

**CHALLENGES OF COMPUTER NETWORK INFRASTRUCTURE IN
ACCESSING ELECTRONIC INFORMATION RESOURCES IN ACADEMIC
LIBRARIES**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF LIBRARY AND
INFORMATION MANAGEMENT OF THE OPEN UNIVERSITY OF
TANZANIA**

2020

CERTIFICATION

The undersigned certifies that he has read and here by recommends for acceptance by the Open University of Tanzania a dissertation entitled, “Challenges of Computer Network Infrastructure in Accessing Electronic Information Resources in Academic Libraries” in partial fulfillment of the requirements for the award of Degree of Masters of Library and Information Management (MLIM).

.....
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Date

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DECLARATION

I, Musa Amosi Kasella, do hereby declare that this proposal is my own original work and that has not been submitted for the same or similar to any University for a similar or any other research.

.....

Signature

.....

Date

DEDICATION

This dissertation is dedicated to my family; my beloved wife, Elinetha Leonard Ntaganyira,; my sons, Gadiron Chobateze Musa, Victor Chamvyo Musa, Barack Milembe Musa, and Hezekiah Musa,; my daughters, Besta Kilemya Musa, and Ilankunda Ivanna Musa.

ACKNOWLEDGEMENT

First of all, I acknowledge supernatural power from Almighty God for without His own hand nothing could be accomplished. Secondly, are my late parents, Amosi Kasella Kwanjalala and Victoria Bukuru Kizega by empowering me spiritually. Thirdly and most important, many gratitude go to Dr. Magreth J. MUSHI for her continuous and benevolent support of my work from refining of the research problem up to the completion of this dissertation. Her guidance and suggestions were of high value when I was proceeding with the research process. Also, my sincere thanks go to Dr. Henry Mambo who made final contributions on matters which should be corrected.

Other people are; Dr. Lilian ISOWE, the programme coordinator whom I consulted when I needed some information and or clarifications. Dr. Athumani SAMZUGI gave me suggestions and ideas during my first research proposal draft which gave me light on the pathway towards continuing with my research. Also, Mr. Benard KAPAYA who always strengthens my ambitions of pursuing studies at Open University of Tanzania.

The Institute of Rural Development Planning at Lake Zone Centre (IRDP-LZC) together with Catholic University of Health and Allied Sciences (CUHAS), and St. Augustine University of Tanzania, (SAUT), for allowing me to take them as case study to study on challenges of network infrastructure and access of electronic resources.

I am grateful to my cousin Mr. Wilbert Daudi Lubika, and the whole family who always prays for my career success. Office-mates; Mr. Peter M. Chiduo, Madam

Agnes Mbenjile, and Madam Catarina Moses, who, normally appreciated my endeavors. Likewise, my friends, who often kept me happy and uplifted my working morale towards accomplishing my studies including all others that I have not mentioned in person but contributed substantially in one way or another to the accomplishment of this work.

ABSTRACT

This study is concerned with challenges of paradigm shifting in libraries' practices from only using conventional printed information resources to using both printed and electronic information resources. The research has attempted to study challenges of computer network infrastructure in relation to accessing of e-resources by information seekers. The specific objectives of this study were set to assess challenges of e-resources access, to identify challenges of network infrastructure installation and to examine policies and pricing in academic library arena. This case study by cross-sectional approach comprised population of 10350 people. Measurement tools used were semi-structured interviews, documentary observations and questionnaires. Data analysis and presentation were done by using descriptive statistics to explain the characteristics of the sample population. Findings showed that library patrons face two major challenges which are experience and skills in ICT and financial capability. On the institutional side it was seen that policies, pricing, managing of e-resources, and availabilities of highly skilled library and ICT workers. But also, establishment, running and maintaining computer network infrastructure were still challenges. Likewise, finances, multimedia processing and connectivity hindered efficiency and effectiveness. Practically, it was recommended that; first of all, registration of all library patrons' digital appliances on MAC should be done effectively at beginning of studies and enhancement of ICT subjects in primary and secondary schools should be done also. Policy recommendations saw that government should assist in budget to run academic libraries.

