ethiopian context. The reasons behind such learning challenges are wider and to be investigated, examined/measured and then an alternative technology model over cloud is aimed to be designed for resolving the enlisted issues and challenges. Supplementary, it is still unknown that what are the challenging factors and what kind of systems should be needed for next generation teaching/learning in Ethiopian context that can support Employees ' development in their respective working organizations. This research study has tried to answer the following research questions:

- What are the basic learning challenges faced by Employees, disables, females with pregnancy?
- What are the challenges that could not be addressed by existing e-learning technologies?
- What kinds of educational model over cloud can be able to resolve such challenges of Employees?

II. REVIEW OF RELATED WORKS

To understand the domain; the technical concepts used in this this research study are reviewed. A rigorous review of related and previously research works done on this domain was done. The reviewed papers were evaluated as presented in the table 1 and prioritized based on their three parameters; Relevancy to the research domain, Quality of Journal, the year of their publication (latest).

Table-1: Review of Related Literature with Critical Remarks

No.	Author & Year	Title & Journal Names	Major Findings, Contribution and Conclusion	Critical Remarks & Research Gap
1	Rumana Javali, 2016 [15]	Cloud Computing in Education System (<i>International Journal of</i>	The researcher find that Cloud based can reduce infrastructure costs, increase ease of access, make possible collaboration, and enhance flexibility and customization of software based on	The research showed great contribution by introducing the core advantageous of cloud computing in education but failed to design a model that can be used in education systems

		<i>Advanced Research in Computer Science and Software Engineering)</i>	the need of organization and modernization learning by introducing technology to classroom can increase student's learning opportunities while improving students' skill. Researcher quantified the advantage & drawback of cloud computing.	transformation with contextual need of Employees, disables and females with pregnancy.
2	Kiran Yadav 2014 [16]	Role of Cloud Computing in Education <i>International Journal of Innovative Research in Computer and Communication Engineering</i>	The research presents how cloud could be a better alternative in higher education and benefit to learners' community, educators & institutes.	But research failed to address the way forward especially for how to implement this technology by using both functional & theoretical model over cloud.
3	Alemseged & Prof DP Sharma, 2016 [13]	Suitability analytics and cloud computing adoption modeling For educational institutions <i>Pezzottaite journals</i>	In this research study, researchers tried to develop a cloud adoption model for higher educational institution in Ethiopian context with study of Arba Minch university as case analytics. And model was developed for Arbaminch university with shallow scope.	This study is relevant to the proposed research but it does not cover the opportunities and challenges in higher education delivery for Employees, disables and females with pregnancy in convenient and cost effective manners in Ethiopian context. But our study made survey for the challenges that prevent Employees to learn and developing the model.

Sources: Authors Compilation

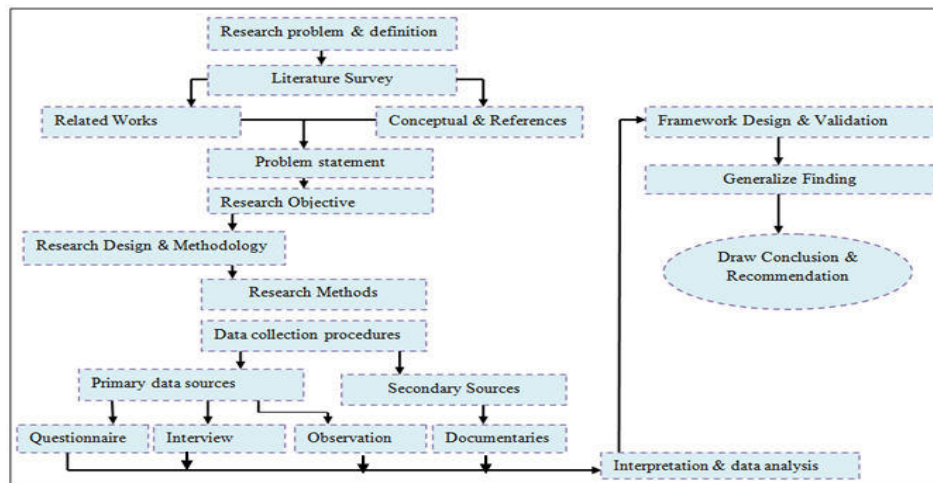
III. RESEARCH DESIGN AND METHODOLOGY

Research Design & Approach

The design of the study is mixed of i.e. exploratory and applied research because the study problem is in preliminary stage as only few researches are conducted the research in this domain with contextualized parameters. A mixed design is the best approach if the study requires both quantitative and qualitative designs to analyze the problem attributes. An exploratory applied design gives a clear view of the problem, familiarity of idea, develop a model and test.

