**DEBREBERHANUNIVERSITY**



**DEBREBERHAN SCHOOL OF POST GRADUATE STUDIES DEBRABERHN INSTITUTE OF TECHNOLOGY DEPARTMENT OF COMPUTER SCIENCE & INFORMATION**

**E-RESOURCE MANAGEMENT IN USING CLOUD COMPUTING ADOPTION IN RESOURCE LIMITED CONTEXT:**

**(THE CASE OF HARARI EDUCATIONAL BUREAU PUBLIC HIGH SCHOOLS)**

**MASTER’S THESIS**

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**DEBRE BERHAN UNIVERSITY SCHOOL OF POST GRADUATE STUDIES DEPARTMENT OF COMPUTER SCIENCE**

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**A RESEARCH PROPOSALUBMITTED TO THE SCHOOL OF POST GRADUATE STUDIES OF DEBRA BERHAN UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN INFORMATION TECHNOLOGY**

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# Declaration

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# Acronyms and Abbreviation

|  |  |
| --- | --- |
| **Abbreviation** | **Long term meaning** |
| API | Application program interface |
| AWS | Amazon web service |
| BYOL | Bring your own license |
| CBT | Computer based Training |
| CC | Cloud computing |
| CD | Compact disk |
| CSP | Cloud service provider |
| DARPA | Defense Advanced Research Projects Agency |
| DEVOPS | Development to deployment |
| DVD | Digital versatile disk |
| HTML | Hyper Text Markup language |
| IAAS | Infrastructure as service |
| IBM | International Business Machines |
| IBT | Internet based Training |
| ICT | Information communication technology |
| LMS | Learning management system |
| MIT | Massachusetts Institute of Technology |
| PAAS | Platform as a service |
| PAYG | Pay as you go |
| QOS | Quality of service |
| SAAS | Software as a service |
| SLA | Service level agreement |
| TOE | Technological Organizational Environmental |
| UNDP | The United Nations Development Program |
| VOD | Video on demand |

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# Abstract

*Last decades witnessed a huge paradigm shift in the field of computing world. This shift is from traditional stand alone systems to Cloud enabled computing systems which are based principal theme of sharing pooled resources based on demand pay-per-use model. Harari regional government and private high schools assign lots of budget for ICT infrastructure like thin client, plasma, Video on demands (VOD) Technology each year to enhance the use of E-resources. But due to many factors and improper maintenance, management and distribution of resources they fail to ensure the optimum utilization of these resources. High Schools of Public in the Harari Region suffer from common problems like inflexibility associated with E-Resource services, lower levels of efficiency, poor maintenance, unequal distribution of information resources and huge costs involved in managing the entire Information and Communication Technology(ICT)infrastructure. The main aim of this study is to examine the current state of art of maintenance, management and distribution of electronic resources and designing a framework that can enhance the existing practices. This study is an exploratory and applied design science research in which a preliminary survey is proposed to assess the existing status and facts to design E-resource maintenance, management and distribution framework using cloud enabled platforms to demonstrate the finding as a prototype.*

*Keywords: -E-resource, cloud computing, thin client, plasma, video on demand*

# CHAPTER ONE

# Introduction

## Background

National Institute of Standards and Technology (NIST) defines the cloud as “a huge pool of easily usable and manageable virtualized resources such as hardware, development platforms and/or services. These resources can be dynamically reconfigured to adjust to a variable load allowing for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized Service Level Agreements (SLAs)”.

Cloud computing became one of the essential technologies in the last decade. The conventional information technology (I CT) setup requires the same location as the data storage device. However, in cloud computing, one can access and update information through the internet from anywhere at any time. Data from the cloud is accessed by a wireless/wired or mobile broadband connection. The common example of cloud computing is webmail, where the service provider maintains the server space and allows access to email service based on their email address and password. Cloud computing provides a variety of services depending on organizations’ requirements. Major services are Software as a Service (SAAS), Platform as a Service (PAAS), and Infrastructure as a Service (IAAS). .In the recent years, there has been an increasing interest in the development of e-learning systems to enhance the quality of teaching and learning in secondary schools and to implement e- learning systems without procuring and hosting ICT infrastructure in their premises.

. Educating citizens also ask the governments’ high commitment and responsibility to invest on education in order to educate their citizens well. Student intake capacities in Ethiopian High School are on the increase from time to time t h e s a m e rate in Harariregion.This Region is one of the nine regional states that form current federal democratic republic of Ethiopia. It is situated on eastern spur of southern Ethiopian mountain massif. Latitude and longitude location of the region is between 1N-25N and 42.04E-42.22 .E respectively. The city of Harar is the only urban center of the region and located at about 350 miles or 526 Km from Addis Ababa, the capital city of Ethiopia [ 1 ]

In Harari region there eight public and six private high schools but all schools are working individually to enhance their Education services and resources. To meet the information needs of their patrons at all levels. Without quality service, establishing Education by itself cannot be the solution we seek for. Education should be supported by information technology (IT) infrastructure, web2.0 applications, enough information resources, up-to-date information and services with better ystem for delivery. Sharing resources among Schools define the “notion ofwhatmakesEducationsuccessful“Itisobviousthatschoolsare notonlya knowledgeocean;it stimulate a timestoprovide satisfactoryservicesforallthe users[2]. Sointhe newera,Schools shouldimprovethemselvesconstantlybysharing resourceandinformationtechnologies[3].But inexistingsituation PublicandprivatehighschoolsintheRegionsuffer fromcommonproblems like flexibilityassociatedwith E-library services,lower levelsof efficiency, unequaldistribution of informationresourcesandhugecostsinvolvedinmanagingtheentireInformationand CommunicationTechnology(ICT) infrastructure.If the conceptof cloudisappliedinallthe SchoolstheywillhavechancetoaccesssimilarE-resources.

## Statement of the problem

The successful implementation cloud based education in Ethiopian school is hindered by a multitude of factors ,including in adequate technological infrastructure, organizational readiness, stake holder acceptance , and community support. These challenges pose significant barriers to the effective integration of cloud –based learning in to the educational landscape.

Specifically, the research seeks to address the following key issues.

* Technological infrastructure: the limited availability of reliable internet connectivity insufficient devices, and in adequate IT Support hinder the effective implementation of cloud based education
* Organizational readiness; schools may the necessary leader ship commitment, financial resources strategic planning and established policies to support cloud based education.
* Stake holders acceptance; teachers, students, parents and other school stuff may have varying levels of readiness and acceptance for the transition to cloud based learning.
* Community readiness; the local community support for cloud based education may be influenced by government policies, internet infrastructure, school preparedness, and community receptiveness

## Research question

Q1. Is the school’s technological infrastructure, including internet connectivity, devices, and it support, sufficient to implement cloud based education effectively?

Q2. Is the school organizationally prepared to implement cloud based education considering factors like leader ship commitment, financial resources, strategic planning, and established policies?

Q3. Is cloud based education feasible and beneficial for all stakeholders involved(teachers, students, parents and other stuff members)?and Are they ready for the transition

Q4. Is the local community ready to adopt cloud-based education, considering government support, internet infrastructure, school preparedness, and community receptiveness?

Q5. Is the school prepared to implement cloud-based technology considering its infrastructure ,resources, facility, leadership and strategy?

## Objectives of the study

### 1.4.1. General objective

The general objective of this study is to investigate how cloud computing will be used to enhance better utilization E-resources Service and to develop cloud based prototype that enhance utilization of E-resource among Harari education bureau public High schools .

### 1.4.2. Specific objectives

* To assess a school readiness for technology based by learning, by examining factors liken internet stability ,device availability , it infrastructure and teacher proficiency
* To determine if the school has necessary foundation and support structure to make a smooth transition and effectively manage cloud based education with in its systems. This analysis helps identify potential challenges and allows institutions to develop a comprehensive plan for successful implementations.
* To gain knowledge and insights that can be used to make better decision or take informed actions and to diagnose the root cause of problem and inform the development of effective solutions.
* To determine the institution’s capability and suitability for adopting this educational approach by analyzing how government and internet infrastructure , school preparedness ( security/privacy measures)are factor contributes.
* To determine an institution’s capacity for successful adoption by analyzing internal factors (infrastructure, resources, facility, leadership and strategy for cloud-based teaching readiness.)

## 1.5 Justification

Let’sconsiderafewofthemostimportantfactorsthatprovidekeyincentivesfororganizations to use cloud computing.

**Elasticity**

The abilitytoscale computing capacityupordownon-demandisveryimportant. For example,

Imagine a company thatprovidessoftware-as-a-service (SaaS) online tax-fillingservices. Obviouslywithsucha businessmodel,this organization’s computingresourcedemandwillpeak duringtaxseason–onlytwoto threemonths eachyear. Financially,it doesn’tmake senseto investup-frontknowingthat computinginfrastructure willremainonlypartiallyutilizednineor ten months peryear.

**Pay-As-You-Grow**

Public cloudproviderslikeAmazon allow companiesto avoidlargeup-frontinfrastructureInvestment andpurchasenew computingresourcesdynamically asneeded– companiesneedn’t plan ahead and commitfinancial resourcesup-front.Thismodelisparticularly feasiblefor smaller companies andstart-ups,which often cannot affordtospendlargesumsofmoney atthe beginning oftheirbusiness journey

**Benefits of Cloud Computing in Education System**

Nomore carrying arounddevices,such asthumbdrivesorCDs.Youdon’tneedtoworry aboutlosing the device, breaking the CD, ornot having yourinformation load properly.

* **Easyaccess:** - Lesson plans, labs, grades, notes, and PowerPoint slides – just about anything digital that you use in teaching is easily uploaded and accessed anytime.
* **Stability**: cloud computing is now to the point of being a very stable technology that you can rely on
* **Security:** -Your data, content, information, images – anything you store in the cloud usually requires authentication (ID and password, for example) – so it is not easilyaccessible by anyone. In addition, should something happen to the technology at school, your content will still be available to you and your students if it is stored elsewhere.
* **Shareability:** - Working on an instructional assignment with other teachers? You canshare some or all your files that you have stored in the cloud. No more obtaining an extra thumb drive or burning another CD or DVD.

## 1.6. Scope of the study and limitation of the study

Scopeis thepotential coverage areaof thestudy.Thestudy willfocus on allHarariregional state eightpublichighschools and alsolimitedonly those E-resourcethatusedforTeaching and learning purposein the schools and School ITlabs.

## 1.7 Significance of thestudy

The importanceof doingthisstudyisthatnow adaygovernment of Ethiopia aswell asregional governmentofHarariinvestahugenumberof budgetsto enhancetheuseof ICT andutilization ofE-resourceinhighschoolsbutstillnowit’snot thatmuchpossibletouse effectively allthose E-resource andinfrastructures’ due tosomany reasons.Therefore thebeneficiary of thisstudy willbeschools,teachers,students and also regionalgovernmentitself willsaveahuge amount ofbudgetsthat allocated for thispurpose by improving the rate of use of IT resources, reduce the maintenance costs of the infrastructure, provide everyone with access to optimized resources by using proposed technologies on this study .

## *1.8*Definition of terms

**Cloud computing**:- Is methods of using applications and services that run on a Distributed networkthat can be accessed by a common internet protocols

**E-Resources**:-aresourcewhichrequires computer accessor any electronicproductthat delivers

collectionof data be intextreferringtotextbases electronic journals,image collection,other multimediaproducts.

**Cloud**: -avisible mass of IT infrastructuremoving and being processedin asingleplace. Infrastructure:-thebasicphysical andsoftwarestructures ofsystemsthat needfortheoperation cloud application.

**Resource sharing**:-A modeof operation whereby E-resources areshared among schools.

Cloud Service:-Thisisasoftwaresystemwhichisdesignedtosupply andimprove interaction over cloudspace (other cloud service or platforms), since the computer applications are becoming more service oriented their capabilities are accessible more easily to the newer applications [4].

**Cloud Platform**: -A cloudplatformprovidesservicesbasedonthe cloudspace and allow users to create theirown applicationsonit,i.e., creatingSaaS. Sousers are developersnotjustthe end users who use the service. Generally when applications and programs are installed,whether their platform isbased on cloudor isOn-premisesor off-premises,mostof them use some of availableSoftware Platformsinthedeviceonwhichthey arerunning e.g.,Local storage or library functions, which are a part of Foundation or Infrastructure Service. When companieswanttosupply Storageor computing capabilityorbothonthecloud space, based on the structure they need, they have to be equipped with someprerequisite andbe provided with some basic needs [5].

## 1.9 Organization of theThesis

Thisthesisisorganizedintosix chapters. Thefirst chapterbrieflyintroducesthe research, justification andstatementoftheproblem and objectiveofthestudy. Thesecond chapteris devoted toliteraturereview aboutHistory of cloud computing anddefinitionof cloud computing withitsservices andmodels,E-resources, andit alsopresentsrelatedworksdone inthe areasof cloudAdoptionin educationthethird chapter explainsmethodologies oftheresearch explain why andhow tool andresearchmethodused,infours chapter analysis andinfifth chapter proposed frame work and in chaptersix conclusion and recommendation discussed.

**CHAPTER TWO**

**LITERATURE REVIEW**

**Introduction**

This chapter reviews the different literatures that are related to the objective of the study. Literatures covered in this section are the basic concept of cloud computing service types tools, deployment models, cloud computing adoption strategy,cloud challenges and benefits for educationalsector and related works done on cloud based service frameworks locally and abroad revised in order to understand how itis implemented orused the sectors

**2.2 Theoretical concept**

The theoreticalfoundation of thisresearchisbasedonthe technology–organization–environment (TOE) framework. TOE was proposed by TornatzkyandFleischerand iswidely used in studying the technologyinnovation adoption. TOE servesas ataxonomy for factors that facilitator inhibittheadoptionof technologyinnovations[6].TOEhasadvantageovertheDiffusionof Innovationmodeldue toitsaccommodationof theorganizationaland environmentalfactors.The TOE framework identifies threeaspectsof anenterprise's contextthat influence theprocess by which itadopts and implements a technological innovation: technological context, organizational context, andenvironmental context.

**2.2.1 Technology Acceptance Model (TAM)**

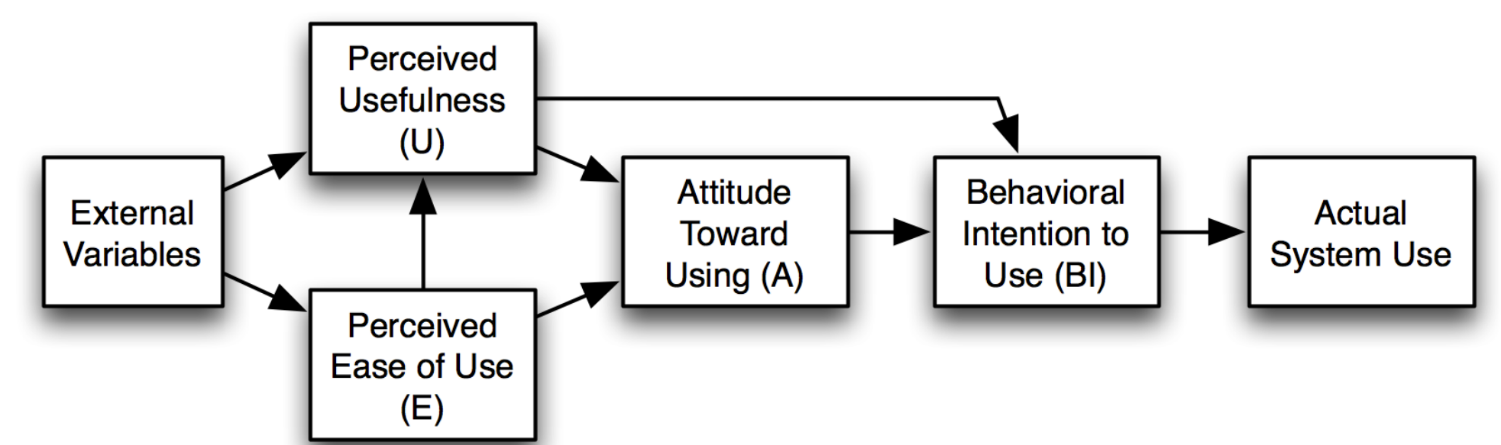
The **Technology Acceptance Model (TAM)** is a theoretical framework that helps explain how users come to accept and use technology. The model suggests that perceived ease of use (PEOU) and perceived usefulness (PU) are the two key factors that influence an individual's intention to use a technology, which in turn influences their actual usage behavior. When applying TAM to adopting **cloud computing technology** in a very resource-limited context for **high school students**, several factors must be considered to make the technology adoption both feasible and effective.

TAMclaimsthattheperceivedeaseofuseandPerceivedUsefulnessselectedasapredictor, directlyaffectusers' intentionstoadopttechnology.Thismodelcanbe appliedin3rd world countries to study how users think about cloud computing and what factorsinfluenceit.

Application:Knowingtheuser needsin developingcountries canhelpwhileadaptingcloud computing to theirspecific requirements which they will probably accept

AccordingtoDavis,F.D.,(1989).Useracceptance ofinformationtechnology:Towarda unified viewPerceivedusefulness,perceivedeaseofuseanduseracceptance.MISQuarterly,13(3):319-

340.

According to TAM, technology acceptance is a three-stage process, whereby external factors (system design features) trigger cognitive responses (perceived ease of use and perceived usefulness), which, in turn, form an effective response (attitude toward using technology/intention), influencing use []]{{behavior

Cloud computing is a flexible technology that stands out in meeting the needs of institutions with its software, platform and infrastructure services. As an internet-based file storage and sharing platform,

***Figure 1 Tam diagram***

cloud computing enables users to access information from anywhere with the internet access and encourage them to learn by ensuring that multiple individuals work in collaboration on the same file without having to install an operating system (Korucu and Biçer, 2017). In addition, as institutions make effort to keep pace with the advancing technologies, they alienate themselves from supporting the learning-teaching activities, which are their actual job, and constantly resort to refreshing and improving their infrastructures based on technological development. The effort to adapt to the 1 2020 (Volume 8 - Issue 4 ) Malaysian Online Journal of Educational Technology technological development may hinder the educational activities, and therefore, important points may be ignored in terms of integration. This is where cloud technologies are needed in education. Indeed, it is stated that cloud computing can have the answers to the questions of educational institutions in regard to the efficient management of their resources (Sultan, 2010), and it is possible to argue that cloud computing is a learning technology open to improvement that can be used in educational settings when its layers of software, platform and infrastructure and a great number of applications are reinforced by appropriate pedagogical approaches.