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LIST OF ABBREVIATIONS

ADSL	Asymmetrical Digital Subscriber Line
AIS	Africa Internet Summit
ARPANET	Advanced Research Projects Agency Network
ATM	Asynchronous Transfer Mode
AUI	Attached Unit Interface
AVU	African Virtual University
CDN	Content Delivery Network
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
CUHAS	Catholic University of Health and Allied Sciences
DHCP	Dynamic Host Configuration Protocol
DLNA	Digital Living Network Alliance
DNS	Domain Name System
eIFL	Electronic Information for Libraries
HTTP	Hypertext Transfer Protocol (http)
IANA	Internet Assigned Numbers Authority
ICANN	Internet Corporation for Assigned Names and Numbers
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFLA	International Federation of Library Associations and Institutions
IGMP	Internet Group Management Protocol
ILS	Integrated Library Services
INASP	International Network for the Availability of Scientific Publications
IP	Internet Protocol

IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IPX	Internetwork Packet Exchange
IRDP	Institute of Rural Development Planning
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
LAN	Local Area Network
MAC	Media Access Control
MSAU	Multi-station Access Unit
NAS	Network Attached Storage
NAS	Network Attached Storage
NAT	Network Address Translation
NetBEUI	NetBIOS Extended User Interface
NetBIOS	Network Basic Input/Output System
NIC	Network Interface Card
NICTP	National Information Communication Technology Policy
OC-768	Optical Carrier 768
OA	Open Access
OSI-model	Open System Interconnections model
RADIUS	Remote Authentication Dial-In User Service
RTSP	Real Time Streaming Protocol
SAUT	Saint Augustine University of Tanzania
SDI	Serial Digital Interface
SDSL	Symmetrical Digital Subscriber Line

SOAP	Simple Object Access Protocol
SONET	Synchronous Optical Networking
SPSS	Statistical Package for Social Sciences
SPX	Sequenced Packet Exchange
STP	Spanning Tree Protocol
TCP/IP	Transmission Control Protocol
UART	Universal Asynchronous Receiver Transmitter
UDP	User Datagram Protocol
UPnP	Universal Plug and Play
URT	United Republic of Tanzania
USART	Universal Synchronous and Asynchronous Receiver and Transmitter
	8251
VLAN	Virtual Local Area Network 802.1q
VOD	Video-On-Demand
VPN	Virtual Private Network
WLAN	Wireless Local Area Network
WWAN	Wide Wireless Area Network

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

A computer network is a collection of computers and peripherals which are connected using devices via cables or wireless so as to share resources. Computer networks support a lot of applications and services. One of vital importance of computer network is to share electronic information resources. Electronic information resources are information resources that are presented in electronic/digital format. These resources can be in form of text, graphic, audio, video, photo, or multimedia.

Electronic/digital information resources are very important in academic matters due to the fact that they have added advantages. According to (Dazie, 2007), advantages of electronic resources include; access to information that might be restricted to the user due to geographical location or finances, access to more current information, and provision of extensive links to additional resources related contents. Other advantages are versatility and interactivity. Computer networking infrastructure and access to e-resources have been matters of great concern since 1960s.

In 1976 Robert Metcalfe and David Boggs wrote a very profound paper known as “Ethernet: Distributed Packet Switching Local Computer Networks” which till now is regarded as the foundation of Ethernet network technology (Thacker, 1986). Here it should be noted that Ethernet is the most common used technology of connecting Local Area Networks. Most academic institutions prefer Ethernet to other network types due to its versatility and simplicity of infrastructure installation and

connectivity, cost-effectiveness and plug-and-play capability. Since early 1980s till now many innovations and inventions on computer network infrastructure and networking systems have taken place. These innovations and inventions vary from hardware, software, devices, cabling, protocols, standards and modes. There is a great difference of computer network establishment and use in supporting access to electronic information between developed, developing and underdeveloped countries. These rates differ from one country to another country due to different challenges.