In order to answer the research questions and achieve the research objectives, the study followed general research approach using chosen methods & tools for statistical analysis of stakeholders' inputs qualitatively and quantitatively using questionnaire, document analysis and technical observation. In order to find out the critical gape, from the previous work done, several related works published in journals, research reports, thesis project were critically reviewed and summarized. To synthesize what researcher has proposed to do through the study, the researcher summarized the flow of works as presented in the figure 1 of how this research study was done.

Figure-1: Research Process Flow and Methodology



Sources: Authors Compilation

IV. DATA ANALYSIS AND DISCUSSION

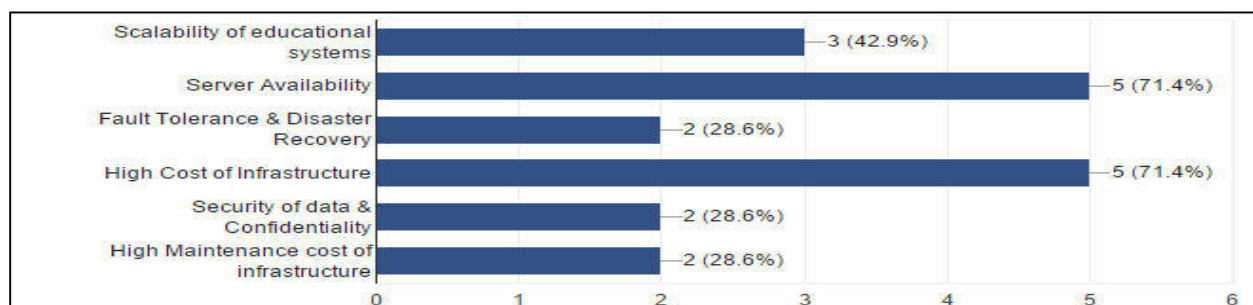
This research study conducted 1) Interview of education and ICT experts, 2) Technical observation by researcher self and 1) survey for investigation, for collecting views and need input of salient stakeholders (Employees) like teachers, managers, secretariats official and others employees about the learning challenges in existing learning delivery systems and their learning perception over cloud to support their learning accessibility as primary data input of the study.

A. Existing Technical Challenges in Traditional & in On-premise E-learning

1. The major challenges faced in the current traditional / conventional or existing e-learning environment (You may select/tick one or more options).

According to the responses as presented in the figure 2, on major challenges in both traditional classroom & e-learning platform, it is observed that the high cost of infrastructures and server availability with 57.4% are the biggest challenges facing the usability of traditional e-learning delivery methods. Furthermore, another challenge is scalability with 42% of both traditional systems, 28.6% are lack of fault tolerant & disaster recovery, cost of maintaining and security of data confidentiality. This has also verified as the highest correlation with the research findings in the review of the literatures. In addition, it was revealed that the on-premise e-learning & traditional learning platform have highest cost of infrastructures i.e. 71.4%.

Figure-2: Challenges faced in the Current Traditional Education System



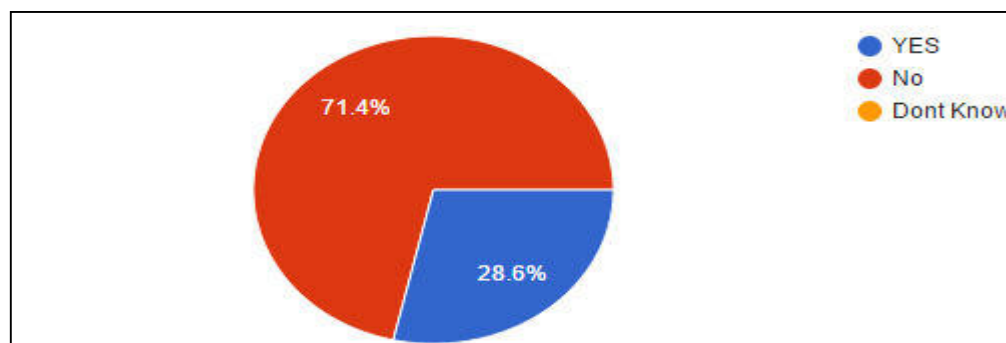
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B. Responses of Respondents on Current E-learning Satisfaction in Educational Delivery

Are you a working professional and satisfied with current education delivery systems in traditional/conventional or e-learning systems?