**Key Constructs:**

* **Perceived Ease of Use (PEOU):** The degree to which users believe a technology is easy to use.
* **Perceived Usefulness (PU):** The degree to which users believe a technology will enhance their performance.
* **Attitude Toward Using:** The user's overall feeling toward adopting the technology.
* **Behavioral Intention to Use:** The likelihood that a user will adopt the technology.

1. **Perceived Ease of Use (PEOU)**

* **Definition**: The extent to which the high school students believe that using cloud computing will be free of effort.
* **Application**: In a resource-limited setting, students may have limited access to advanced devices or internet infrastructure. Therefore, the cloud platform should be simple, intuitive, and lightweight

1. **Perceived Usefulness (PU)**

* **Definition**: The degree to which the students believe that using cloud computing will enhance their academic performance or provide them with tangible benefits.
* **Application**: In a resource-limited setting, the perceived benefits of cloud computing need to outweigh any barriers related to internet access or device limitations.

1. **Attitude Toward Using (ATU)**

* **Attitude Toward Using** refers to the user's overall feeling or disposition toward adopting and using a particular technology. It's an evaluative judgment about the technology — whether the user likes it, finds it useful, or perceives it to be beneficial.
* The **attitude** is typically influenced by how **useful** and **easy to use** the technology is (i.e., influenced by **Perceived Usefulness (PU)** and **Perceived Ease of Use (PEOU)**).

1. **Behavioral Intention to Use (BI)**

* **Definition**: This refers to the students' intention to use cloud computing, influenced by both PEOU and PU.
* **Application**: The more students perceive cloud computing as easy to use and beneficial for their academic success, the more likely they are to adopt it.
* **Behavioral Intention to Use** is the **likelihood** or **intention** of a user to actually use the technology in the future. In other words, it reflects a person's plan to adopt and use the technology based on their attitudes, perceptions of ease of use, and usefulness.
* The TAM model suggests that **attitudes** toward using the technology directly influence the **behavioral intention** to use it. The stronger the positive attitude toward using the technology, the more likely the individual is to intend to use it regularly.

**Application in a Resource-Limited High School Context:**

* **Perceived Usefulness (PU)**: If students see the value of cloud computing (e.g., easier access to educational resources, ability to store and share work, improve collaboration), they will be more likely to intend to use it in the future.
* **Perceived Ease of Use (PEOU)**: If the technology is easy to use, students are more likely to plan to continue using it. If students struggle to access or use the technology, their intention to use it may decrease.
* **External Factors**: Internet accessibility, device availability, and support from teachers and administrators also influence students' intention to use cloud computing. For example, if internet access is slow or unreliable, students may intend to use the technology less frequently or abandon it altogether.

**Key Relationships in TAM:**

* **Attitude Toward Using (ATU)** → **Behavioral Intention to Use Cloud Computing (BI)**
  + A **positive attitude** toward using the technology increases the **behavioral intention** to use it. This, in turn, increases the likelihood of **actual usage**.
  + Conversely, if students have a **negative attitude** (e.g., they find it too difficult to use or not useful), their **behavioral intention** to adopt the technology will be weak, and they may ultimately not use it.

**Conclusion:**

In the context of high school students with limited resources, the **Attitude Toward Using (ATU)** and **Behavioral Intention to Use (BI)** are crucial in determining whether cloud computing will be adopted successfully. By improving the students' attitudes through support, training, and showcasing the technology's benefits, and by fostering positive intentions through regular use and positive reinforcement, educators can help ensure that students are more likely to adopt and continue using cloud computing technologies. The ultimate goal is to make cloud technology not just an abstract tool, but an integrated, helpful part of their educational journey

**2.2.2 Digital Divide Theory (Moderator).**

A digital divide is an economic and social inequality regarding access to, use of, or impact of information and communication technologies (U.S. Department of Commerce, 1995). Existing literature indicates that the digital divide at the individual level springs from many different sources. Comparisons between educational and occupational groups, income brackets, age groups, and genders have revealed systematic variation in both internet access and the frequency of its use (Hampton, 2010; Lehdonvirta and Räsänen, 2011; Rice and Katz, 2003; van Deursen and van Dijk, 2014). Economic or other resource gaps, differences in cultural tastes and preferences of different social classes are factors contributing to disparities in internet use (Emmison&Frow, 1998; Hargittai& Hsieh, 2010).

Digital inequalities have emerged as a growing concern in modern societies. These inequalities relate to disparities in *access, actual use* and *use efficacy* of digital resources. Digital resources including transformative technologies, such as business analytics, big data and artificial intelligence are key for the transition of societies towards sustainability (Pappas et al. [2018](https://link.springer.com/article/10.1007/s10796-020-10096-3#ref-CR45); United Nations [2018](https://link.springer.com/article/10.1007/s10796-020-10096-3#ref-CR62)). Reducing digital inequalities is critical for sustainable digitalized societies. At a high level, all types of digital inequalities are encompassed in the term *digital divide*. One of the first uses of the term is traced back in a US government report published in 1999 referring to the divide between those with access to new technologies and those without (NTIA [1999](https://link.springer.com/article/10.1007/s10796-020-10096-3#ref-CR39)). The term was soon broadened to signify the “gap between those who can effectively use new information and communication tools, such as the Internet, and those who cannot” (Gunkel [2003](https://link.springer.com/article/10.1007/s10796-020-10096-3#ref-CR25)). Overall, the term digital divide includes digital inequalities between individuals, households, businesses or geographic areas (Pick and Sarkar [2016](https://link.springer.com/article/10.1007/s10796-020-10096-3#ref-CR50); OECD [2001](https://link.springer.com/article/10.1007/s10796-020-10096-3#ref-CR42)). The conceptual broadness of the term aims to capture a multifaceted economic and civil rights issue in an era of continuous efforts to digitalize society. The ongoing digitalization poses a challenge for individuals who are not fully capable of using digital resources and may feel partially excluded or completely left out of the society.

The digital divide encompasses differences in both access (first-level digital divide) and usage (second-level digital divide) of computers and the Internet between (1) industrialized and developing countries (global divide), (2) various socioeconomic groups within single nation-states (social divide), and (3) different kinds of users with regard to their political engagement on the Internet (democratic divide) (Schweitzer, 2015).

**Key Constructs:**

* **Access:** Availability of technology and internet connectivity.
* **Skills:** The ability to use technology effectively.
* **Motivation:** The desire to engage with and learn through digital platforms.
* **Economic and Social Barriers:** Factors such as income, education, and geographical location.

The **Digital Divide Theory** refers to the gap between those who have access to modern information and communication technology (ICT), particularly the internet, and those who do not. This divide exists not only in terms of **physical access** but also in terms of **skills, usage**, and **benefits** derived from technology.

The "digital divide" is a complex issue with many facets, and a clear, singular "current citation" is difficult to pinpoint. However, the concept is widely discussed in academic literature and news articles. [Research Gate publication](https://www.researchgate.net/publication/220580508_The_Digital_Divide_Current_and_Future_Research_Directions) mentions various authors and their work on the digital divide, including Cullen (2001), Dewan& Riggins (2005), and Sipior et al. (2017). Other sources like [Wikipedia](https://en.wikipedia.org/wiki/Digital_divide) and [Springer](https://link.springer.com/10.1007/978-0-387-93996-4_107) also offer information and different perspectives on the digital divide.

* **Key Constructs of the Digital Divide Theory:**

1. **Access Divide**:
   * **Definition**: This refers to the gap in physical access to technology, such as computers, smartphones, and internet connections.
   * **Example**: In resource-limited settings, students may not have access to personal devices or reliable internet, which limits their ability to benefit from online learning or digital resources.
2. **Usage Divide**:
   * **Definition**: Even when individuals have access to technology, there is often a gap in how they use it. This refers to the difference in frequency and nature of technology usage between different groups.
   * **Example**: Wealthier students might use the internet for a wide range of academic and extracurricular activities, while students from low-income backgrounds may only use it sporadically for basic tasks.
3. **Skills Divide**:
   * **Definition**: The skills divide addresses differences in technological proficiency. Some individuals are more tech-savvy, enabling them to use ICT effectively, while others may struggle with basic digital literacy.
   * **Example**: Students in high-income areas often receive better training in digital literacy and advanced tech skills, while students in underserved communities may lack the resources and guidance to develop these skills.
4. **Outcomes Divide**:
   * **Definition**: This relates to the different levels of benefits individuals or communities can derive from technology. Those with better access, skills, and usage tend to achieve more significant personal, educational, or economic benefits from ICT.
   * **Example**: Students in digitally connected schools may have better access to online resources, educational platforms, and collaboration opportunities, enhancing their academic performance. In contrast, those without access may miss out on these opportunities.
5. **Economic Divide**:
   * **Definition**: Economic factors heavily influence the digital divide. Those with higher incomes can afford more advanced devices, faster internet connections, and a broader range of tech services, while those with lower incomes face financial barriers to technology adoption.
   * **Example**: High-income families can afford high-speed broadband and the latest laptops, whereas low-income families may only have access to outdated equipment or rely on public internet facilities.

* **Implications of the Digital Divide:**
* The digital divide exacerbates existing social inequalities by limiting opportunities for education, economic advancement, and social participation for marginalized groups.
* To bridge the digital divide, interventions must focus not only on improving access to technology but also on increasing digital literacy, enhancing infrastructure, and ensuring equitable outcomes for all users.

**Relevance to Cloud-Based Educational Systems:** The Digital Divide Theory highlights the gap between those who have access to technology and those who do not. In low-income developing countries, the divide may exist in terms of not only access to the internet or devices but also in terms of digital skills and the ability to participate in cloud-based educational systems. Addressing this divide is crucial for ensuring that all students and educators can benefit from cloud-based technologies. In summary, the **Digital Divide Theory** highlights the disparities in access to and the use of technology, which are shaped by various social, economic, and geographic factors. Addressing the digital divide is essential for ensuring that all individuals, regardless of background, can fully participate in the digital world and its associated opportunities.

**2.2.3Technology-Organization-Environment (TOE) Framework with a Focus on Economic Constraint.**

Extant research has demonstrated that the TOE model has broad applicability and

Possesses explanatory power across a number of technological, industrial, and national/  
cultural contexts. The TOE model has been used to explain the adoption of interorga-  
nizational systems (Grover 1993; Mishra et al. 2007), e-business (Zhu et al. 2003; Zhu  
UncorrectedProofand Kraemer 2005; Zhu et al. 2006b; Zhu et al. 2004), electronic data interchange  
(EDI) (Kuan and Chau 2001), open systems (Chau and Tam 1997), enterprise systems  
(Ramdani et al. 2009), and a broad spectrum of general IS applications (Thong 1999).  
The TOE model has been utilized to explain the adoption of innovations in a host of  
industries, including manufacturing (Mishra et al. 2007; Zhu et al. 2006b), health care  
(Lee and Shim 2007), retail, wholesale, and financial services (Zhu et al. 2006b).  
Furthermore, the TOE model has been tested in European, American, and Asian con-  
texts, as well as in both developed as well as developing countries (Zhu et al. 2003; Zhu  
and Kraemer 2005; Zhu et al. 2006b, 2004). In each study, the three elements of tech-  
nology, organization, and environment have been shown to influence the way a firm  
identifies the need for, searches for, and adopts new technology.  
In each of the empirical studies that test the TOE framework, researchers have  
used slightly different factors for the technological, organizational, and environ-  
mental contexts. In essence, researchers have concurred with Tornatzky and  
Fleischer (1990) that the three TOE contexts influence adoption, but these research-  
ers have then assumed that for each specific technology or context that is being  
studied, there is a unique set of factors or measures. For instance, in Zhu et al.  
(2004), the authors argue that one pertinent factor in the technological context that  
affects the adoption of e-business is “technology readiness.” Similarly, these authors  
argue that “firm size,” “global scope,” and “financial resources” are the pertinent  
factors that should be studied to understand how the organizational context affects  
the adoption of e-business. Finally, the “regulatory environment” and “competition  
intensity” are relevant when researchers wish to understand how the environmental  
context influences the adoption of e-business. Different types of innovations have  
different factors that influence their adoption. Similarly, different national/cultural  
contexts and different industries will have differing factors as well. Thus, other  
research studies use different factors for the technological, organizational, and  
environmental contexts

The **TOE Framework** (Technology-Organization-Environment) evaluates cloud adoption across three dimensions: technological, organizational, and environmental. In an economically constrained context, the framework must be adapted to place particular emphasis on economic factors such as financial feasibility and cost management.

* **Key Constructs:**
  + **Technology Context**: The perceived advantages of cloud technology, such as cost efficiency, scalability, and operational flexibility. In an economically constrained context, the focus is on technologies that offer the best value for money, with minimal investment in hardware or infrastructure.
  + **Organization Context**: Includes financial resources, organizational readiness, and the ability to absorb the costs of cloud adoption. Key variables here are financial health, budget constraints, and resource allocation. The organization's ability to manage and prioritize investments becomes crucial.
  + **Environmental Context**: Refers to the economic conditions, industry standards, market competition, and regulatory landscape. Organizations under financial constraints may need to consider external market pressures or competitors that are also adopting cloud solutions to remain competitive.

The **Technology-Organization-Environment (TOE) Framework** is a widely recognized model that explains how organizations adopt and implement technology. It considers three key contexts that influence technology adoption:

1. **Technology**: The characteristics of the technology itself.
2. **Organization**: The internal characteristics of the adopting organization.
3. **Environment**: The external environment in which the organization operates, including industry, market forces, and government regulations.

In the context of **economic constraints**, the TOE framework can be used to understand how financial limitations affect the adoption of technology, particularly in resource-limited environments (e.g., for small businesses, schools, or organizations with budget constraints). Economic factors play a crucial role in each of the three TOE dimensions.

How **economic constraints** influence each component of the TOE framework:

* **1. Technology (Economic Constraints)**
* **Cost of Technology**: The cost of acquiring, implementing, and maintaining technology is a major factor. In resource-limited contexts, organizations may be unable to afford advanced technologies or may be limited to lower-cost alternatives. This includes both **initial investment** (hardware, software) and **ongoing costs** (subscriptions, maintenance, training).
* **Return on Investment (ROI)**: Organizations are likely to adopt technologies that offer a clear and substantial return on investment, which is particularly crucial in economically constrained environments. If the cost of technology exceeds its potential benefits, adoption may be avoided or delayed.
* **Affordability of Updates and Scalability**: Economic constraints can also limit an organization's ability to upgrade technology or scale it as the organization grows. For example, a business or school may be able to adopt a basic version of a cloud computing service but may lack the resources to scale to more advanced services as needs grow.

**Example**: A school with limited funding may struggle to adopt expensive cloud-based learning platforms, opting instead for lower-cost alternatives or open-source software. The high costs of licensing, training, and infrastructure may prevent them from scaling the solution over time.

* **2. Organization (Economic Constraints)**
* **Budgetary Constraints**: The organization's budget and financial health are central to its ability to adopt and maintain new technologies. Economic limitations may force organizations to prioritize essential activities over technological upgrades or investments.
* **Staffing and Training Costs**: Implementing new technology often requires training for staff and management. In organizations facing economic constraints, training costs may be viewed as an unnecessary expense. This can limit the extent to which new technologies are embraced and properly utilized.
* **Resource Allocation**: Limited financial resources may lead to misallocation or under-investment in technology, especially if organizations perceive other areas (e.g., marketing, operations) as more critical for short-term survival.
* **Adoption of Cost-Effective Technologies**: In economically constrained environments, organizations tend to favor cost-effective solutions that provide essential functionality. This might include opting for open-source software, cloud-based services with pay-as-you-go models, or using pre-owned or refurbished hardware.

**Example**: A non-profit organization operating under tight budget constraints may limit technology spending to tools that are free or low-cost, such as open-source software or cloud services with no upfront fees.

* **3. Environment (Economic Constraints)**
* **Market Competition**: In economically constrained environments, organizations may be reluctant to invest in technology if competitors are not doing so. If the market is saturated or highly competitive, firms may adopt technology as a **strategic necessity** to survive or maintain a competitive edge, even if it stretches their financial resources.
* **Economic Conditions and Regulations**: Broader economic conditions, such as recessions or inflation, can impact the ability of organizations to invest in new technologies. Additionally, regulations around funding, taxes, or incentives may either ease or exacerbate financial constraints. For example, government grants or subsidies for technology adoption in education or healthcare can reduce the burden of economic constraints.
* **Industry-Specific Economic Factors**: The industry in which an organization operates can significantly impact how economic constraints shape technology adoption. Industries with high margins (e.g., technology, finance) may be better positioned to absorb the costs of new technology, while industries with low margins (e.g., education, small retail) may find it more difficult to make such investments.
* **Access to Funding and Credit**: Economic constraints in the environment can also relate to the availability of external funding, such as loans, grants, or investments. In times of economic instability, the availability of external financing may be reduced, making it harder for organizations to afford new technologies.

**Example**: A small business in a developing country may face pressure to adopt mobile payment systems to stay competitive, but high transaction fees or limited access to capital may delay the investment. Alternatively, if the government offers financial incentives or grants to support small businesses in adopting digital technologies, this can ease economic constraints.

* **Implications of Economic Constraints in the TOE Framework:**

**1. Technology**:

* The cost of acquiring and maintaining technology directly influences the decision-making process. Organizations in economically constrained environments often prioritize technologies that have low upfront costs, are easy to implement, and provide high utility for the price.
* The availability of low-cost or open-source alternatives plays a significant role. Cloud computing services with flexible pricing models (e.g., subscription-based, pay-per-use) become attractive options.