In Tanzania, the first great emphasis on the application Information Communication Technology in many aspects of the nation's welfare was done in March, 1989, when the Minister of Finance proclaimed that computers and computer knowledge is the backbone of Tanzanian national development. By then the challenges of computer and network infrastructure were; apathy or technophobia, lack of instructors, lack of hardware, informatics education and trainings (Klodwig Mgaya).

In 1994, Tanzanian passed legislative reforms in the ICT sector that introduced the separation of responsibilities between operative and regulatory bodies (Mwiyeria & Swarts, 2010). In 2003, the first National ICT policy was adopted to assist to achieve 2025 Millennium Development Goals among others. The second National ICT Policy was passed in 2007 after reforms and amendments to the first one. These subsequent reforms enabled enormous importation of computer hardware and software, increased efforts on ICT trainings and literacy and progress in knowledge and skills in use of electronic information resources and their enabling infrastructures. This was enhanced by partner NGOs assistance. The current National ICT Policy was passed in 2016.

Although there are implementations on policies and other reforms towards ICT knowledge provisions, skills and use but still there are some challenges persisting especially in the education sector where ICT is taught from primary school education level to tertiary education levels (Esselaar & Adam, 2013). Academic libraries and their parent institutions are struggling to provide electronic resources along with conventional printed information media to their patrons. Electronic information resources availability and use, installation of infrastructures and network connectivity in academic premises are some of the prime challenges. This research is going to assess the prevailing situation in higher learning institutions around Lake Zone of Tanzania.

1.2 Statement of the Research Problem

Streaming electronic information resources in academic libraries for educational purposes are crucial and indispensable practice which nowadays determines improved quality of a modern library. This high paradigm shift is due to their versatility, scalability, intuitive nature, pedagogical facility, and availability. This study has attempted to explore “Challenges of Computer Network Infrastructure in Accessing Electronic Information Resources in Academic Libraries” by regarding, first of all, assessment of electronic information resources access in academic libraries and this aspect the challenge concerning speed of internet, connectivity, and skills in academic institutions were to be assessed.

Secondly, had been identification of challenges of network installation and provisioning in academic libraries. In this aspect the problem of establishing and managing of computer networks seemed still problematic which this study attempted

to deal with. And lastly, but not least in its importance, some challenges pertaining to policies and pricing of electronic information resources, which obviously seemed to be persistent in academic libraries, had to be examined.

Specific issues to be assessed in this study were three namely; access, installation and policy challenges. Challenges facing network infrastructure and access to electronic media in academic and research institutions have been factors of great concern since 1960s. It should be born in mind that, in practice, Ethernet networks, optical fibers networks, token ring networks and wireless networks infrastructure have many challenges associated with installation, creation of links, connectivity, sharing, storage, structures, financial support, administration and so on. Many studies have been conducted so as to create knowledge, awareness and skills to develop and implement computer networking (Bhattacharya, 2002; Uche, 2011; Ugwu, 2017; Dordal, 2020). These researches have yielded high impacts in learning environment and behavior of learners, tutors and information workers. High disparity between developed and developing countries exist when it comes to a matter of utilizing computer network infrastructure. We see that in developed countries networks are more developed, stable and highly utilized compared to developing countries. These problems and challenges which still exist need some attention to solve so that they are minimized, diminished and or removed.

1.3 Objectives of the Study

These objectives of the study are general and specific ones. They are stated here to narrow purpose of the research study into manageable and achievable variables of the research problem.

1.3.1 General Objectives of the Study

To understand challenges of computer network infrastructure in supporting access to electronic information resources in academic libraries.