Based on the responses of the respondents (as in the figure 3) on how these traditional delivery methods impact their learning experiences? It was identified and observed that the highest 71.4% strongly expressed their dissatisfaction with the current learning platforms. In addition, 28.6% expressed good concern in these traditional deliveries. This proved that different learners have different learning preferences. May be learning in this system satisfied their learning need and demand. This clearly reveals that two third majority of the target stakeholders need an alternative education and training delivery systems for their convenience and comfort

Figure-3: Employees Satisfaction Level

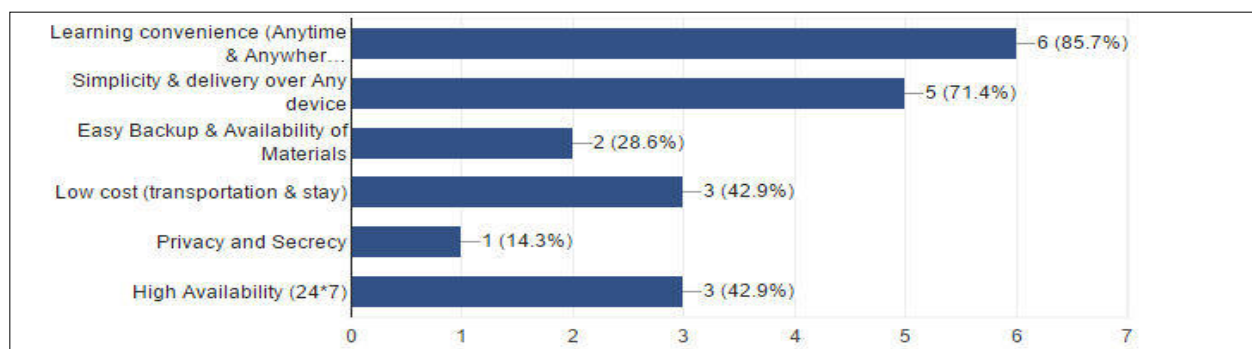


Sources: Authors Compilation

3. Which amongst the following do you believe to be expected benefit of learning over the cloud than traditional e-learning for higher education by Employees? (You may select/tick one or more options)

According to the responses of the respondents as presented in the figure 4, it has been observed that Employees like and prefer to move towards the learning platform over the cloud for their learning convenience that have highest degree of 85.7% which is not available in others learning platforms and this is strongly supported by the research [17], Cloud computing have high interoperability for the salient types of access devices. Furthermore, high availability also ranks third with 42.9%. In addition, devices interoperability with 71.4% is the second significant use of e-learning over the cloud. All these were the keys motivations too much company as the study [8] revealed about the availability, devices interoperability & cost cutting which are the main factors for migrating data/information/ systems like learning systems over the clouds infrastructures.

Figure-4: Expected Benefit of Cloud Computing in Higher Education

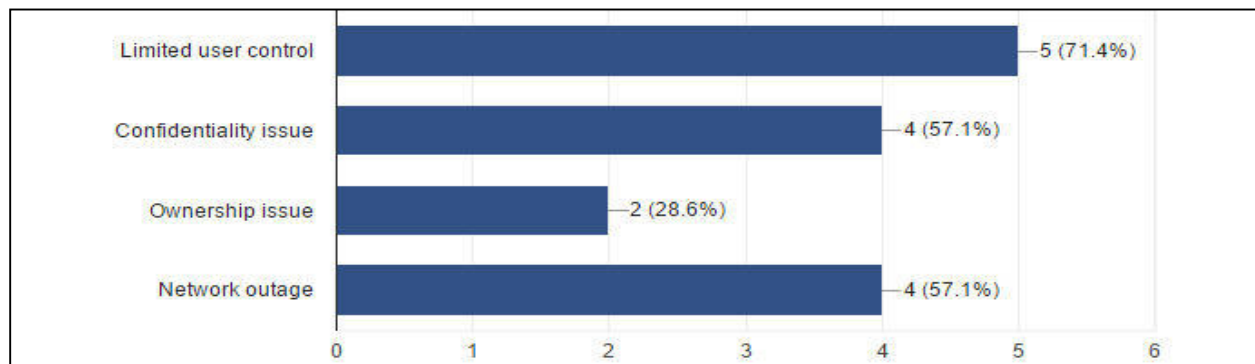


Sources: Authors Compilation

4. Which amongst the following you believe to be a main challenge for the implementation of cloud based learning in higher education for Employees? (You may select/tick one or more options)