**2. Organization**:

* Economic constraints can limit the **capacity for innovation**, reducing the organization's ability to experiment with new technologies or adopt advanced tools. As a result, organizations may adopt technology more conservatively, sticking with solutions that meet only their immediate needs.
* Organizations might also rely on **external expertise** or consultants rather than investing in expensive in-house training. Limited budgets might restrict the level of training or the number of staff members who can be trained.

**3. Environment**:

* Economic factors in the environment, such as the overall economic climate and government policies, can either constrain or encourage technology adoption. For example, government funding or subsidies can help reduce financial barriers to technology adoption, especially in sectors like education or healthcare.
* In some cases, **economic crises** can accelerate technology adoption, as organizations are forced to cut costs and seek more efficient, tech-driven solutions.

**Importance in Economic Constraints**: The TOE framework, when adjusted for economic constraints, helps organizations focus on evaluating cloud adoption readiness with a deep understanding of their financial and resource limitations. The framework assists in making informed decisions about which cloud technologies can be adopted at a lower cost, with maximum flexibility and scalability, and minimal operational disruption.

Economic constraints have a significant impact on technology adoption, particularly in organizations with limited financial resources. The **TOE framework** highlights how **technology**, **organization**, and **environmental** factors interact, with economic constraints influencing each of these domains. Organizations facing financial limitations tend to adopt cost-effective, scalable solutions and are more likely to prioritize short-term technological needs that offer clear, tangible benefits. Policymakers and leaders must consider these constraints and look for ways to reduce the financial burden on organizations (e.g., through subsidies, financing models, or grants) to enable broader technology adoption and innovation.

**2.2.4 Unified Theory of Acceptance and Use of Technology (UTAUT).**

The growth of an e-commerce sector, emerging digital technologies, such as big data, Artificial Intelligence, cloud computing and robotics, drive the implementation of new technologies in organizations (Verhoef et al., 2021). The advances in information communication technology (ICT) have dramatically changed the way organizations conduct business. The application of the technologies in the workplace has redefined inter- and intra-organizational communication has streamlined business processes to ensure benefits, such as higher productivity, the wellbeing of employees and the satisfaction of consumers (Papagiannidis&Marikyan, 2020). To achieve such benefits, companies make massive spending on technologies. However, investment in ICT implementation does not guarantee successful deployment and often bring low returns (Davis, 1989; Venkatesh et al., 2003). The results of market research suggest that the success rate of new technology adoption in organizations, whereby technologies bring expected return on investment (i.e. improved performance), is below 30 percent. The number is less optimistic if consider the companies, who could improve performance, but could not sustain the improvements in the long-term (De la Boutetière, Montagner& Reich, 2018). Given the consequences of technology adoption on organizations’ performance and a cost-revenue structure, the technology utilization-acceptance gap remains one of the major areas of research in the IS literature.

1. Research community accelerated its interest towards technology acceptance in the private and organizational contexts almost three decades ago (Davis, 1989; Compeau& Higgins, 1995; Goodhue, 1995; Leonard-Barton &Deschamps, 1988). By 2000, technology acceptance research had resulted in a substantial body of evidence on user behavior related to technology adoption (Hu et al., 1999). Numerous models/theories had been introduced to understand the acceptance of the technology, which cumulatively explained 40% of the variance in technology use intention (Davis, 1989; Davis, Bagozzi&Warshaw, 1989; Taylor & Todd, 1995; Venkatesh& Davis, 2000). The models had roots in different disciplines, which limited the applications of these theories to certain contexts. For example, the Theory of Planned Behavior and the Theory of Reasoned Action offer a psychological perspective on human behavior by examining the variables, such as perceived behavioral control, attitude and subjective norms (Ajzen, 2011). The theories provide generic insights into individuals’ attitudinal underpinnings, which make them applicable to a wide range of research contexts, not limited to information system management. In contrast, Diffusion of Innovation Theory focuses on innovation-specific factors that determine users’ behaviour when it comes to new technology adoption (Moore &Benbasat, 1991). In addition, the models had different perspectives, reflecting the type of variables in the model, such as subjective norm, motivational factors, attitudinal factors related to technology performance, social factors, experience and facilitating conditions (Venkatesh et al., 2003; Taylor & Todd, 1995; Ajzen, 2011; Thompson, Higgins & Howell, 1991; Davis, Bagozzi&Warshaw, 1992; Venkatesh&Speier, 1999). The selection of either of the models constrains research findings to particular scenarios and conditions. Therefore, a unified approach was needed to embrace variables reflecting different perspective and disciplines and increase the applications of the theory to different contexts (Venkatesh et al., 2003)

***Key Constructs:***

* **Performance Expectancy**: The degree to which using the technology is perceived to enhance job performance.
* **Effort Expectancy**: The perceived ease of using the technology.
* **Social Influence**: The degree to which individuals perceive that others believe they should use the new technology.
* **Facilitating Conditions**: The resources and support available to use the technology, including infrastructure, training, and access to necessary tools.

The **Unified Theory of Acceptance and Use of Technology (UTAUT)** is a comprehensive model developed by Venkatesh et al. in 2003 to explain and predict users' acceptance and usage behaviors regarding technology. The UTAUT consolidates elements from several existing technology acceptance models (such as the **Technology Acceptance Model (TAM)**, the **Theory of Planned Behavior (TPB)**, and others) into a unified framework that is more robust and generalizable across various contexts and technologies.

* **Key Constructs of UTAUT:**

UTAUT identifies four key factors that influence an individual’s **Behavioral Intention to Use (BI)** and **Actual Usage Behavior (UB)** of technology. Additionally, UTAUT includes **moderating variables** that can influence these relationships.

1. **Performance Expectancy (PE)**:
   * **Definition**: The degree to which an individual believes that using a technology will enhance their job performance or personal productivity.
   * **Application**: If users believe that the technology will make their tasks easier or more efficient (i.e., they see it as useful), they are more likely to adopt it.
   * **Example**: A student may be more likely to adopt an online learning platform if they believe it will help them achieve better academic results.
2. **Effort Expectancy (EE)**:
   * **Definition**: The degree to which an individual believes that using the technology will be free of effort or easy to use.
   * **Application**: If a technology is perceived to be easy to use and intuitive, users are more likely to accept and adopt it.
   * **Example**: A mobile app with a simple interface and clear instructions is more likely to be used by students in a high school setting, compared to a complicated app with a steep learning curve.
3. **Social Influence (SI)**:
   * **Definition**: The degree to which an individual perceives that important others (e.g., peers, teachers, colleagues, or family members) believe they should use the technology.
   * **Application**: Social influence is particularly important in group or community-based environments. If others (especially influential figures or peers) advocate for or encourage the use of technology, individuals are more likely to adopt it.
   * **Example**: If teachers and peers encourage the use of cloud-based platforms for submitting homework, students are more likely to adopt and use them regularly.
4. **Facilitating Conditions (FC)**:
   * **Definition**: The degree to which an individual believes that the resources and infrastructure needed to use the technology are available.
   * **Application**: Adequate resources (e.g., hardware, software, internet access, technical support) are critical for technology adoption. If the technology can be used without barriers related to accessibility or technical difficulties, users are more likely to engage with it.
   * **Example**: If students have reliable internet access, modern devices, and adequate technical support, they are more likely to use online educational tools effectively.

* **Moderating Variables:**

UTAUT also proposes that certain **moderating variables** can influence the relationships between the key constructs and **behavioral intention (BI)** or **actual usage (UB)**. These include:

1. **Age**: Younger users may be more comfortable with adopting new technologies compared to older users. In a high school setting, for example, students may be more likely to embrace new tech tools than older teachers or administrators.
2. **Gender**: Men and women may have different attitudes toward technology, influencing their usage behavior. For example, men may be more inclined to adopt certain tech gadgets or platforms, depending on the context.
3. **Experience**: Users with prior experience with technology may find it easier to adopt and use new systems compared to novices. In a school setting, students who are already familiar with digital tools may have an easier time adopting a new online learning platform.
4. **Voluntariness of Use**: If the use of technology is voluntary, users may be more motivated to engage with it compared to situations where the use is mandated. Students might be more willing to adopt technology for extracurricular activities (voluntary use) than for compulsory coursework.

* **UTAUT Model in Action:**

To apply the **UTAUT framework** in a real-world context, such as in **adopting technology in education** (for example, adopting a new online learning platform or digital tool in schools), we would consider the following:

1. **Performance Expectancy (PE)**:
   * **Key Question**: How useful do students and teachers perceive the new platform or tool to be for improving learning outcomes? Will it help improve grades, save time, or enhance productivity in the classroom?
   * **Actionable Insight**: Highlight the educational benefits of the platform, such as access to better learning materials, ease of collaboration, and personalized learning features.
2. **Effort Expectancy (EE)**:
   * **Key Question**: How easy is it for students and teachers to learn how to use the platform? Is it intuitive? Does it require significant effort to get started?
   * **Actionable Insight**: Ensure that the platform is user-friendly, provide clear instructions, and offer training or tutorials to help users get comfortable with the system.
3. **Social Influence (SI)**:
   * **Key Question**: Are influential individuals (e.g., teachers, peers, administrators) advocating for the use of the platform? Is there peer pressure or encouragement to use it?
   * **Actionable Insight**: Encourage teachers and leaders to promote the platform and demonstrate its use. Peer mentoring or student-led tutorials can also enhance adoption among students.
4. **Facilitating Conditions (FC)**:
   * **Key Question**: Do students and teachers have access to the necessary resources (e.g., devices, internet, support)? Are there any technological barriers to adoption?
   * **Actionable Insight**: Ensure that there is adequate infrastructure to support the technology. Provide support services for troubleshooting, and ensure access to devices and reliable internet for all students.

* **Implications of UTAUT for Technology Adoption in Education:**

The **UTAUT** model is highly applicable to educational settings where the adoption of new technology (e.g., online learning tools, digital classrooms, cloud platforms) is often a key focus. To encourage adoption and ensure successful implementation:

* **Performance Expectancy**: Schools should emphasize how the technology will improve learning outcomes, make education more efficient, or provide access to new educational resources.
* **Effort Expectancy**: It’s essential that educational technologies are easy to use and require minimal technical skills. Platforms with simple interfaces, easy navigation, and intuitive features are more likely to be accepted by students and teachers.
* **Social Influence**: Teachers and administrators play a significant role in shaping students' attitudes toward technology. By actively promoting the platform, demonstrating its value, and showing students how it can enhance their learning, educators can drive adoption.
* **Facilitating Conditions**: Schools must address infrastructure issues, ensuring that all students have access to the necessary hardware (e.g., computers, tablets) and a reliable internet connection. Schools should also have technical support in place to assist with troubleshooting.

**Relevance in Economic Constraints:** The UTAUT model integrates elements from multiple adoption theories and focuses on both individual and organizational factors influencing technology adoption. In resource-constrained environments, it is critical to assess how the perceived benefits (performance expectancy) of cloud technology align with the organization’s capacity to support it (facilitating conditions). Economic constraints may limit investment in infrastructure, so ensuring that the organization has the necessary resources, training, and support to effectively implement and use cloud technologies is vital. Social influence may also be significant in contexts where peer organizations or industry leaders are adopting cloud technologies, prompting others to follow suit.

The **UTAUT model** provides a comprehensive, unified view of the factors influencing technology acceptance and usage. It focuses on key factors like **performance expectancy**, **effort expectancy**, **social influence**, and **facilitating conditions**, which are critical in understanding why people adopt or resist new technologies. In an educational context, addressing these factors—particularly around ease of use, perceived usefulness, and ensuring access to resources—can significantly enhance the success of technology adoption. By taking a holistic approach to these constructs, schools can increase the likelihood of successful technology implementation and improve the overall learning experience for students and educators alike.

**2.3 Influence of Technological Factors onCloud Computing**

Consideringthewayin whichadoptionofcloudcomputingcanrevolutionize theeducational scenarioindifferenttechnologicalinnovations .itsfacilitiesandresourcescouldbe accessedon demand[7].Manypreviousstudiesinthefieldofcloudcomputinghaveaddressedtheareasof new technologies,securityrequirementandthe future expectationsintheseemerging environments.

Outsourcingthe provisionofLMSssuch as Blackboard or Module to a third partymakes sense for institutions who cannot justify thecosts of purchasing, maintaining and supporting the hardware and software themselves[8]...Thisstructuralchangehasthepotentialtocausean enormous shift in the economics of the data and in the way companies store and process informationCloudcomputingalsopresentsmany opportunitiestoimprovetheeducationalprocess inschools.Existingcloud-basedsoftwareenablesreal-timecollaboration;fine-grainedsharingof

data, analysis of scientific data sets, and management of course material (e.g., lectures, assignments, projects, exams, etc.)**[9]**.

A survey by Rania Mohammed ameenAlmajalidon the Adoption of Cloud Computing in EducationSectorconcludedthat Theeconomic growth of any country is usually maintainedand enhanced by education in terms of quality and level. Cloudcomputingisanexciting developmentintoday’seducationsystem. The flexible aspectofcloudcomputingrelievesITstaff of maintenancecostsandduties, thuseliminatinghighoperationalcostsanddisasterrecoveryrisks andits costs.Thereforeitwillbevitalfor schoolsand individuals toshifttothecloud, toexperience the cheap and convenient avenue to informationandtechnological services, especially the benefits and abilities, such as access to complex applications, minimalcosts of cloud data storage, scalability and flexibility ofan e-learning platformthatiscloudcomputing enabled [10].

**2.4 History of cloudcomputing**

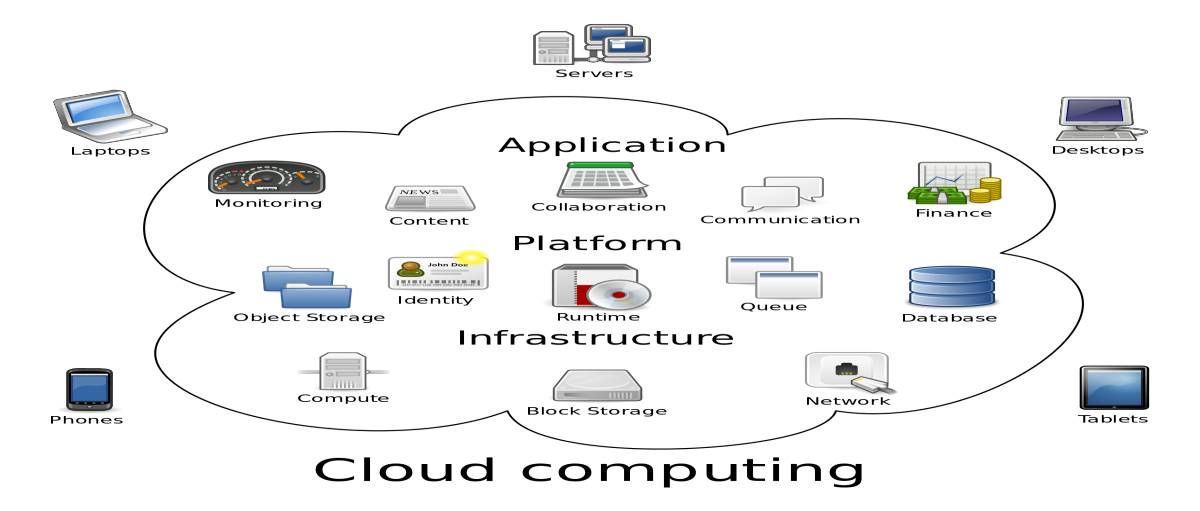
In1963,[DARPA(theD](http://futurism.com/darpa-were-moving-to-merge-humans-and-machines/)efense Advanced ResearchProjectsAgency),presentedMITwith$2 millionforProjectMAC.ThefundingincludedarequirementMITdeveloptechnologyallowing for a“computertobeusedbytwoormorepeople,simultaneously.”Inthiscase,oneofthose gigantic,archaiccomputersusing reels of magnetic tapeformemoryandwasthe precursor towhathasnowbecomecollectivelyknownas[CloudComputing.I](http://www.dataversity.net/cloud-computing-latest-trends-issues-innovations/)tactedasaprimitiveCloudwithtwoor three people accessingit.Theword“[Virtualization”w](http://www.techrepublic.com/article/why-your-traditional-virtualization-vendor-cant-help-you-with-containers/)asusedtodescribethissituation,thoughthe word’s meaning later expanded [24].

**2.5Cloudcomputingdefinitions**

ThefollowingdefinitionofcloudcomputingisasimplifiedextractfromthedefinitionproducedbytheNationalInstituteofStandardsandTechnology(NIST) (United States)andtheITUFocus Group.

The National Institute of Standards and Technology (NIST) defines cloud computing as “a model for enabling ubiquitous, convenient, on demand network access to a shared poolofconfigurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal managementeffort or service providerinteraction.Thiscloudmodeliscomposedoffiveessentialcharacteristics,threeservice models, and fourdeployment models [25].”

Gartner definescloudcomputingas a style of computing in which scalable and elastic IT- enabled capabilities are delivered as a service using Internet technologies [26]



***Figure 2 Cloud computing***

**2.5.1 Cloudcomputingservicemodel**

ThethreemostcommonservicemodelsareSoftwareasaService(SaaS), Platform as aService

(PaaS)andInfrastructureasaService(IaaS).Thesemodelsaredescribedas follows:

**tructure-a2.5.1.1Infras s-a-Service(IaaS)**

This modelusually includes tangible as wellas intangible components used in availing ICT services, suchas virtual computers, traffic monitoring and re-directing, basic network components etc. This isthemostprominentbenefitof cloud computing asthe organizations invest the mostin establishing infrastructure [30].

Sharing of fundamentalresourceslike storage model,networkarchitectureetc. isdone under IaaS. These resources are used for running various applications present in SaaS/ PaaS(Software as a Service/ platform as a service, discussed below). TheIaaSlayerisuseforestablishingandsharingoftheDataCenter.SomebasicexampleslikestoragefacilityprovidedbyGmailtoitsemail users, is thebest explanation ofIaaSlayer.