1.3.2 Specific Objectives of the Study

- i. To assess challenges of electronic information resources access in academic libraries
- ii. To identify challenges of network infrastructure installation and provisioning in academic libraries
- iii. To examine challenges associated with policies and pricing of network connectivity in academic libraries

1.4 Significance of the Study

Information workers and other stakeholders in information matters are specific people whom this study will benefit. As a matter of fact the world is experiencing big changes in information and communication technology. Due to this tendency it is necessary to information producers, providers, users and others to be acquainted with knowledge and skills on modern computer networking and electronic information provision. At institutional level through this study librarians, ICT managers, publishers, innovators, and academic institutions management teams, will be in a position to learn challenges of installing and managing computer network infrastructure. Also they will understand some challenges associated with accessing electronic resources, policies as well as financial implications of running networks. And lastly, at national level information workers and stakeholders will understand challenges associated with computer networks and facilitation of accessing electronic

information resources in academic libraries.

1.5 Scope and Limitations of the Study

The area of study was Mwanza Region, Tanzania and the sampling frame was three Lake Zone Academic Institutions namely; Catholic University of Health and Allied Sciences (CUHAS) comprised about 1750 population, St. Augustine University of Tanzania (SAUT) comprised about 6800 population and Institute of Rural Development Planning (IRDPP) comprised about 1800 population which made about 10350 of total population. The study population was composed of sampling units of students of variety levels of education which were; certificate, diploma, undergraduate degree, and postgraduate degree and members of staff of various professions. In this study there are several variables which were put into consideration gender and age as important demographic characteristics of the respondents were included surely each gender representatives were selected almost equally so as to avoid biasness but I did not indicate them in the questionnaire or interview questions.

The basis for selecting 3 academic institutions' libraries was to get a population within the vicinity around Lake Zone of Tanzania which was apparently enough to conduct a research in a mode of case study. There were about three main limitations to this study were obvious. First of all is that, I am not a professional researcher and due to this fact I believe that some faults might appear in this document because I am a student researcher and not an expert in researches. Another limitation is the methodological approach in this study whereby I used both qualitative and quantitative tools of data collection by means of triangulation so as to bring about

trustworthy findings. Qualitative tools used were documentary, interviews, and observations. Quantitative and qualitative tool used was questionnaires. Last matter which seemed to be a limitation was finance to conduct research.

1.6 Operational Definitions and Concepts used in the Study

Access challenges - In the information science these are drawbacks which hinder full optimal availability and utilization of electronic information resources stored in the computer network systems

Computer networking – is the connection of pieces of computer devices so as to enable them to communicate and share resources

Computer workstation – a computer workstation is normal Personal Computer (PC) within a computer network which has been assigned to carry out special tasks by computer engineer

Database – a structured set of data stored in a computer or computer system

E-resources - these are digital information resources in the sense that they are created, processed, stored, accessed and shared in electronic format

Ethernet – is a computer network which its primary feature is connection of Ethernet wires or cables compare to wireless network

ICT policy – is an information communication technology document prescribing rules, procedures, and principles of actions adopted by an business organization, institution or nation as guide

Infrastructure installation – putting in place pieces of equipment in a systematic order so as to perform intended duties such as computer networking

Multimedia – a multimedia is an information material which comprises more than

one medium of communication. A video is one example of multimedia because it is audio-visual in nature

Network connectivity – mode of sharing electronic information resources involving internet service provider, servers and peers

Optical fiber – is a thin flexible fiber with glass core through which light signals can be sent with very little loss of strength. They permit transmission over longer distances and at higher bandwidths (data rates) than electrical cables.

OSI-model – is a standard conceptual framework of interrelated seven layers of computer network infrastructure which are basically used for reference in computer communication

Paradigm shifting - a fundamental change in approach or underlying assumptions. In ICT it denotes the fundamental shifting from only using conventional printed information resources to utilization of electronic resources especially in academic matters.

Streaming media - is video or audio content sent in compressed form over the Internet and played immediately, rather than being saved to the hard drive

Wireless network – also known as Wireless Fidelity (WiFi) is a means of connecting networked computers or mobile devices by using router rather than wires

1.7 Research Questions

- i. How are the challenges in network infrastructure, affects access of electronic information resources?
- ii. What are challenges associated with network installation and provisioning in academic libraries?