The users' negative reactions over cloud based e-learning implementation are found limited to user control over the system with 71.4% and presented in the figure 5. The confidentiality issues & network outage 57.1% respectively and are significantly not important. The ownership issue with 28.6%, which is most likely because owners always like to own their data in their own hands but they also accepted during fact findings that maintenance and owning security is not only costly but challenging these days in connected world. These issues can be resolved by implementing hybrid cloud and with appropriate Serve Level Agreement (SLA) as research finding recommended.

Figure-5: Main Challenges for Cloud Computing Implementation



Sources: Authors Compilation

Critical Analysis

In the table 2, the features based critical analysis was done by researchers using observation and facts collection and finally supported by secondary sources.

Table-2: Feature Based Critical Analysis of Existing Learning Platforms vs. Learning over Cloud Based

S/N	Parameters	Traditional Learning	E-Learning	Cloud Based Learning	Critical Remarks
1.	Security	Low	Medium	High	However Cloud based learning platform ensures promising security under SLAs.
2.	Accessibility	Low	Medium	Medium	Every one having mobile or any hand held device can access e-resources over cloud via the internet.
3.	Scalability	Low	Low	Very High	Cloud based learning systems promise high scalability (vertical / horizontal) with no geographical limitations.
4	Flexibility	Low	Medium	Very High	The contents of cloud-based management are very dynamic. Anyone can customize but this feature does not exist in existing learning platforms.
5	Storage	Low	Medium	Very High	Both traditional learning and e-learning systems have limited storage capacities but in case of cloud it's unlimited and 24/7 scalable with fast upgradability.
6	Blending	Low	Medium	High	Only one or two style of learning existing in both traditional teaching methods but over cloud variety is available.

7	Collaboration	Low	Medium	High	Class based & on-premise eLearning teaching methods have limited interaction in 24/7 model for learners but cloud based is 24/7 anywhere over any device.
9	Compatibility	Low	Low	High	The cloud based learning platform has better compatibility because it supports all accessible devices. It supports cross platform.
10	Infrastructure Cost	High	High	Very Low	Both traditional platforms need high capacity infrastructures and the cost of maintenance, and installation are very high but over cloud based only internet connection needed and rests are very low or almost negligible.
11	Fault Tolerant	Low	Low	Very High	Cloud based education systems have better fault tolerance and reliability because the cloud service providers promises 99.99 percent uptime. The on-premise eLearning & traditional class room method are not high fault tolerance and all time available.
12	Disaster Recovery	Low	Medium	Very High	In traditional or on premise eLearning methods, there is limited provisions of disaster recovery but over the cloud, the offsite replication and redundancy of servers ensure high disaster recovery and promised under SLAs.