Usuallythe E-Learningworkswiththehelpofsoftwareapplicationsandusuallytheinformationistransferredwiththehelpofinternet,audio/videofiles,satelliteTV,mediadisks.Thesematerials arehavingthecontentsliketext,image,animation,audio/videotodeliver thelearningmaterialsto E-Learning users [31].

**Services of IAAS**

IaaShas two types of services

➢ Apublicserviceisdesignedsoconsumersinanysizebusinesscanacquireservicesinarental model.Some public cloud services are opentoanyonewithacreditcard that pays per use.Otherpubliccloudservicesarecontractualandprovideahigherlevelofservicetothe buyer

➢ In contrast, private services are provided inside a company’s firewall, enabling IT

managementtoprovideaself-serviceportalforemployeesandpartnerstoeasilyaccessapproved services.

**2.5.1.2 PAAS (Plat formas a service)**

PaaSisanotherfoundationalservicethatprovidesanabstractedandintegratedenvironmentforthedevelopment,running,andmanagementofapplications.OftenthePaaSistightlyintegrated with IaaSservicesbecauseit’sutilizing the underlying infrastructureprovidedbytheIaaS. [32]

Inthistypeofcloudcomputing,acustomerpaystotheserviceprovidertousetheirplatformastheirIT solution. For example, ifyou need email system ordatabasesoftwareforyour business,

youcanuseathirdparty'scomputingservicethatproveemailanddatabasesolutionsPaaSvendorscreateamanagedenvironmentthatbringstogetheracombinationofcomponentsthatwould’ve been managed separately in a traditional development environment. Servicesintegratedin a PaaSenvironmentincludemiddleware(forexample,softwarethatallowsindependentsoftwarecomponents to work together), operating systems,and development anddeployment services to support softwaredevelopmentand delivery.

Platformlayerisusedtoprovide the resourcesfordevelopmentofcloudapps.ThislayerworksincombinationwithIaaSlayerfortestinganddesigningofapplications.MicrosoftAzureisoneof thebestexamplesforPaaSplatformprovider.Usersworkingatthislayerarenotresponsiblefor maintenanceofsoftwareofhardwarecloudserviceproviderwilltakecareoftheentireprocess [33].

The goalof thePaaSprovideristocreateanabstractedandrepeatableprocessforthecreationanddeploymentofhigh-qualityapplications.Theseapplicationsaredesignedtobeimplementedin public orprivatecloudenvironments.

OrganizationscangainafewdifferentbenefitsthroughaPaaSenvironment.Forexample,it’spossibletoarchitectaprivatecloudenvironmentsodevelopmentanddeploymentservicesare integratedintotheplatform.ThisprovidesasimilarbenefitgainedfromapublicPaaSbutin a privateenvironment.AprivatePaaSimplementationcanbedesignedtoworkinconcertwith publicPaaSservices[33].

Thebenefits to using PaaSincludethefollowing:

**Improving thedevelopmentlifecycle:**-Effectivelymanagingtheapplicationdevelopmentlifecycle canbechallenging.Forexample,teamsmaybeindifferentlocations,withdifferent objectives, and workingondifferent platforms.

**Eliminatingtheinstallationandoperationalburdenfromanorganization:** - Traditionally, whenanewapplicationserverorothermiddlewareisintroducedintoanorganization,ITmustmakesurethat the middlewarecanaccessotherservices that arerequiredtorun that application.

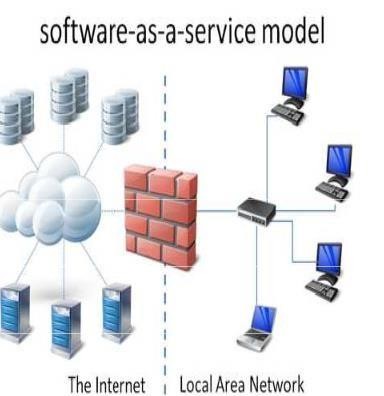
**Implementingstandardization:** - PAASenablesdevelopmentprofessionalsandIT operations professionalstousethesameservicesonthesameplatform.Thisinturnimprovesefficiency,

reduceserrors,andensuresconsistencyinthemanagementofthedevelopmentlifecycle. Additionally,PaaSprovideseaseofprovisioninginruntimeservicesthatincludeapplication runtime containers for staging,and running and scaling applications [33].

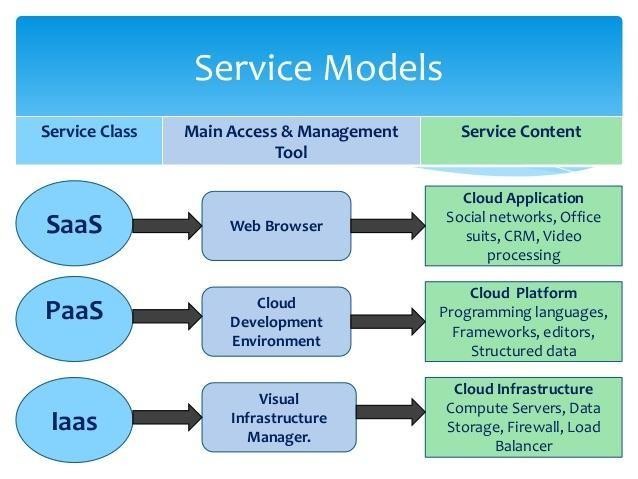
**2.5.1.3 SAAS(softwareasaservice)**

Generally cloud providersusepublic cloud resourcestocreatetheirvirtualprivate cloud to makeofcloudcomputingaccessthescalablecomputingresourcesandITservices.SaaSisoneofthe servicedeliverymodelswhereofsoftwareasaservicewillchangethewaypeoplebuild,sell, buy andusesoftware.Inthismodel Software isprovidedasa service where cloudusercanaccessthe software fromhiswebbrowserwithouttheconcernsofdeploymentorinstallation&maintenance. SaaSapplicationsareknownasWeb-based software, on-demand software or hostedsoftware.Forexampleletusconsider Google Play Storewhereapplicationscanbepurchasedonthegoandcanberunfromthewebbrowser,anynumberofpeoplecanpurchaseandrunthe application simultaneouslybutonly one instanceoftheapplicationisrunningontheserverside.Thishelpsinreducingcostsonresourcesandonthecustomerspointofviewitishasslefreeprocessserviceondemandwhere Cloudusercanrentapplicationswithouttheneedofinstallationandmaintenanceof the software[34].

SaaSArchitecture Software asaService(SaaS)hasadistinctiveadvantageofServiceOriented Architecturewheresoftwareapplicationscommunicatewitheachother.Anapplicationrunningas a serviceactasaserviceproviderandexhibitsitsfunctionalitytootherapplicationsor servicesviapublicbrokersandalsoactsasaservicerequesterwhenrequiredforincorporatingdataand functionality from otherservices..



***Figure 3 SAAS architecture***



***Figure 4 Cloud service model***

**2.5.2 PrivateCloud**

The clouddevelopedasper the rulesof single organizationisknownas Private Cloud.Thiscloud couldbe developedforspecifiedpremises.Thiscloudcouldbeusedasperour security requirementsi.e.mostlydedicatedtoa single organization.Multi-tenantandScalabilityissome feature ofthismodel.For e.g. Rack spaceandVMwareare thecompaniesprovidingprivatecloud facility [33].

Therearetwo variationsto a private cloud

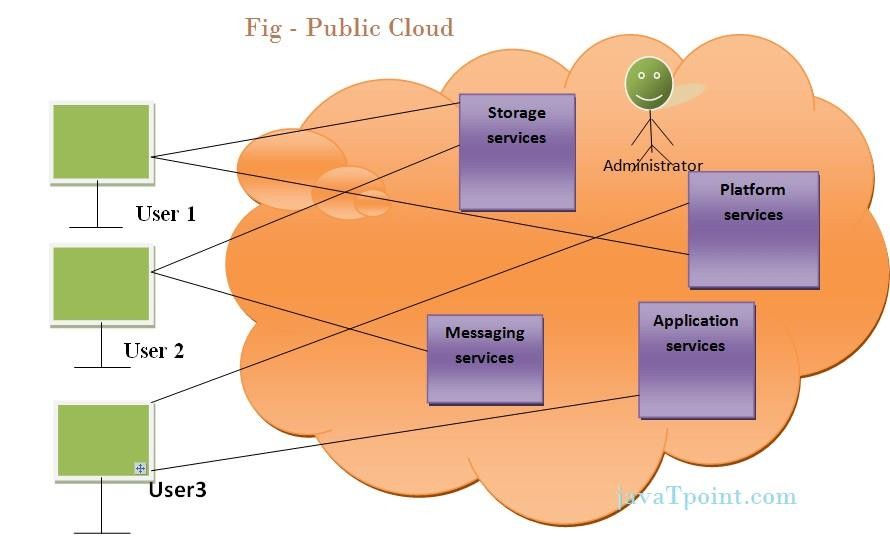
➢ On-premisePrivate Cloud: On-premise privateclouds, also known as internalclouds are hosted within one’s own data center. Thismodelprovidesa more standardizedprocess andprotectionbutis limitedinaspectsofsizeandscalability.ITdepartmentswouldalso need toincur thecapital and operational costs for the physicalresources.Thisisbestsuitedforapplicationswhichrequirecomplete controlandconfigurabilityof the infrastructure and security.

➢ ExternallyhostedPrivateCloud: Thistype of private cloud is hosted externallywitha

cloudprovider, where the providerfacilitatesanexclusivecloudenvironmentwithfull guarantee of privacy. Thisisbestsuitedforenterprisesthatdon’tpreferapublicclouddueto sharing ofphysicalresources.

**2.5.3 PublicCloud**

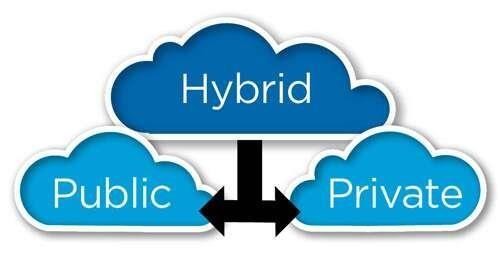
Public cloudsarecomputingandstorageservicesthatareopentoanyconsumer.Animmediateadvantageofusingapubliccloudisthatthereisnoupfrontcapitalexpenditurerequired of businessusers.Cloudconsumerspurchasecomputingandstorageservicesasneededandpayas they go. customizable than private cloud



***Figure 5 public cloud***

**2.5.4 Hybridcloud**

Ahybridcloudcombinespublicandprivateclouds.Abusinessthathasimplementedaprivate cloudcanuse public cloudresourcesasanextensionof their owncloud.There are a few different waystodoso.Thetwocloudscouldbeseparatelymanagedserviceplatforms.Policiesareestablishedtogovernwhatkindsofjobscanruninthepubliccloud,andcloudconsumers have the option to run and managetheir jobs in the public cloud.



***Figure 6 Hybrid cloud***

**2.6Cloud services withapplicationsineducation**

Amongthemostpopularcloudservicesthataresuccessfullyimplementedineducationarecloud- based officesuitesand storageservices(cloud storage).

**2.6.1 Cloud-basedofficesuites**

Cloud-basedofficesuites,alsoknownasonlineofficesuitesorcloud-basedcollaborationtoolsinrealtime,areofficesuitesthatareprovidedasSaaSservices.Amongthemostpopularcloudoffice suites, used in education, areGoogleApps for Work,Office365, ZohoOfficeSuite, Apple Productivity Apps, Amazon Work Docs, Thinkfree Online, Live Documents.Cloud- based office suites are available through Web browser, so theyare platform and hardwareindependent. Thereisnoneedtoinstallandconfiguresoftwareonlocalcomputersthatallowsstudentsandteachersto work with cloud-based officesuites on a variety of devices.

Onlineofficesuitesofferopportunitiesforsharingandcollaboration,because data are storedinthecloud,allowingaccesstomultipleusers fromdifferentlocationsthroughavarietyofdevicesviacloud-basedofficesuitesteachersandstudentscanworktogetheronshareddocuments,projects and tasksinreal time. Everyone canseeandcomment other participants’ activities, which increasestheproductivityofcollaboration.Onlinepackagesareatoolforcreatinginteractive

learningenvironmentwhere studentsparticipateactivelyinlearningactivities,collaborate,interact andcommunicatewithallparticipantsintraining.Foreducationalorganizationsthisisanopportunitytoimplementtheideasofactivelearningandsocialconstructivismparadigm.Cloudofficesuitesareanappropriatetoolforcollaborationbetweenstudentsoncommonprojectsandtaskseachstudentperformshisindividualtasksinagroupproject,andtheresultsaresummarized inajointdocument. Studentscan"assess"andedittheircolleagues’assignmentsorprojectworks duringcollaboration,whichleadstodevelopmentofcriticalthinking,skillsforanalysisandevaluation,motivateownopinion,etc.Collaborationencourageslearnerstoparticipateactivelyin performingdifferenttasks,becausetheiractionsandresultsarevisibletoothers.Teacherscan assesslearners’knowledgeandskillsobjectively,sincethereare optionstotraceandestablishthe personal contribution ofeach student.

**2.6.2 Cloudstorage**

Storage is a model for storing data on multiplevirtualservers that userscanaccess from anywhere andanytimeusingmultiple devices.Storingdatainthecloudisgainingpopularity because of the potential for collaboration between multiple users, which increases the productivityofwork.AmongthemostpopularcloudstorageservicesareDropbox,Box,Google Drive,OneDrive,iCloudDriveandothers.Theofferedfreediskspaceperuservariesin differentservices.Freediskspace inDropboxis2,5GBandcanbe increasedupto16GBby attractinguserstoDropbox.Boxoffers10GBfreediskspace,whichcanbeincreasedto100GB inpaidversions.EachpersonalaccountinGoogle Drivehas15GBfree diskspaceinthecloud. UsersofGoogleAppsforEducationhave 30GBof diskspace,whichissharedbetweenGmail, DriveandGoogle+ photos.Theavailablespacecanbeextendedbypurchasingadditional.One Driveusershave5GBofstorageforfreeandtheycanpurchaseplanstoexpandtheirstorage limit.iCloudDrive offers5GBfree diskspace,whichissharedbyiCloudBackup,iCloudDrive, iCloudPhoto Library, iCloudMail and iCloud applications.

**2.7E-Resources**

Electronic resourcesarethe electronicrepresentation ofinformation. There areavailablein variousformslikee-books,digitallibraries,onlinejournalmagazine,ande-learningtutorsand online test. Because oftheeffectivepresentationwithmultimediatools,thesee-resourceshave become the source ofinformation.Electronicresources delivers the collectionofinformationas fulltextdatabases,e-journals,imagecollections,multimediaintheformofCD,tape,internet,

web technology etc.E-resources mayincludee-journals,e-discussions,e-news, dataarchives,e- mailonlinechatting,etccanbecalledasane-resources.Electronicinformationsourcearea wide rangeofproductsgoingfromelectronicperiodicalstoCD-ROMs,frommailinglistto databases,allofthemhavingacommonfeatureofbeingusedandsometimemodifiedbyacomputer [38].

**2.7.1Types of E-Resources**

Therearemainly two types of e-resources

1. OnlineE-ResourceTheonlinee-resourcesarethoseresourceswhichareunderthecontrol ofthecentralcomputer.E.g.,E-journals,E-Books,E-Thesisanddissertation,E-Images, E-Music,E-SoundCollections,In-House database,E-References,E-Dictionaries,Virtual Newspapers and Encyclopedia

2. OfflineE-Resources:TheOfflinee-resourcesarethoseresourceswhicharenotunderthe controlofthecentralcomputer. E.g.Offlinemail,offlinemediaplaying,offline- dictionary,CD-ROM,offlinebrowsing,subjectguides[39].AdvantagesofE-Resources:

-Thefollowingarethesome of the advantages ofe-resources. They are

➢ E-resources provide24X 7 access service.

➢ E-resourcescanbesearch,browse,access,copy,downloadquicklyandcustomizeaccording to yourrequirements

➢ E-resourcesareavailableinthevariousfiles and formatsthat can beavailable very

fastas they are uploaded on the server which save time, money, place and environment

➢ It allows various types ofsearchingfacilities.

➢ It is moreeconomicthantheprintversion.

➢ It supports multimedia applications

➢ Modification, alteration and updating can be made easily with in fraction of second

**2.7.2 Issues andchallengesinE-Resourcesmanagement**

The adoptionof the e-resourceshasmade a greatadvantage over thelibraryservicesforeasyretrievalofrequiredinformationwithinashortperiodoftime.Thereissomeofthechallengesinofferingthehighlevelof the servicestousers.Some of thechallengesfacingwithe-resources management arediscussed below: [39].

**A. ShortageofE-resource funds:**

ICTdemandmorefundsforitsinfrastructureandcontinuingservices.MostoftheSchoolshaveinadequatefundforacquiringe-resourcesandsotheusersdonotgettheirneedyinformationat the righttime.

**B. Technical infrastructure:**

In a digital information service system, infrastructure such as software, hardware, internet facilities and other physical equipment‘s arerequired to provideeasier, faster andcomprehensiveaccesstoinformation.Absenceofstabletechnicalnetworkinfrastructuresintermsofservers, physicalcablingandwirelessaccesspointsarechallengeswereidentifiedforimplementationof the digital libraries.

**C. Lackofprofessional skills:**

Duetolackofmanagementandtechnicalskills,theschoolsarenotabletohandlethee- resources.Therefore,shortagesoftheprofessionalskilledpersonnelwhocanestablishorrunE- resources arechallengeswereidentifiedforE-resources Management.

**D. Online/ virtualcrimesandsecurity:**

Web/cybercrimeshavebecomeacommonthreatoninternet.Toovercomethisissue,compulsory Virus Proof proceduresshouldbeadoptedwhiledownloadinge-informationfromanyother system.Tosecurethesystemfromviruses,thedatabasescanbemodifiedbyhackerproof procedures.SeparateloginandpasswordsystemsaretobecompulsorilyadaptedtotheNetworksystems.Toovercometheabovedatabasesecurityproblemsandissues, itisessentialtoinstalladatabasesecuritysoftwareor firewall technology to protect thedatabases.