Sources: Authors Compilation

V. PROPOSED MODEL

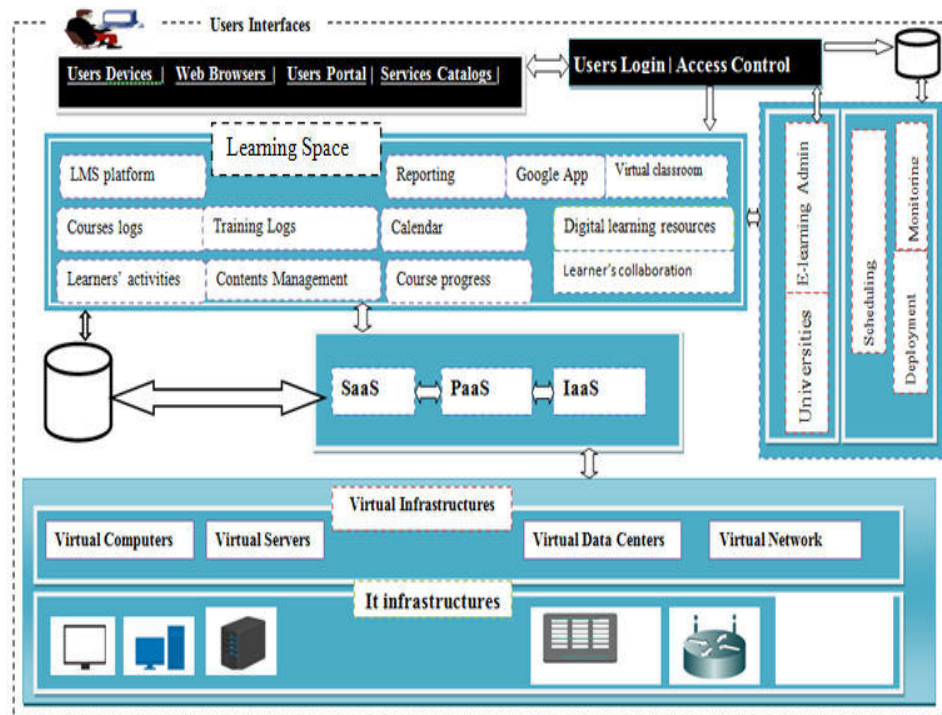
Technologies have been changing with fast speed. The existing systems, Models in educational domains are required to be reviewed, restructured and redesigned in align with evolving technologies so that they can survive for a longer time in highly competitive global environments. The International Society for Technology in Education (ISTE) based standards clearly revealed a new idea that education delivery systems should transform from traditional to technology-enabled environment for learners and educators. Currently the COVID-19 pandemic has also proved that we must have alternative teaching learning systems to alleviate the emergencies and disasters. The proposed model fits to solve problems of learning challenges is Unified Learning method and it can be deployed over the cloud platform as a Unified Cloud based E-Learning Model. The Unified-learning platform is defined as:

$$\text{Unified Learning} = \frac{f(\text{time, space, path, place, teacher, resources})}{\text{individual learning objective}} + f(\text{Mobile Technology})$$

Implementation of Unified E-Learning Model

In the literatures review, it has been clearly observed that the existing eLearning systems of both traditional and on premise have a lot of limitations/short comings and challenges that are faced by higher education systems and their stakeholders. However, the proposed Unified-learning model over cloud in Ethiopian context can be better and alternative learning platforms that can be the best fit in localized system attributes. Also existing or pre adopted Ethiopian curriculums can easily adopt and install over the cloud platform to achieve the flexibility in Hardware/Software/Communication (HW/SW/COM) services, high accessibility, and cost effectiveness with high security and high scalability of learning system without any disparity. Here the entire teaching-learning process is required to be migrated from either traditional or e-learning to cloud based teaching-learning environments/platforms. All the Advanced features and add on services can be easily availed when needed in education delivery when it is migrated over cloud. The figure 6 presents the proposed i.e. cloud based unified e learning model.

Figure-6: Unified Cloud based E-learning Model (UCELM)

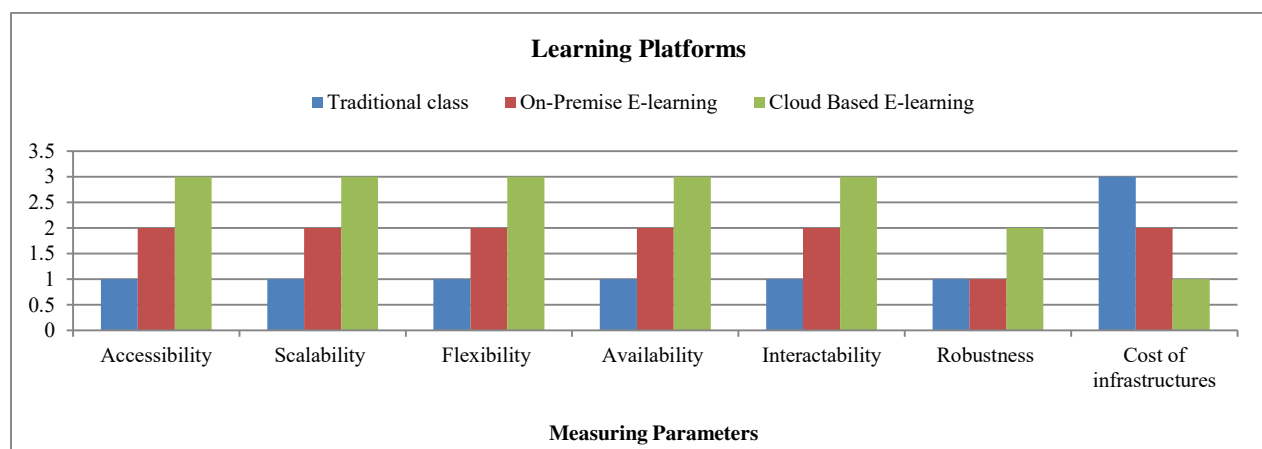


Sources: Authors Compilation

Processes of Unified Learning Model

The proposed model does not change or alter the features of the existing learning platforms (i.e. Traditional Class Room Learning, E-Learning over localized Intranets/servers) rather, it just promises to enhance and integrate all the best features together so that Employees can have sufficient choice to choose among different learning styles /platforms they want. In addition, cloud is advised to be the best amongst all. The figure 7 clearly compares the three specified learning platform features with quantitative measures and justifications.

Figure-7: Comparison of Learning Platform Features



Sources: Authors Compilation

The proposed model has several components which are described in the table 3.

Table-3: Description of the Model

No.	Layers	Description
1	User Interface & Access control	This layer of the model (as presented in the figure 6) is the first entry layer of the proposed model. Here the users can use to access the education service or resources over the cloud infrastructure. It includes the browsers platform, different website links, users' portals, and services catalogs. In this design users can uses any access devices using any browsers. In addition, before accessing any services, the users should pass through services catalogs. This services catalog contains services that are available within the Unified learning system. Afterwards users can choose their services or program preference based on their interest and after users choose their preference program, the users can create his/her course portal site. The admin within the university can provide limited access control to users through cloud infrastructure interface. After the user created course portal, they can access the Unified learning spaces layers that rely over the Software as services platform. The authentication and authorization will be done using the Users Login and access control sub-layer to verify the entered users' credentials. Afterwards the system forwards the users' request to the appropriate component in the same layer or may be in the different layers as well. Furthermore, this layer has full access to the Services layers, which comprises of the following components: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and SaaS (Software as a Service). The users can use; different access devices like, thin client, user portals and services catalogs to access different services and offers within the cloud model. The Users devices can be any device that can support web-browsers, Users portal are gateway or entrance that users can use to access cloud services via their users accounts. Services catalogs when the users successfully login to the system. The users can be directed to which service that the best suit to his/her needs. In this design, the users include Employees (students/learners), faculty, administrator, or others who can be created by the system's administrator and managed by several types of users like Admin & Student themselves. This system is proposed be controlled by the universities and ministry of education as policy negotiators with cloud vendors under the hybrid Cloud governance provisions.
2	Unified Learning Space	After the users successfully registered, the system directs them to a layer where the users can use the different SaaS applications and other cloud based educational tools that are integrated for learning support to the Employees. In this layer (as presented in the figure 6), the Unified learning resources are populated so that learners' communities can access them using any device through their registered web portals. The experienced users such as developer, Lecturers and professionals can develop, design and deploy their applications over the cloud services and can indirectly access public cloud services and some advanced services such as Platform as Services & Infrastructures as Service based on their demand.
3	Service Layers	In this layer (as presented in the figure 6), the users can get everything/anything as services. These services are Software as Services (SaaS) that Unified different resources to enhance the learning environment. SaaS gives clients to access over different application gadget through system interfaces. Over the Platform as Services (PaaS) platform users can have control over their application development and deployment. In this regard, advance users can place advanced program. Virtual Infrastructure i.e. Infrastructure as a Service (IaaS), level provides better flexibility that includes; the Hardware layer through the virtualization of ICT infrastructure such as servers, computation, Network and Data Centers. The notion of implementing IaaS is the utilizing ICT Infrastructure to overcome the resources boundaries. In this model, public Cloud is embedded with Infrastructures so that the users can access virtualized service in the

		Unified learning space within the public or virtualized with in hybrid cloud.
4	Cloud Management	The proposed cloud model's e-resources are designed to be managed by higher education in collaboration with the ministry of education. In this platform layer (as presented in the figure 6), ministry can work as negotiator that can agree with cloud vendors for liability and policy of the service based on the service level agreements (SLAs). Within this management layer there are cloud build in management service. These services are; performance and scheduling service that report cloud model performance to its adopter's different tasks and activities scheduling and cloud deployment management policy.
5	Database	This layer (as presented in the figure 6) is the place where the user log, courses, training, contents and all others service data are stored as a centralized repository but distributed over replicas and used and managed by the hosting institution.