**E. Privacy / confidentiality:**

Maintainingprivacyandconfidentialityisanotherprobleminaccessingonlineinformation.Tocontrolpiratingofsoftware,copyingordownloadingallthecontentsofanye-resource atatime, righttoobtaininformationandrighttowithholdorbantheaccessisessentialandsothere isadelicatechallengebetweenprivacyandrightstoinformation. ProtectingonenetworkfromanothertomaintainconfidentialityofinformationisanotherprobleminsecuringdatabasesonInternet andIntranet.

**F. Copyright issues:**

Large scaleofpiracyofsoftwareandplagiarismisanimportantissuethatthepresentdaytheacademiclibraryprofessionalsarefacinginprovidingelectronic/digitalinformationservice.The

costandtimelinessinretrievingtheinformationarealsoconsidered.Whennegotiatingaccess with apublisher,thelibrarianmustagreetocertainrestrictionsonphotocopyingordistribution of electronic materials.Thelibraryisresponsible for maintainingtheawarenessofallusersaboutcopyrightissues.

**G. Collectionofe-resources:**

Collectingthematerialsandmakingitavailabletoallcurrentandfutureusersisanothercore value of librarianship.Thechallenge isfor the librariantocontributetoestablishrealisticcollection-developmentpoliciescoveringacquisition of and provisionofaccesstoelectronic resourcesforusersnowandinthefuture.Adigitizedcollectionmeansthatlibrariessharethe use ofthecollectionswithotherinstitutions,notonlylocally,butalsoglobally.Itisthepublisher whodictateshowmuchaccesswillbeprovided,whichissueswillbeavailable,andhowmuch that access will cost.

**H. Organizational structure:**

Technology has broken down the rigid hierarchical structure of the organizations which is another importantissueinchangingtherolesofthelibrarianintheknowledgesociety.Farfromemulatingtheorganizationofconventionallibraries,theorganizationandstructureofdigital libraries, and the divisionoflaborwithin them, areopen to considerable experimentation.

**2.8ExistingCloud-based Frameworks (Related work)**

KaurandChawlaproposedCloudbasedELearning(CEL)toprovideaplatformtoimplementadvanceJavae-learning in the Cloud.TheirproposedframeworkutilizesWeb 2.0todevelop, test anduse the e-learningapplications.ThreetypesofClouds,namelyprivateCloud,public Cloud andHybridCloudaredeployedinCloudModelLayerthroughwhichuserscan accesstheirresources. Service ModelLayerconsistsofvariousservicesprovidedbyCloudsuchas Software asaService(SaaS),PlatformasaService(PaaS)andInfrastructureasaService(Iaas). Oneof the worthmentioning modules is the well-defined learningcontent such as content creation and content delivery in the LearningApplication layer. Thisframework very much suited foradvanceJavaelearning[40].

BoDongandhisfriendspresentedane-LearningframeworkcalledBlueSkyCloudframework to offerane-learning platform based on Cloud computing for the basic education throughout China. In order to deliver a scalable, cost-effective and reliable ITeducationservices,loadbalancinganddatacachingare incorporated in this framework. Subsequently

resourceutilizationandscalabilityissuesinE-learningareresolved. Core components of BlueSky Cloud framework are mainly located in Capability Layer, Data Information Layer and VirtualInfrastructure Layer. Virtualresourcepool,Imagerepository,Monitoring,Trigger, Provision manager, Router, and Data caching are the core components to perform their respectiveoperationsandservices[41].

ShaikSaidhbi presented Cloud frameworkcalledEthiopianUniversitiesHybridCloud(EUHC) toservestudentsin Ethiopian Universities to improvethe teaching-learning and service delivery. ThisframeworkadoptshybridCloudcomputingfortheirhighereducationinstitutions,whichoffersthejointbenefitofpublicandprivateCloud. Thisframework is very much customized to suit the currentEthiopian Universities IT infrastructure which may not necessarily becompatiblefor e-learning IT infrastructurein other countries[42].

Anthony Sulistioetal.ofHochschuleFurtwangenUniversity, Germany establishedCloudIA (Cloud Infrastructure and Application) framework to form private Cloud to run e-Science and e-Learning applications in the university. In CloudIAframework, Cloud Management System (CMS) is deployed to specify the components used in building private Cloud. The strength of this framework is the incorporation of Monitoring andManagementcomponentand Securitycomponentsacrossall layers to guarantee high reliability and secured services. However, there isnoefficientloadbalancingalgorithms used in the Cloud and more number of virtualization technologies has been specifiedinthis framework [43].

MadhumathiandGopinathGanaphatyproposedan academic Cloud framework for adapting e-Learning in universities using Cloud computing in order to help the students, faculties,research scholars and administrators of theuniversitytobetterutilizetheirinfrastructure.Theirproposedframework specifies the virtualizationtechnology to be used to build an academic Cloudabove the existinguniversityinfrastructureinorderto use the resources more effectively and also to support the QoS(Quality of Service) objectives in the service models (IaaS, PaaS, SaaS) of the Cloud.Theframeworkconsistsofsixlayers where eachlayerhasits own set of components within it. It isbest suited for academic institutionswhichare readytouseCloudintheirinstitution.Theselayersincorporatethethree servicesofferedbytheCloudwithinthem. The frameworkalsosupports variousdeployment methodsinadaptingCloudwithintheiracademicinfrastructure. Eachlayer inacademicCloud framework consists ofvarious components.Security, Monitoring and Managementare incorporatedacrossalllayersto ensure objectives. Thisisoneofthemostcomplete

academicCloudframeworks.However, detailed specifications on learning content in Cloud environments havenotbeen discussed [44].

Ibrahimetalconductedasurveytoanalyzethe evidence of cloudcomputingadoptionintheeducationalsector.Atotalof27paperswere includedintheliteraturereview.Theresultsofthe study revealed a clear lack ofresearchfocusing on using cloud computing in educational institutions[45].

AsIBMGlobal Technology Services on its whitepaperthattitled Applyingthecloud in education an innovativeapproachtoITdiscussedthatTheworldofeducationandtraininghasalwaysembracednewteachingmethodsandtools,albeitatdeferentratesoftake-up.Sincethe arrivalofthe computer –andlatertheinternet–inclassrooms,administrationdepartmentsandourdaily lives,schools(inthewidestsenseoftheterm)havebeeninaracetokeepupwith

society’srequirements[46].

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# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1. Introduction

This chapter provides a discussion of the research methodology that were used in this study. It discusses the research design especially with respect to the choice of the design. It also discusses the population of study, sample and sampling techniques, data collection methods as well as data analysis and data presentation methods employed in the study.

## 3.2 Population and Sampling Design

### 3.2.1 Population

According to Cooper and Schindler a population is the total collection of elements about which researcher wish to make inferences The target population in the study were government owned schools of Harari region by taking seven sample from public high schools, Aboker preparatory school, Junior secondary School, Abadir Secondary, Erero secondary School,Hamaresa secondary School, Dire Tiyara Secondary school and Shakib secondary school.

### 3.2.2 Sampling Frame

The sample will be determined using statistics. Simple random sampling technique will be used to select the sample. In this type of sampling each element of the population has an equal chance of being selected in the sample. Accordingly the following target populations were identified from seven public schools in interviews and the remaining 103 respondent questioners are done by using google forms..

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. N.** | **Name of Schools** | **Student** | **Head Library** | **School director** | **ICT professional** | **Teachers** | **Total** |
|  | Aboker preparatory school | 1 | 1 | 1 | 1 | 1 | **7** |
|  | Junior secondary School | 1 | 1 | 1 | 1 | 1 | **7** |
|  | Abadir Secondary School | 1 | 1 | 1 | 1 | 1 | **7** |
|  | Erero secondary School | 1 | 1 | 1 | 1 | 1 | **7** |
|  | Hamaresa secondary School | 1 | 1 | 1 | 1 | 1 | **7** |
|  | Dire Tiyara Secondary school | 1 | 1 | 1 | 1 | 1 | **7** |
|  | Shakib secondary school | 1 | 1 | 1 | 1 | 1 | **7** |
|  |  | **7** | **7** | **7** | **7** | **7** | **35** |

Table 1 Sample population from schools

## 3.3 Research Procedures

The questionnairesdesignedbytheresearcherbasedontheresearchquestionswere pretested through a pilot study to ascertain the validity and reliability of thetool before the actual administration. The pilot study was conducted among 10 respondents to check for inconsistenciesintheresearchinstrument. Thequestionnairewasestimatedtotaketenminutes tocomplete. The researcher soughtthe servicesof a researchassistanttoadminister the refined questionnaire andassist in data entry.

## 3.4 Methods of Data Analysis

One hundred three(103) respondentswithnoregardstotheirsexwere randomlyselectedacrossthe Schoolstofillthequestionnaire thatdistributedtothemusingGoogle form.Byusingrandom sample technique, student, Librarians, Top Managers and ICT teachers were involved in the interviewprocess.Andquestionsusedforinterview are mixedtypequestions;i.e.structured, unstructured, openended and close ended because inthe open type questions,the respondent shouldexplaintheirproblemwithoutlimitationandalsoresearchercanaddsomequestions duringinterview.Duringthesurvey,researcherobservedcurrentE-resourcesManagementon the schoolsuchashowE-resourcesareaccessed,whichtypesof devicethey use, capacityfor network,network infrastructures, E-resourcesAvailabilities plusothersfactorssuchasinternet availability,weaknessofthepresentE-resourcesutilizationandattitudeof top administration toward theusageof E-resources .

## 3.5 Tools Selection Methods

The conductof researchrequiresa systematicapproachinvolvingdiligentplanningandits executionasplanned.It comprises various essential predefined componentssuch asaims, population,conduct/technique,outcomeandstatisticalconsiderations.Inthisstudytoolsfor data collection,analysisandframeworkdesigning&evaluationwere selectedbasedontheselected suitabilityparametersthatwouldyieldthedesire outputfor theabove-mentionedproblemand specificobjectiveof theresearch.

## 3.6 Tool selection strategy for data collection, analysis and FrameworkDesign

The Cloud opensources tools/software were usedto design andevaluate theframewokusing selected deploymentmodel.And the framework of studyisvalidated withsuitable cloud technology platformbasedontheinput that have beenso farcollectedfrom researchers, academics and senior official who are the core beneficiary of this framework.

Inthis phasetheanalysis, designingand simulation tools using feature basedmost/best fit strategic analysis under specified scope and limitations were selected for data analysis, designing and demonstration of framework. The study tried to focus on the following Open-Sourcetools and services.

**1. G Suite for Education:**G Suite for Education is actually a collection of web-based programsandfilestorage(Gmail,Calendar,Drive,GoogleDoc,GoogleSheet,Google Slide,GoogleForms,GoogleSite,Google Hangouts,GoogleGroups,andGoogle Classroom)thatrun inawebbrowser withoutrequiringuserstobuyor setupsoftware and youcouldworkanytime,anywhere onanydevice.GoogleClassroomOneoftheGoogle's productstogether help educationalacademic tobe able toapaperlesssystemit’s available ordertoschoolswithGoogleApplicationforEducationTeacherscanquicklyobserveto who hasor hasnotcompleted the work, plusprovide direct, real-timecommentsand marks fromthe inside Classroominfactblendedlearningplatformregardingschoolsthataimin ordertohavetheability to simplify creating, distributing and grading assignments within a new paperless method

**2. Google form:** It is online cloud open source that is using for surveying and analysis of the collected data. It is very easy to use. And allow us to include different types of questions such as short answers, paragraphs, multiple selection, verification boxes, pull-down, linear scale, grid of several options, among others.

**3. Msoffice Visio:** Microsoft Visio can be used to create simple or complicated diagrams. It offers a wide variety of built-in shapes, objects, and stencils to work with. You can also make your own shapes and import them if you’re willing to do all that extra work. The driving idea behind Visio is to make diagramming as easy as possible for the user.

## 3.7 Summary of the chapter

The chapterdescribedthe methodologyadoptedincarryingoutthestudy.The populationisthe entire public SchoolsofHarari region.Thesamplesize,thesamplingtechniquesand questionnaireasaprimarydatacollectioninstrumentwere describedandtoolsusedfor frame workdesignandcloudservicesfor simulationstated. The chapter alsoindicatedthat,datawas analyzedusingGoogleformandpresentedinchartandcolumns.Thenextchapterwillpresent the findings of theresearch.

# CHAPTER FOUR

# DATAANALYSIS, PRESENTATIONAND INTERPRETATION

## 4.1 Introduction

This chapter of the study comprisesof the data analysispresentation andinterpretationof the study findings. They are presented in five main readiness sections and sub-sections which include the general information of high schools education cloud based readiness and the study objectives. Tothis effect,a totalof 35 interviewquestionnaires and readiness of cloud computing questionnaires were distributedto Seven Schools and 103 respondents which implies therateofreturnofthe quantitative survey wasareasonable amountto conduct analysis.

## 4.2 Primary Data Collection & Analysis

Primary data analysisistheoriginal analysisofdata collectedfor aresearchstudy.Analyzing primarydataistheprocessofmakingsenseof the collecteddatato answerresearchquestionsor support orreject researchhypotheses that astudy is originally designedto assess [47].

Therefore theresearchstudy,open endedquestionnaire and close endedquestionnairewere distributedtosomeselectedschool communitieslike , ICTprofessionals, Teachers who havegooddomainknowledge, students , directors of the schools, and other school stake holders were distributedthrough cloudbasedonline Googleform.To prove thestatusofthe investigated challengestorespondent,theresult ofthefindingswere presentedindifferentdata presentation visual formats. Based on the presented result, the frameworkwas designed.

## 4.3 Finding Analysis Using Questionnaires& Technical Observation Fact

### 4.3.1 Analysis Using Questionnaires

Inthe top andbottomline of researcher’sdirectobservation andinterview resultsfromthe concerning officialslike ICT professional,head of library,school directors, student parents ,studentsandTeachers existing E- resourcesManagementMechanismisnotMaintainable,flexible and accessible tothe school communities.HighMaintenance Costof ICTinfrastructure,poordistributionof E-resourcesin the schoolsEnvironment and alsoithasbeenobservedthatthe adoption of cloud computingin High SchoolEducationisstillininfantstage. The questionnaire where groupedintofivecategories based on the research questions & objectiveof thestudy

## 4.4. Demographics survey of Respondents data analysis

The current section will present information on the participants' demographics, which will provide an indication of the results provided. The results are shown in Table (4) demonstrate that most of the participants were males (70%) and females are (30%). Most of the participants were academic staff (40 %) holding second degrees and (48 %) first Degree with almost five years of experience or less the remains respondents 12% are high school students, college and university students

|  |  |  |  |
| --- | --- | --- | --- |
| Sex | Total | Years of experience in terms of number | |
| Male | 73 | <=5 | 18 |
| Female | 30 | 6 to 10 | 27 |
| Types of educational institution | | 11 to 15 | 35 |
| Public high schools | 7 | >20 | 23 |
| Education | | Occupation | |
| BSC | 33 | Academic stuff | 53 |
| MA | 3 | Directors | 7 |
| BA | 15 |  | |
| MBA | 13 |
| MSC | 24 | Vice directors | 14 |
| LEVEL IV | 7 | Lab technicians | 14 |
| UNIVERSITY STUDENT | 4 | Library heads | 7 |
| GRADE 11 & 12 | 4 | High school students | 4 |
| TOTAL | 103 | University students | 4 |

Table 2 demographics of research participants

**Research question**

Q1. Is the school’s technological infrastructure, including internet connectivity, devices, and it support, sufficient to implement cloud based education effectively?

**1. Technological readiness**

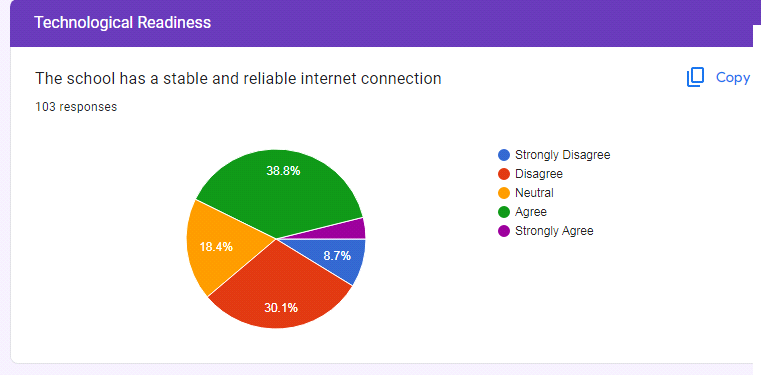


Figure 6 schools stable and reliable internet connection

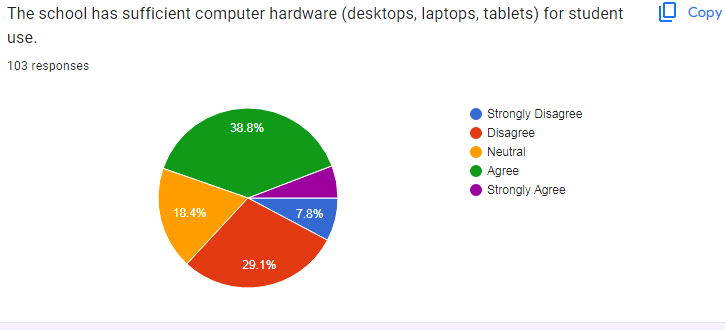


Figure 7 schools sufficient andreliable internet connection

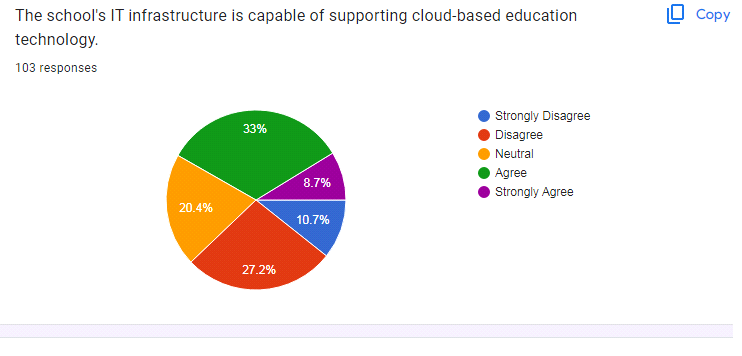


Figure 8 capable of schools it infrastructure supporting cloud based education

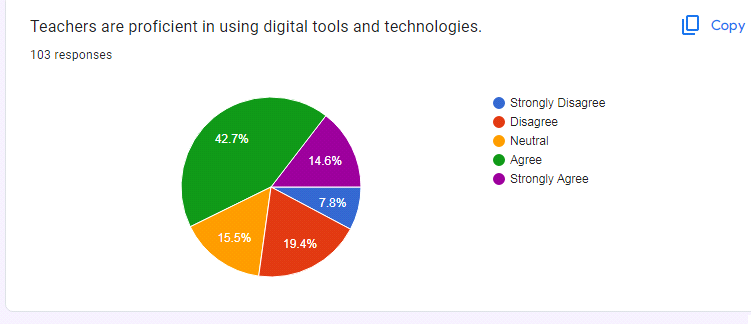


Figure 9 teachers proficient using digital tool

**Answer Q1**. Regarding technological readiness the data analysis and its summary is as follows

The analysis of 103 respondents reveals significant challenges in technological readiness, with 57.2% dissatisfied with internet stability, 67.7% finding computer hardware insufficient, and mixed opinions on IT infrastructure for cloud-based education—33% strongly disagreeing about its effectiveness. Additionally, 42.7% feel teachers lack adequate digital skills. Overall, there is a critical need for improvements in connectivity, hardware, infrastructure, and teacher training to enhance the educational environment.