Sources: Authors Compilation

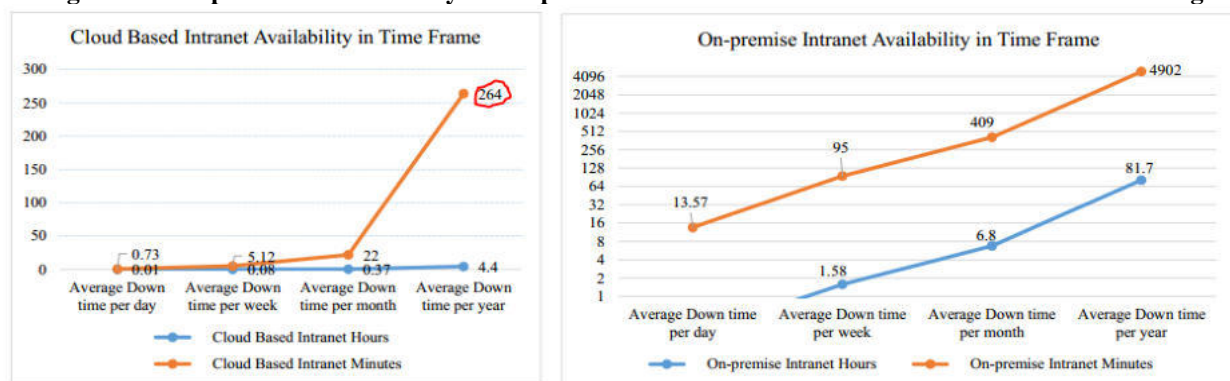
VI. EVALUATION OF THE MODEL

In this model, the existing educational delivery in both traditional & on-premise eLearning platform verse education over Cloud has been evaluated for their performance in terms of high uptime (*availability*), *On demand needs fulfilment (scalability)*, *On demand provision and provision of products and services (flexibility)*, *Promising reliability with Least downtime (reliability)*, *Cross boundary usage over any electronic device (accessibility)* and *Promising optimized performance under SLA (performance)* in the real world computing and communication scenarios of higher education environment.

User's acceptance & Availability of System

Available of educational e-resources over the server is the most critical challenges in many academics' institutions. The 99.99% of On-premise/traditional eLearning is not guaranteed while 99.99% from the cloud counterpart is guaranteed. Due to these challenges there is no or poorly guaranteed availability for e-learning over existing platforms. There is no such SLA provided by existing e-Learning service providers as on date in Ethiopia. Hence cloud based eLearning platform can definitely promise 99.99% uptime availability. The figure 8 shows the output comparison of On-premise E-Learning over localized intranet vs. Cloud Based Intranet Availability based on 24/7 requirement. This challenge has already been investigated and proved for high uptime assurance services over cloud.

Figure-8: Comparison of availability of On-premise vs. Cloud Based Intranet Services like E Learning