Overall, the data underscores a pressing need for improvements in internet connectivity, hardware availability, IT infrastructure, and teacher training to enhance technological readiness within the educational environment.

**2. Organizational readiness data analysis**

Q2. Is the school organizationally prepared to implement cloud based education ,considering factors like leader ship commitment, financial resources, strategic planning, and established policies?

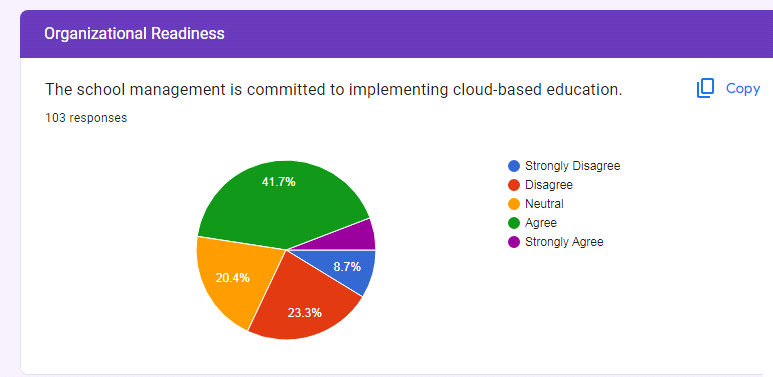


Figure 10 committed of school management to implement cloud-based education

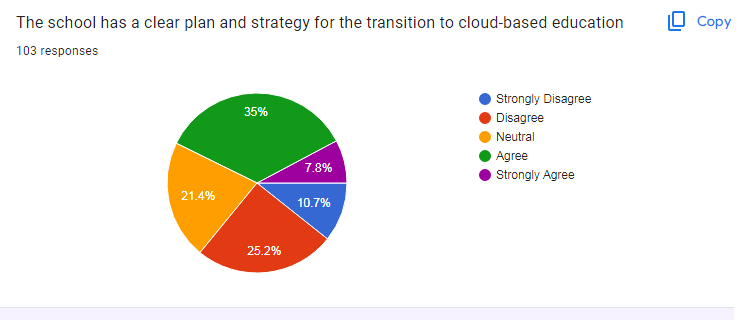


Figure 11 clear plan and strategy for transition to cloud based education

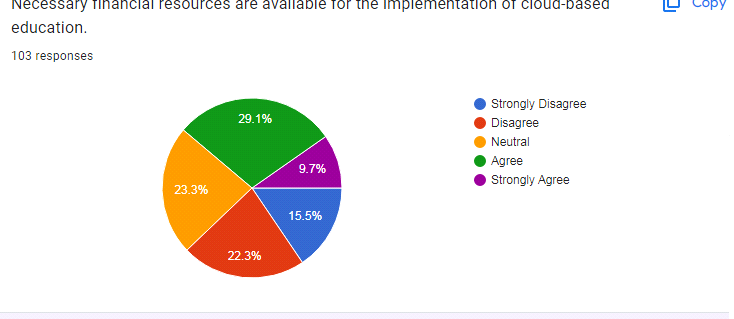


Figure 12 availability of financial resources to implement cloud based education

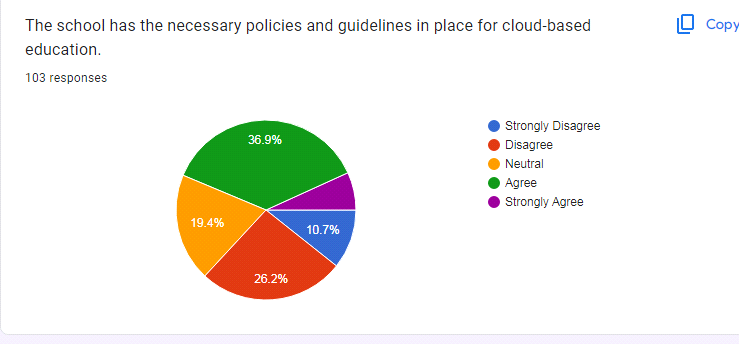


Figure 13 policies and guidelines in place for cloud-based education

**ANSWER Q2. Regarding organizational readiness the data analysis and its summary is as follows**

The analysis of responses from 103 individuals reveals significant concerns regarding the school's readiness to implement cloud-based education:

1. **Commitment**: A majority (62.1%) expressed doubts about the school management's commitment, with 41.7% strongly disagreeing and 20.4% disagreeing. This indicates a pressing need for improved communication to clarify management's dedication to the initiative.

2. **Clarity of Transition Plan:** A significant portion (56.2%) reported a lack of clarity in the school's strategy for transitioning to cloud-based education, with 35% strongly disagreeing. Enhancing transparency and communication about the transition plan is essential to address these concerns.

3. **Financial Resources**: Over half (52.4%) of respondents indicated insufficient financial support for implementing cloud-based education, with 29.1% strongly disagreeing. This suggests a critical need for increased investment in financial resources to facilitate the transition.

4. **Policies and Guidelines**: A majority (56.1%) expressed disagreement regarding the existence of necessary policies and guidelines for cloud-based education, with 36.9% strongly disagreeing. Developing clear policies and guidelines is crucial to support the initiative and alleviate stakeholder concerns.

Overall, the findings highlight a significant need for improved communication, financial investment, and policy development to enhance organizational readiness for cloud-based education.

.**3. Human readiness data analysis for Cloud-Based Education**

Q3. Is cloud based education feasible and beneficial for all stakeholders involved(teachers, students, parents and other stuff members)? and Are they ready for the transition

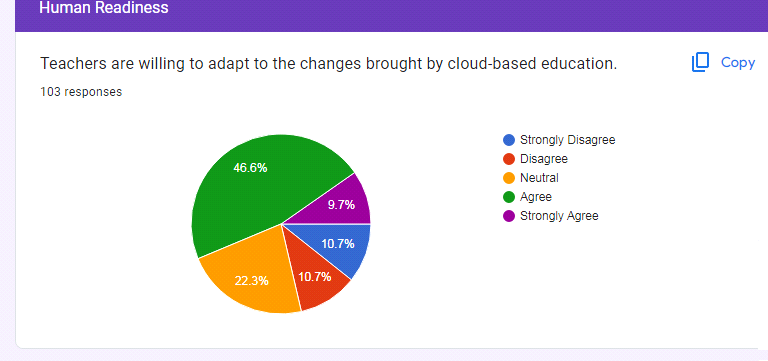
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Figure 14 teachers willing to adopt changes of cloud-based education

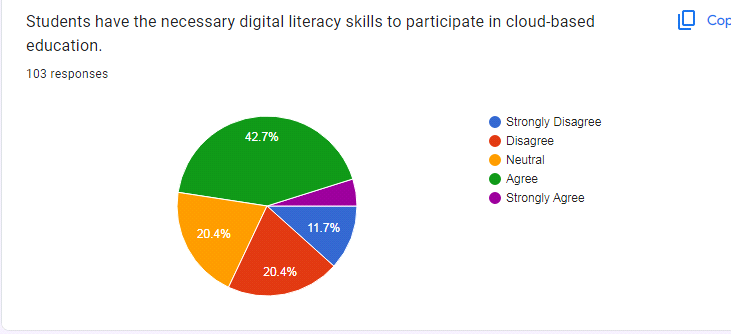


Figure 15 students digital literacy skill to participate inscloud-based education

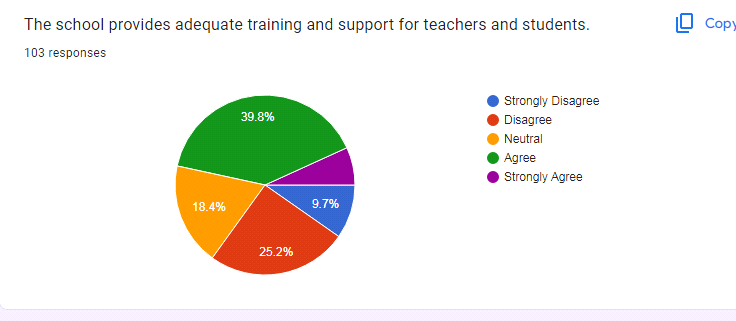


Figure 16 schools adequate training and support for teachers and students

ANSWER Q3. Regarding human readiness the data analysis and its summary is as follows

The data analysis reveals significant challenges regarding the readiness of teachers, students, and parents for the transition to cloud-based education, as illustrated by the responses of 103 individuals across four key areas:

1. Teacher Willingness to Adapt:

1. substantial 46.6% of respondents strongly disagree with the notion that teachers are willing to adapt to cloud-based education, indicating considerable resistance to change. When combined with the 19.4% who either disagree or are neutral, it is clear that only 33% express any level of agreement. This suggests a critical need for targeted professional development and support initiatives to foster a more positive attitude towards this transition.
2. Students' Digital Literacy Skills:The perception of students’ digital literacy skills is concerning, with 42.7% strongly disagreeing that students possess adequate skills for cloud-based education. An additional 31.8% either disagree or are neutral , leaving only 25.2% who feel confident in students' abilities. This highlights a pressing need for enhanced digital literacy programs to equip students for effective participation in cloud learning environments.
3. Parental Support:Parental backing is also lacking, with 40.8% strongly disagreeing that parents support the transition to cloud-based education.Combined with the 34.6% who are either neutral or disagree , only 24.3% show any level of support. This indicates a critical need for improved communication and engagement strategies to address parental concerns and build their support
4. Adequacy of Training and Support:A significant 58.5% of respondents express dissatisfaction with the training and support provided by schools, with 39.8% strongly disagreeing and 18.4% simplydisagreeing. Only 25.2% agree or strongly agree that adequate training exists, underscoring the necessity for schools to enhance their training programs for both teachers and students.

Overall, the data highlights a pervasive lack of readiness for cloud-based education among teachers, students, and parents. Addressing these gaps through focused professional development, improved digital literacy initiatives, enhanced parental engagement, and robust training support programs is essential for a successful transition to cloud-based learning environments.

4. Environmental readiness data analysis

Q4. Is the local community ready to adopt cloud-based education, considering government support, internet infrastructure, school preparedness, and community receptiveness?

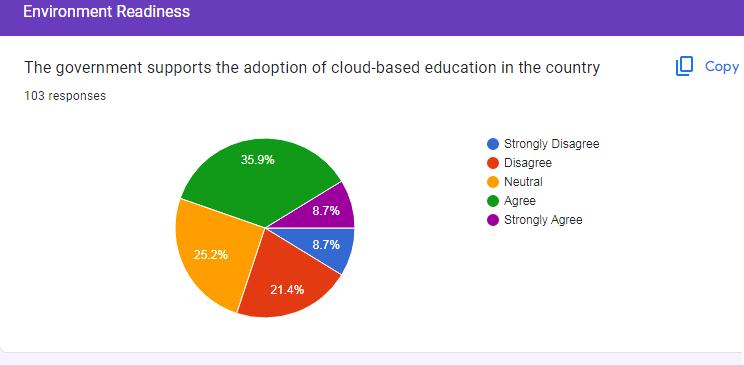


Figure 17 government supports adoption of cloud-based education

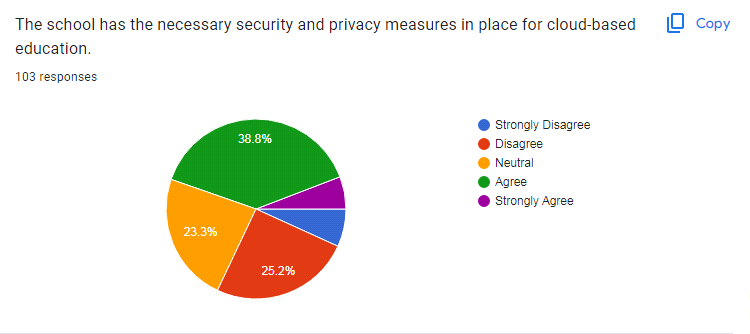


Figure 18necessary security and privacy measures

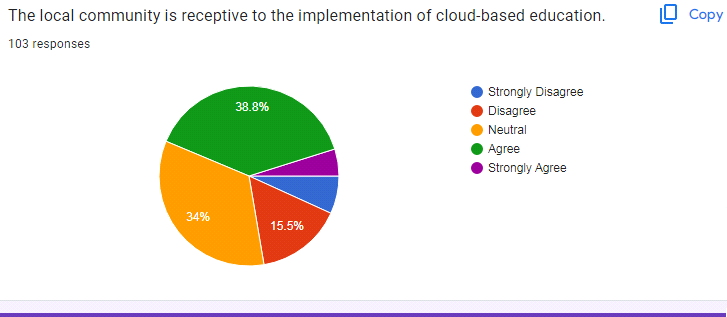


Figure 19 community receptiveness of implementation of cloud based education

ANSWER Q4. Regarding environmental readiness the data analysis and its summary is as follows

The gathered data from 103 individuals regarding environmental readiness for cloud-based education reveals significant concerns across several dimensions:

1. Government Support: A majority (54.6%) perceive a lack of government support for cloud-based education, with 35.9% strongly disagreeing with the notion of adequate support. Only 25.2% express agreement, indicating a need for increased advocacy and support from government entities.

2. Internet Infrastructure: A substantial 59.4% of respondents feel that their local community lacks reliable and affordable internet infrastructure, with 27.2% strongly disagreeing with the availability of such resources. This points to a critical need for improvements in internet accessibility and affordability.

3. Security and Privacy Measures: Concerns about security and privacy in cloud-based education are prevalent, with 62.1% disagreeing on the adequacy of existing measures at schools. This includes 38.8% who strongly disagree, suggesting a pressing need for schools to bolster their security protocols to instill confidence among users.

4. Community Receptiveness: The data indicates a general lack of community support for cloud-based education, with 38.8% strongly disagreeing about the community's receptiveness, and only 15.5% expressing agreement. This highlights the necessity for better communication and engagement strategies to address community concerns and foster support.

Overall, the data underscores significant gaps in perceived government support, internet infrastructure, security measures, and community receptiveness, indicating a comprehensive need for targeted improvements and engagement strategies to facilitate the adoption of cloud-based education.

5. Readiness to implement cloud based technology (dependent variable)

Q5. Is the school prepared to implement cloud-based technology considering its infrastructure ,resources, facility, leadership and strategy?

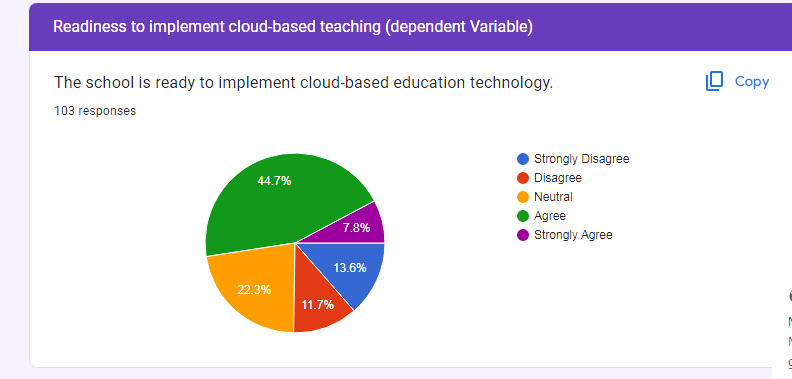


Figure 20schools readiness to implement cloud based education

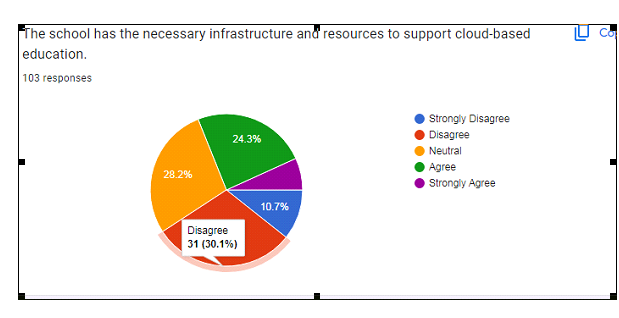


Figure 21 necessary infrastructure and resources and infrastructure

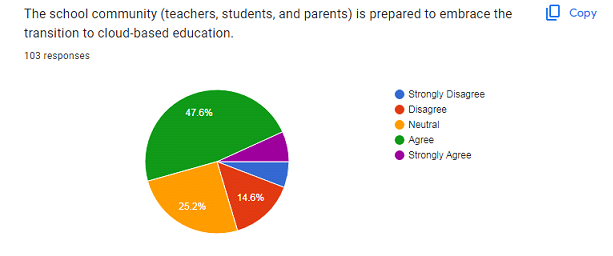


Figure 22 pre preparations of school community to embrace transition

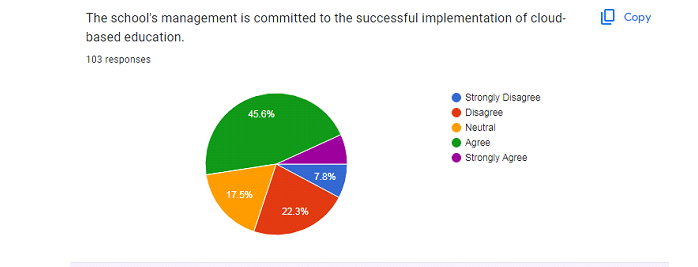
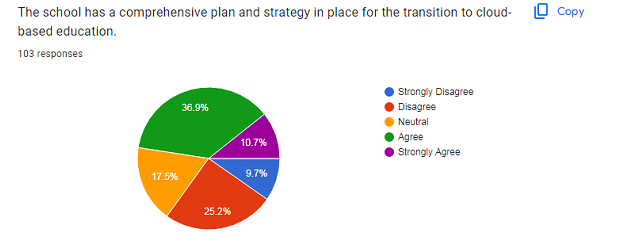


Figure 23 committed of management to implementing cloud based education



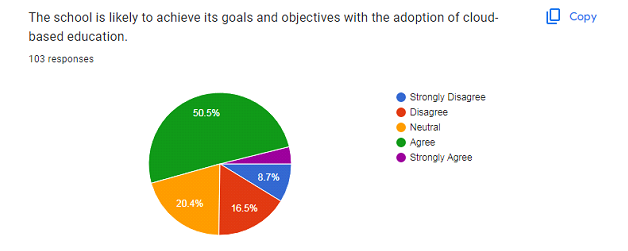


Figure 24 schools likely to achieve goal and objectives with adoption of cloud based

Answer Q5. Regarding the data analysis and its Readiness to implement cloud-based technology (dependent variable) summary is as follows

The analysis of responses from 103 individuals regarding their school's readiness to implement cloud-based education technology reveals significant concerns across multiple dimensions:

**1. Overall Readiness:** A substantial majority (67.6%) express disagreement about their school's readiness for cloud-based education, with 44.7% strongly disagreeing. Only 24.3% show agreement, indicating a pressing need for enhanced preparation and development.

**2. Infrastructure and Resources:** The perceived lack of necessary infrastructure and resources is evident, with 52.5% of respondents disagreeing with the statement regarding the school's capability to support cloud-based education. This suggests a critical need for investment in infrastructure to facilitate this transition.

**3. Community Preparedness:** The school community's readiness is also in question, as 47.6% strongly disagree about their preparedness to embrace cloud-based education. With only 25.2% showing support, there is a clear indication that communication, training, and support must be improved to foster a more positive outlook.

**4. Management Commitment:** Concerns about school management's commitment are pronounced, with 45.6% strongly disagreeing and a total of 63.1% expressing doubts about management's dedication to cloud-based education. This highlights the need for management to actively demonstrate their commitment to encourage broader support.

**5. Strategic Planning:** A lack of a comprehensive plan for transitioning to cloud-based education is evident, as 54.6% of respondents disagree with the existence of such a strategy. This underscores the importance of developing a clear plan to guide the transition effectively.

Over all, The data collectively indicates a significant gap in readiness, infrastructure, community support, management commitment, and strategic planning for cloud-based education within the school. Addressing these concerns through targeted investments, enhanced communication, and strategic planning is essential for successful implementation and acceptance of cloud-based education technology

Analysisfrom observationand interview

The survey results indicate a mix of perceptions among respondents regarding the school's readiness and preparedness for implementing cloud-based education. On the positive side, the majority of respondents agree that the school community is prepared for the transition (69.4%) and that the school is ready to implement cloud-based education (61.1%). However, there are significant concerns about the adequacy of the school's infrastructure and resources to support this transition, with over 58% of respondents disagreeing or strongly disagreeing on this aspect.

Additionally, the survey highlights areas that require further attention and improvement. Respondents’ express doubts about the school management's commitment to implementation, with 36.1% agreeing and 44.5% disagreeing or strongly disagreeing. There are also concerns about the school's comprehensive plan and strategy for the transition, with 55.6% agreeing or strongly agreeing, but 38.9% disagreeing or strongly disagreeing. Respondents are generally positive about the school's likelihood of achieving its goals with cloud-based education, with 63.9% agreeing or strongly agreeing. However, this optimism needs to be balanced with addressing the identified gaps in infrastructure, resources, management commitment, and planning to ensure a successful and sustainable transition.

# CHAPTER FIVE

# Cloud computingAdoption for E-resources Management

## 5.1 BuildingtheFramework

Recognizingthe keyroleofthetechnologiesinthe socio economicdevelopmentofthe country, theGovernmentistakingmeasuresto addressmajor ICT challenges,whichinclude poor infrastructure,inadequateskilledworkforce andhightelecommunication costs, andto enhance itsgrowth, amongother things,by encouraging investmentinthe sectorwithfocuson infrastructure andhumanresourcesdevelopment.The Governmentis alreadyimplementinga number of programmers andrecently,withthe assistance of the UNDPhaddeveloped ICT4Dpolicy as a framework for the facilitating Ethiopia’s ICT-led socio-economic development.OneofTheobjectivesofthepolicyisto Promote ICTin educationaldevelopment at alllevelsof the educationalsystem anddevelopinfrastructure includingtelecommunications andphysicalinfrastructure [48].Therefore with these changingscenariosit’s advisable adopting Cloud Computing technology for delivering different services such as e-learning environment, Class Room Management Systems, Enterprise Resource Planning Systems, and similarservices will givemoreflexibilities and dynamicEnvironment .

Based onthestudyof current E-resources managementthe researcher proposed a Cloud Computing framework for E-resourcesManagementforHarari regionschool.TheCloud computing empowers new approach of processing,integrating and consuminginformation.The mostimportantfunctionalityofCloud-basedlearningobjectsistheflexibilityofbeingreused andshared tousers. Forthispurpose, anunderlyingframeworkisproposedtodescribethe Cloud-basedE-resourcesmanagement. The proposedCloud-basedframework adoptspublic Cloudservice andits characteristicsinorder toMange,maintain and distribute E- resources effectively.

## 5.2 Proposed framework for E-resources management

Cloud computing empowers new approach of processing, integrating and consuming information.The mostimportantfunctionality ofCloud-basedE-resourcesmanagementisthe flexibility of being reused and shared to users. Recently, Cloud computing has become oneof theemerging technologies that can transform andrestructure the learning landscape. VariousCloudtoolshave beendevelopedandmade available online. Despite ofthereadiness of Cloudinfrastructures for collaboration and wide accessibilitysuchasWeb2.0tools,the development of redefining learning objects to suit e-learning in Cloud environment isnot encouraging.Uptillnow,therehasbeenratherlittleactivitybeingcarriedoutto ensurethate-

learningapplications are beingdesignedinsuchawaythatpromoteflexibilityuseof the learning content.For thispurpose,anunderlyingframework isproposedtodescribe the Cloud- basededucationalE-resourcesmanagement. The proposedCloud-based E-resources management frameworkutilizesCloudtechnologytouse learningresourcesmore effectively and to adopt Cloud characteristics.

The proposed frameworkcanbe usedtoformanew E-resourcesutilization method that shares the Cloud characteristics of elasticity, flexibility, efficiency and reliability. Principal to theframework design is the development of Cloudbased E-resources management where schoolshave toflexibility to share, access, personalize and deploy them in schools environment.

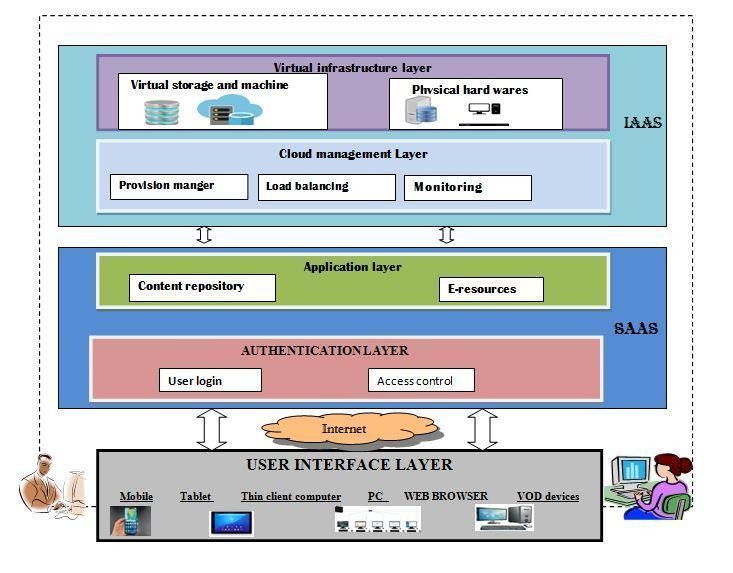


Figure 25Proposed Cloud-based E-resources management Framework for Harari high schools

The proposedCloud-based E-resource managementframework iscomposed of five layers, which are User Interface Layer, Application layer, Authenticationlayer ,Cloud Management Layer,and Virtual InfrastructureLayer. Eachlayerintheframeworkconsistsofvarious components.

## 5.3 Description of the frameworkUser Interface Layer

User Interface Layer acts as interface between users and Cloud infrastructure. This layer of the framework is the first entry layer of the proposed framework that users can use to access the educational service and resources over the cloud infrastructure. It includes the browsers platform, different website links, and users’ portals. In this design users can use any services by using any device via browsers.

**Authentication layer**

The main purpose of this layer is to validate the user's right to access the system and information after user signed, He/she can access service from 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’ information. And the admin within the cloud service can provide access control and privilege to the users who want to use available E-resources.

**Application Layer**

ApplicationLayerconsistsof contentrepository andE-resources. Thislayer providesfunctions andinteractioninterfacesfor userstoacquire resources andservices.Throughapplicationlayer, pre-builtapplication services improvethe interactionsbetween applications and users.

**CloudManagement Layer**

This layer enables schools to work with cloud vendors for liability and policy of the service basedonthe service levelagreement.Cloud Management Layer maintains and managesE- resources infrastructure by the means of three components namely ProvisionManager, , Load Balancing and Monitoring. Provision Managermanages the execution of resource allocationbydeploying resources to users automaticallyin a shorttime.Monitoringcomponent keepstrack of the execution of requests, the real-time configuration informationand resource utilization levels to verify iftheQoS objectives are met acrossall thelayersoftheCloud framework.

**CloudLoadbalancing**istheprocessofdistributingworkloadsandcomputingresources acrossone ormore servers.Thiskindof distributionensuresmaximumthroughputin minimumresponsetime. Theworkloadissegregatedamongtwoormoreservers,hard drives, network interfacesor other computingresources,enablingbetter resourceutilizationandsystem responsetime.Cloudproviderslike**Amazon WebServices(AWS),Microsoft Azureand Google**offercloud loadbalancing to facilitate easy distribution ofworkloads[49].

**VirtualInfrastructure Layer**

Virtualizationisthe "creationof a virtual(rather than actual) versionof something,suchasa server,a desktop,a storage device,anoperatingsystemor networkresources”.Inother words, Virtualizationisa technique,whichallowssharinga single physicalinstance ofa resource oran applicationamongmultiplecustomersandorganizations.Itdoesbyassigninga logicalnametoa physical storage and providing apointer to that physical resourcewhen demanded.[50]

Virtual InfrastructureLayer enhances the transparency of hardware by virtualization, and realizes resources handling. TherearetwocomponentsinthislayernamelyVirtualStorages and Physical Hardware.Storagevirtualizationis also implementedbyusingsoftwareapplications. Storage virtualizationismainlyusedforback-up and recovery purposes.

HardwareVirtualizationistheabstractionofcomputing resourcesfrom thesoftwarethatusescloud resources.Itinvolvesembeddingvirtualmachinesoftware intothe server'shardwarecomponents.That software is calledthehypervisor. The hypervisormanagestheshared physical hardware resources between the guestOS&the hostOS. The abstracted hardware is representedasactualhardware.

**5.3AdoptionofSuitable Cloud Services for the proposed Framework**

**Implementation**

For the successfuloperationof the proposed framework,theresearcher triedtoidentifythe most suitable cloudtechnologiesandvendors thatcanprovideSAASandIAASfor theof educational E-resourcesmanagementbecause the targetofresearcher istoenhance E-resourcesmaintenance managementanddistributionwithinHarariregionhighschools.Andtheidentification and selectionof cloudsfor thecloudservice isbasedonthe degree theyprovide like scalability, accessibility,availability, userscustomizationandcost,easeofuseandsecurityofdata.Thebest cloudsvendors that support different Softwareasservicesplusotherplatforms areGoogle, Microsoft Azure, andAmazon Web Servicesand etc.

A. Google app foreducation

Google Apps is a collection of web-based programs and file storage that run in a web browser, without requiring users to buy or install software. Users can simply log in to theservice to access their files and the tools to manipulate them. The communication tools of Google Apps are Gmail, Google Talk, and Google Calendar and the productivity tools are Google Docs:textfiles,spreadsheets, andpresentations,iGoogleandGoogle Sitesto developweb pages . The tools are free, or users can pay for a Premium Edition that

adds more storage space and other features. An Education Edition includes most of the extras in thePremiumEditionandisofferedatnocosttoK–12 (designationfor thesum of primary andsecondaryeducationandhighereducation). GoogleAppsallowsinstitutionstouse their owndomainnamewiththe service andtocustomize the interfacetoreflectthe brandingof that institution[51].

B. Amazon Web Servicesfor Education (AWS)

Amazon Web Services provides the cloud services in categories of Compute, Software, ContentDelivery, Database, Storage,Deployment&Management,Application Servicesand Workforce. Compute service includes Amazon Elastic Computer Cloud (EC2), Amazon Elastic MapReduce, Auto Scaling and Elastic Load Balancing. Amazon ElasticCompute Clouddelivers scalable,pay-as-you-gocomputecapacityinthe cloud.AmazonElastic Map Reduce isa webservicethatenablesbusinesses,researchers, dataanalysts,anddevelopers to easilyandcost-effectivelyprocessvastamountsof data.Auto Scalingallowsuser to automaticallyscale yourAmazon EC2 capacity up or down according to conditions. ElasticLoad Balancingautomaticallydistributes incomingapplication traffic acrossmultiple Amazon EC2 instances [52].

In Software, AWS Marketplace is an online store that helps customers find, buy, and immediately start using software that runs on the AWS cloud. It includes software from trusted vendors like SAP, Zend, Microsoft, IBM, Canonical, and 10gen as well as many widely used open sourceofferings including Wordpress, Drupal,and MediaWiki.

In Content Delivery, Amazon CloudFrontis a web service that makes it easy to distribute contentwithlow latencyvia aglobalnetwork ofedge locations.In Database, it has the category of Amazon Relational Database Service (RDS), AmazonDynamoDB, Amazon SimpleDBand Amazon Elastic Cache.

AmazonRelationalDatabase Service isa webservice thatmakesiteasytosetup,operate,and scale arelational database inthe cloud. Amazon DynamoDBisafully-managed, high performance, NoSQLdatabase service that is easy to set up, operate, and scale. Amazon Simple DB is a managed NoSQLdatabase service designed for smaller datasets. Amazon ElastiCacheisawebservicethatmakesiteasytodeploy,operate,andscaleanin-memory cachein the cloud.

In Networking, the classifications are Amazon Route S3, Amazon Virtual Private Cloud (VPC)andAWSDirectConnect.In Storage, depending on the needs the service provided by AWS are Amazon SimpleStorage Service(S3), Amazon Glacier, Amazon Elastic Block Store (EBS), AWSImport/Export and AWS StorageGateway

Application Services of AWS are Amazon CloudSearch, Amazon Simple Workflow Service (SWF), Amazon Simple Queue Service (SQS), Amazon Simple Notification Service (SNS) and Amazon Simple Email Service (SES).

In Workforce, Amazon Mechanical Turk enables companies to access thousands of global workers on demand and programmatically integrate their work into various business processes. AWS in Education is working with many Independent Software Vendors (ISV) and System Integrators (SI) to bring solutions for common education infrastructure challenges like storage, disasterrecovery, archiving and content delivery.

C. Micr[osoft Live@edu](mailto:Live@edu) foreducation

Microsoft [Live@edu](mailto:Live@edu)is intended foreducational needs. It provides a set of hosted collaboration services for the educations institutions. The hosted service includescollaboration services, communication tools, mobile, desktop, and web-based applications. It has the feature of data storage capabilities. Office Live Workspace, Windows Live SkyDrive, Windows Live Spaces, Microsoft Shared View Beta, Microsoft Outlook Live, Windows Live Messenger andWindows Live Alerts are the part of [Live@edu](mailto:Live@edu) suite. By means of free registration process universities, colleges and schools can enroll in the program Microsoft[Live@edu](mailto:Live@edu) is mainly fortheinstitutions for enabling facilities for their academic activities [53].

## 5.4 Selected cloud services for implementation of the frame work

The researcher selectedGSuite for educationfor the implementationofproposedframework because. GSuiteisafreeserviceofferedbyGoogletoschoolsystemsacrosstheworld. Itis accessible from anyInternet-enabled device,allowing access fromschooland from home.