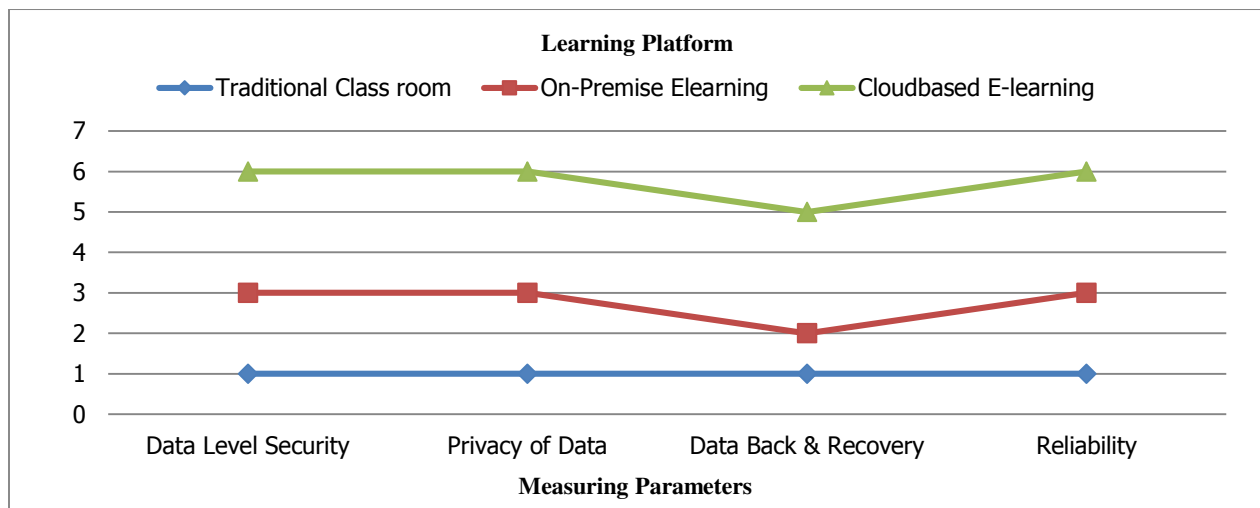
Sources: Authors Compilation

Security, Reliability and Privacy

During the survey, security, privacy and reliability of the data over the cloud platform were criticized. Apart from this; there is another angle, where different stakeholders also understand and feel that these challenges are also associated with both the traditional education system like; Traditional class method and On-premise E-learning methods. Researcher decided to compare these challenges against three learning platforms with special reference and

focus of learning objectives of Employees. The critical observations with argumentations of the results are presented in the figure 9 (plotting point graph). As a final note, security, privacy and reliability perspectives conclude that cloud based education system have better and promising data security, privacy and reliability with recovery commitment and guarantees under SLA however traditional system or e-educational system over local intranets or web servers are missing such provisions under SLA, even no SLA exists in their practices.

Figure-9:1 Data Reliability, Security & Privacy Comparison



Sources: Authors Compilation

VII. CONCLUSION

In this research work, status of education access for Employees, benefits of shifting e-learning over cloud platform and its limitations have been carefully studied and analyzed with different perspectives and parameters. During information gathering & analysis, researcher grouped the questionnaire under four different categories based on the stakeholders' responses to research questions and associated problems. Demographically the participants in the survey were managers, technocrats, secretarial staff and officials. The respondents clearly responded the education challenges in traditional classroom delivery systems and eLearning over web or intranets i.e. 87.7% limited time to attend the schools, poor technical feasibility of On-premise e-learning i.e. 71.1% for Employees, 85.7% respondents perceived that the cloud platform can be better option for learning convenience to the Employees and the 71.1% Employees agreed to move education system over the cloud to harness the cloud's potential features like *high uptime (availability)*, *On demand needs fulfilment (scalability)*, *On demand provision and provision of products and services (flexibility)*, *Promising reliability with Least downtime (reliability)*, *Cross boundary usage over any electronic device (accessibility)* and *Promising optimized performance under SLA (performance)*, *better security, privacy and robustness of the system at low cost*. Different inputs from different stakeholders pointed out that both traditional education delivery system and non-contextualized cloud platform might not improve the Ethiopian education system for Employees. Therefore the proposed Unified Cloud based Education Model (UCELM) can be an important instrumental and guideline to reduce the existing challenges faced by Ethiopian Employees. Also this model can reduce the complexity of the previously adopted cloud based models that lack contextualization of Ethiopian learning systems. For the deployment of the model, Amazon & Azure were selected to be the best for the model deployment based on the suitable functionalities to support Software as Services (SaaS). Here the cloud based Learning Management Systems (LMSs) were compared and Talents was selected to demonstrate the learning collaboration of the model's users. The Unified structure of designed model, the researcher concluded that this model can significantly reduce many of the aforementioned issues and challenges that hinders extension of higher education to the door of learners especially Employees, disable and females with pregnancy.

VIII. RECOMMENDATION

During the research survey and data analysis, it has been found that the higher education needs an alternative learning platform that can support Employees. In this regards the researcher likely to recommend that; the proposed Unified Cloud Based Education Model (UCELM) need full implementation over real sites so that's its full potential benefits can be explored and recommended. And it should be checked for all the stakeholders like academicians, institutions and government to invest on most suitable platforms of education to serve better as the future generation of educational systems

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