G Suite is used:

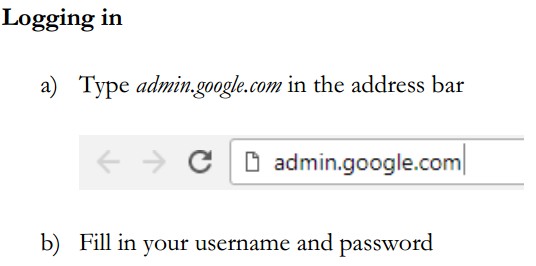
* For communication– Gmail, Hangouts, Calendar,and Google+
* for collaboration– Docs,Sheets, Slides, Forms, and Sites
* forstorage–Drive
* For managing users andservices– Admin panel.

USERSAND ADMINS

The GSuiteismanagedwithasystem ofusersandadministrators. Student,Teachersandschool communitieswillbe classifiedasusers, whereasICTprofessionalinschoolassignedthe administrator role.

Regular users(student)have accesstoallofthe Google Appsmentionedabove,while administratorshaveaccesstoapanelwhere he/shecanmanagetheusersinhis/herLocalGroup. Forexample,theadministratorofGSuite(ITprofessionalinschool)willbeabletoViewuser list ,Create auser ,Rename users , Reset password , Forcepassword change, Add/removealias,Suspendusers , Deleteusers, View user profile,View enabled services,View groups,View licenses , View security settings and View adminroles.

TheuseofGSuiteforAdmins:-Havingdefinedbasictermsandfunctionsavailabletous,it’stime westartviewing how the system work.



A screenshot of a login page

Description automatically generated

N.B this is only administrators.

Intheeducationsetting,GSFEismanagedthroughwhatiscalledtheGoogleAdminConsole. The consoleallowsfor the creationandmanagementof user accountsandservices.The common applicationsthatmakeupGSFEare Gmail,GoogleDrive,GoogleDocs,Google Sheets,Google Slides, Google Calendar, Google Forms, Google Drawings, Google Sites, and Google Classroom.Accesstovariousservices canbe turnedonandoff throughGoogle AdminConsole. Google AppsG SuiteforEducationincludesGoogleDrive,whichoffersfree unlimitedonline storage of filesandthe abilitytocreatea varietyof documentsusingtheir apps.The convenience of GSFEincludeseasyaccesstofilesfromanInternetconnectionfromanydeviceandlocation. Filesandfolders canbesharedwithotheruserswithGoogleaccountsallowingforcollaboration ondocumentsbetween schools,teachersandstudents.Collaborationcanbelimitedtowithin the school’sdomain,afactorwhichpreventsusersfromsharingfileswithanyoneoutsideoftheirschool. Sharing files eliminates theneedforattaching documents through email, flash drives, and printingdocuments.Inorderforstudentstosign-ontoGoogletheyneedtologin usingaGSFE usernameandpasswordcreatedbytheschoolwhichgiveseachuseraccesstoGSFEappssuch asDriveandGoogleDocuments.Thiseliminates the needtopurchase expensive desktop computers and setup computerlabs.

## 5.5 Implementation of the Proposed Framework

The proposed framework will utilize the existing IT infrastructure for schools which would adapt the E-resources management Framework for Harari high schools as illustrated above. In such a situation, the framework needs to deploy public Cloud model which accessed by the schools localinfrastructure A publiccloud isatype of computinginwhich a service providermakes resources availableto the public viatheinternet. Resources varyby providerbut may include storage capabilities, applications or virtual machines. Public cloud allows for scalability and resource sharing that would not otherwise be possible for a single organization to achieve.

To implementthe proposedframeworkontheschools wefirst buildthe system byusingGsuitefor educationapp tocreate the cloudand uploadthe documents, files,images,videos onthe cloud.Thenwe canaccessit from anywhere.Inschoolsandcolleges, teachers, studentscanpreparetheirowndocuments and share it with the others.

Teacher will prepare the class and upload the power points and videos for the next class in home using the account createdbyadministration.Teacher canupload thestudymaterials whichcanbeaccessedbythe students inhome as well as inclassroom.Teachers cangivethem theonlinepresentationsor changethe contentoftheany imagedynamicallyduring teaching,studentscansubmit theirassignmentsonlineetc. Studentswill loginbased ontheirauthentication given to themandaccessPowerPoints,Study Materials, ResultsandAssignmentassignedtothem,plasmaVideoLectures(thiswillbe helpfulforthosestudents whocouldn’tattendclassesforsome reason,forslow learnersand alsofor revisionpurpose).Thiswill improve interactivelearning.Theadvantageofcloudserviceisparticularlyusefulforsupportinglab activities intheteaching andlearningprocess.Inclassroomstudentscan even able todo someactivity basedon theteachersinstructions.Henceimprovingtheirskillsandknowledge.Thebelow figureshows howthe SchoolEducationSystemcan use the CloudComputing

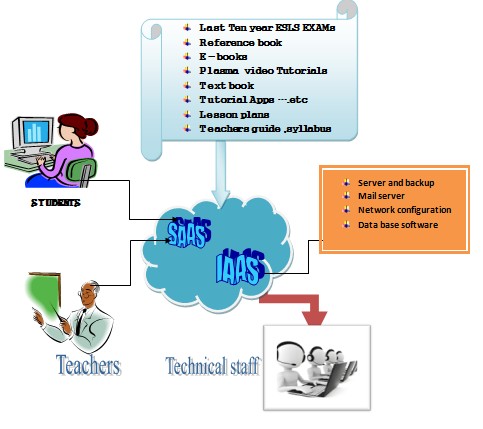


Figure 26 How the School Education System can use the Cloud Computing

# CHAPTER SIX

# SUMMARY, CONCLUSIONANDRECOMMENDATION

## 6.1 Summaryof findings

This chapter presents the results of the questionnaires, interview and observations described in chapter four.

The survey results indicate a mix of perceptions among respondents regarding the school's readiness and preparedness for implementing cloud-based education. On the positive side, the majority of respondents agree that the school community is prepared for the transition (69.4%) and that the school is ready to implement cloud-based education (61.1%). However, there are significant concerns about the adequacy of the school's infrastructure and resources to support this transition, with over 58% of respondents disagreeing or strongly disagreeing on this aspect.

Additionally, the survey highlights areas that require further attention and improvement. Respondents express doubts about the school management's commitment to implementation, with 36.1% agreeing and 44.5% disagreeing or strongly disagreeing. There are also concerns about the school's comprehensive plan and strategy for the transition, with 55.6% agreeing or strongly agreeing, but 38.9% disagreeing or strongly disagreeing. Respondents are generally positive about the school's likelihood of achieving its goals with cloud-based education, with 63.9% agreeing or strongly agreeing. However, this optimism needs to be balanced with addressing the identified gaps in infrastructure, resources, management commitment, and planning to ensure a successful and sustainable transition.

However Inthis researchwork, currentstatusofeffectivenessof E-resourcesservice delivery strategiesof Harariregionpublic highschool,intermsof maintenance,managementanddistributionalso benefitsofadoptingcloudplatformanditslimitationhave been carefullystudied..

Generally it is quite interesting to note that at the study sites the availability, reliability and distribution of E-resources according to respondents’ satisfaction level were very low. The respondents indicated that using of cloud computing approach may result a significant benefit to the school in order to increase readability and accessibility of E-resources. And he study sought to answer four research questions.

## 6.2 RECOMMENDATON

Based on the analysis of the 103 respondents, the following recommendations are proposed:

* Invest in reliable internet infrastructure to ensure stable and fast connections for both students and educators.
* Allocate funds to upgrade and maintain computer hardware in educational institutions. Consider implementing a phased upgrade plan that prioritizes the most critical needs.
* Evaluate current IT systems and invest in robust cloud solutions that can support educational activities. Regular assessments and updates should be conducted to ensure compatibility and effectiveness.
* Implement comprehensive training programs focused on digital skills for teachers and Establish a system for ongoing feedback from educators and students regarding technological tools and resources. This will help identify issues promptly and allow for timely adjustment.
* Encourage collaboration among schools, local governments, and tech companies to share resources, expertise, and best practices for integrating technology into education and Conduct meetings and workshops to publicly reaffirm management's commitment to the cloud-based education initiative.
* Develop a Clear Transition Plan by Create a detailed roadmap outlining the steps, timelines, and milestones for transitioning to cloud-based education.
* Increase Financial Resources by Conduct a financial assessment to identify specific funding needs for the transition and Establish Policies and Guidelines Form a task force to develop comprehensive policies and guidelines that address data security, privacy, and usage of cloud-based tools.
* Involve teachers and staff in the policy creation process to ensure their concerns are addressed and Enhance Communication Channels by Utilize multiple communication platforms (emails, social media, intranet) to reach a broader audience effectively
* Provide Training and Support by Implement training programs to equip staff with the necessary skills for using cloud-based tools effectively and Offer ongoing technical support and resources to help staff adapt during the transition.
* Monitor and Evaluate Progress by Establish metrics to evaluate the effectiveness of the transition and gather feedback from staff regularly and Prepare professional Targeted Training Programs to Implement comprehensive training sessions that focus on cloud technologies, pedagogical strategies for online learning, and tools that facilitate virtual collaboration.
* Preparing Digital Literacy Initiatives for Students on Curriculum Integration, Workshops and Resources and Engaging Parents by Information Session, Regular Communication, Enhancing Training and Support, Feedback Mechanisms and Form dedicated IT support teams to assist teachers and students with technical issues related to cloud-based education, ensuring quick resolution of problems.
* Adjusting Collaborative Learning Environments like Peer Collaboration and Community Building.
* Advocate for policies that promote funding and resources for cloud-based education initiatives.
* Explore grants and funding opportunities aimed at expanding broadband access to ensure all students have reliable internet access.
* Conduct regular assessments of current security protocols and update them to meet best practices in data protection.
* Organize community forums and workshops to educate stakeholders about the benefits and functionalities of cloud-based education.
* Create partnerships with local organizations to foster a supportive environment for cloud-based initiatives, ensuring community voices are heard and addressed.
* Invest in Technology by Allocate budget for upgrading hardware, software, and internet connectivity to ensure all students and staff have reliable access to cloud-based resources.
* Establish a routine maintenance schedule for technology to prevent disruptions and ensure optimal performance.
* Implement comprehensive training sessions for teachers and staff on utilizing cloud-based tools effectively. This can include workshops, online courses, and peer mentoring.
* Create a support system where educators can seek help and share best practices as they integrate cloud technology into their teaching by establish channels for feedback from students, parents, and staff to continuously improve the implementation process.
* School management should actively promote cloud-based education initiatives, demonstrating commitment through participation in training and communication with stakeholders.
* Create a clear roadmap outlining the steps for implementing cloud-based education, including timelines, responsible parties, and evaluation metrics and define specific goals for the implementation of cloud-based education and regularly assess progress towards these objectives.
* Use feedback from evaluations to make necessary adjustments to the implementation strategy, ensuring continuous improvement.

In conclusion, the transition to cloud-based education presents both challenges and opportunities for educational institutions. By addressing key areas such as infrastructure, training, and stakeholder involvement, schools can create a more effective and inclusive learning environment. Implementing the outlined recommendations will not only enhance digital capabilities but also foster a culture of collaboration and innovation. As educational landscapes continue to evolve, proactive measures and strategic investments will be essential in ensuring that all students and educators can thrive in a technology-driven world. Embracing these changes will ultimately lead to improved educational outcomes and better prepare students for future challenges.

## 6.3Future ResearchDirection

The aim of this work was to identify the particularities of adopting Cloud Computing in HarariregionHigh schools fortheir E-resourcesmanagement.And also the study presents a cloud adoption framework withsuitablecloudservices.Theproposedframeworkwouldbeusedasaroad mapfor furtherstudiesonthe topic. some of the future work to be done are as follows

1. The proposed framework should be implementedatdepartmentlevelwithin one schoolandtested withiterative feedbackreflectionfromthe users sothat the proposed frameworkwill be modified basedon hefeedback beforetheframeworks fullimplementation forallschools.

2. The researcher also don’tpropose thistechnologiesforotherpurpose like E-learning therefore this researchpaves away for thoseresearcherneed toimplementE-learningfor high school studentovercloud bytaking proposedframework as abase.

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# Appendix I

**Research Surveying Questionnaires on:**

Thank you for sparing some timeto fill this questionnaire.Yourviews will go a long wayin enhancing this research. Information obtained from thisquestionnairewillbetreatedwith utmost confidentiality and willonly be used for purposes of this research.

Thus, you arekindly requested to read each item carefully and respond honestly. No item is‘right’ or‘wrong.’ Feel freeto respond from yourown personal and school experiencepointofview.

**Section I:Personaldetails**

**Your name**(**Optional**): -----------------------------------------------------------

**1. ChooseyourSchool name**by **Circling?**

1. Aboker preparatory school

2. Juniour secondary School

3. Abadir Secondary School

4. Erero secondary School

5.Hamaresasecondary School

6.DireTiyaraSecondary school

7. Shakib secondary school

**2. What is yourposition/roleintheschool?**

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Description automatically generated with medium confidence](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAADkAAAApCAMAAAC4EHEsAAAAAXNSR0IArs4c6QAAAARnQU1BAACxjwv8YQUAAAASUExURQAAAAAAAAAAAAAAAAAAAAAAAOArGaIAAAAFdFJOUwATL3uF4s8ojwAAAAlwSFlzAAAh1QAAIdUBBJy0nQAAADhJREFUSEtjGAWjgCqAFQMwQWUIAVYoDQeMozpRwahOQmBUJyEwqpMQoEAnMxpgIVbnKBgegIEBAPBXAUCa8jiyAAAAAElFTkSuQmCC)Head of library

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Description automatically generated with medium confidence](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAADkAAAApCAMAAAC4EHEsAAAAAXNSR0IArs4c6QAAAARnQU1BAACxjwv8YQUAAAASUExURQAAAAAAAAAAAAAAAAAAAAAAAOArGaIAAAAFdFJOUwATL3uF4s8ojwAAAAlwSFlzAAAh1QAAIdUBBJy0nQAAADhJREFUSEtjGAWjgCqAFQMwQWUIAVYoDQeMozpRwahOQmBUJyEwqpMQoEAnMxpgIVbnKBgegIEBAPBXAUCa8jiyAAAAAElFTkSuQmCC)School director

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![A black background with a black square

Description automatically generated with medium confidence](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAADkAAAApCAMAAAC4EHEsAAAAAXNSR0IArs4c6QAAAARnQU1BAACxjwv8YQUAAAASUExURQAAAAAAAAAAAAAAAAAAAAAAAOArGaIAAAAFdFJOUwATL3uF4s8ojwAAAAlwSFlzAAAh1QAAIdUBBJy0nQAAADhJREFUSEtjGAWjgCqAFQMwQWUIAVYoDQeMozpRwahOQmBUJyEwqpMQoEAnMxpgIVbnKBgegIEBAPBXAUCa8jiyAAAAAElFTkSuQmCC)ICT professional

# AppendixII

**Readthe following statements thoroughly andcheckthe box according to what you know andrespondso far**

1. **Technological Readiness**

**Questionnaire1:** Is the school’s technological infrastructure, including internet connectivity, devices, and it support, sufficient to implement cloud based education effectively?

1. The school has a stable and reliable internet connection.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school has sufficient computer hardware (desktops, laptops, tablets) for student use.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school's IT infrastructure is capable of supporting cloud-based education technology.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. Teachers are proficient in using digital tools and technologies.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. **Organizational Readiness**

**Questionnaire2:**Is the school organizationally prepared to implement cloud based education ,considering factors like leader ship commitment, financial resources, strategic planning, and established policies?

1. The school management is committed to implementing cloud- based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school has a clear plan and strategy for the transition to cloud- based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. Necessary financial resources are available for the implementation of cloud-based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school has the necessary policies and guidelines in place for cloud- based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Strongly Agree**

**Human Readiness**

Q3. Is cloud based education feasible and beneficial for all stakeholders involved(teachers, students, parents and other stuff members)? and Are they ready for the transition

1. Teachers are Parents aresupportiveofthe transition to cloud-based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school provides adequate training and support for teachers and students.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. willing to adapt to the changes brought by cloud-based education

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. Students have the necessary digital literacyskillstoparticipateincloud- based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

**4, Environment Readiness**

Q4. Is the local community ready to adopt cloud-based education, considering government support, internet infrastructure, school preparedness, and community receptiveness?

1. The government supports the adoption of cloud-based education in the country.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. There is a reliable and affordable internet infrastructure in the local community.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school has the necessary security and privacy measures in place for cloud-based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The local community is receptive to the implementation of cloud-based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. **Readiness to implement cloud-based teaching(dependent Variable)**

Q5. Is the school prepared to implement cloud-based technology considering its infrastructure ,resources, facility, leadership and strategy?

1. The school is ready to implement cloud-based education technology.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school has the necessary infrastructure and resources to support cloud-based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school community (teachers, students, and parents) is prepared to embrace the transition to cloud-based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school's management is committed to the successful implementation of cloud-based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school has a comprehensive plan and strategy in place for the transition to cloud-based education.

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

1. The school is likely to achieve its goals andobjectives with the adoption of cloud-based education

* **Strongly Disagree**
* **Disagree**
* **Neutral**
* **Agree**
* **Strongly Agree**

**Give briefly short answer for the following questioners**

1. What specificfeaturesor characteristics should the chosen cloud computing architecture possess to address resourcelimitationseffectively?(Open-endedresponse)---------------------------

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2. Haveyou hadany experienceusing aparticularcloud computing architecturein a resource- limited context?Ifyes, pleasedescribeyourexperience and its effectiveness. (Open-ended response)---------------------------------------------------------------------------------------------------------

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3. Haveyou observed any tangible improvements in addressing the aforementioned problems through the useof cloudcomputing? If yes, pleaseprovide examples. (Open-ended response)-----

--------------------------------------------------------------------------------------------------------------------- ICT Professional in school Interview

1. Which E-resources Managementtechnology/platform areyou using for your School------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

2. Doyoubelievethatexistingcloud-based systemmanagementisrobustenoughinterms fordistribution, maintenance and management?-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

3. Do you knowthat existing E-resources management isavailable from cloudservice?----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

4. Suggest ways on how to improvecloud-based management in school?----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------