- iii. What are challenges of network connectivity, pricing and policing in academic libraries?

CHAPTER TWO

LITERATURE REVIEW

In this chapter I reviewed contents of other relevant literatures. In these documents I was particularly interested in searching data and information which would lead to fulfillment of objectives of the study, answer research questions as well as fill the gap of the existing knowledge concerning effectiveness of network infrastructure in supporting access to electronic information resources in academic institutions. In order to get well with the search of the literature I presented a sequence of information and empirical data in separate but interrelated order of three topics and their subtopics. The main topics of discussion towards the literature search were;

- i. Electronic information Access
- ii. Supporting Technologies
- iii. Research Gaps

2.1 Electronic Information Resources Access

2.1.1 Types of Media Resources

Electronic information resources in academic libraries have been in use for quite a long time. Electronic resources in libraries began in 1965 with the development of Machine Readable Catalogue (MARC) format (Hawthorne, 2008). In 1980s data sets were stored and accessed on diskettes (CD-ROMs) via microcomputers and Online Public Access Catalogues (OPACs) became common. Tim Lee-Bernes in 1989 laid out a foundation on how World Wide Web is made up of. The World Wide Web was another milestone towards availability and use of electronic resources. Creation of Mosaic browser facilitated browsing web pages. By then, library patrons could

browse information stored in databases worldwide via the hyperlinks. Nowadays electronic information resources access and use in academic libraries are considerably increasing compared to the past time. These resources are of various media such as texts, graphics, photos, audios, videos and combination more than one medium. These electronic media are presented into various formats such as electronic books, journals, local and online databases, institutional repositories, theses and dissertations, Electronic past examination papers and online references. Many literatures have studied about types of electronic resources media, these include: (ACRL, 2018; Van Epps, 2004; Ahmed, 2017; Tariq & Zia, 2014, Aljami, 2019, Akuffo, 2019)

2.1.2 Library Patron-Centered Problems and Challenges

However, academic libraries face challenges when striving to achieve effectiveness and excellence. Some of the challenges are patron centered due to that they appear to affect patrons and or are caused by patrons because they are the main users of the electronic information resources in libraries. These patrons are put into about three major groups which are students, institution's staff members and researchers. Some scholars have delved into studying challenges affecting e-resources users.

Among these studies are; (Adeniran, 2013; Edem & Egbe, 2016; Akpotojor, 2016; Abubakar & Adetimirin, 2016; Millawithanachchi, 2012; Moberg, 1999; Swain & Panda, 2013; Renwick, 2005; Kiilu, 2011; Weir et al., 2009; Isowe, 2016; Venance, 2016; Katabalwa, 2015, Ternenge & Kashimana, 2019; Okogwu, 2019). These studies point out various challenges affecting effectiveness of access to electronic resources in academic premises such as lack of awareness, perception towards

electronic information resources, lack of enough training, lack of technical support, lack of ICT gadgets, computer-based courseware access, poor ICT skills and limited access to electronic information resources, also it is hard to get what you want on the portal and the links etc. In order to solve the mystery of technological applicability challenges some people have been trying to deal with it so as to describe this phenomenon. Two popular descriptions are Technology Acceptance Model (TAM) which was developed by Davis, (1989) to explain computer-usage behavior. It models how users accept and use new technology and the second one is Unified Theory of Acceptance and Use of Technology (UTAUT) which was developed by Venkatesh et al., (2003).

2.1.3 Institutional Access Challenges

When we discuss the effectiveness of network infrastructure and access to electronic information resources we normally cannot afford to bypass challenges pertaining to parent institution in which the academic library is established. Establishment, running and managing network infrastructure in academic area requires predetermined requirements of human resources, equipment, funding, policies and procedures of running, design, and management. This is genuine reason for preparedness to achieve high efficiency during running information provision business.

Carnegie Corporation and the International Telecommunications Union (ITU) supported the Africa Information Society Initiative (AISII) which was concerned with promoting ICT policy formation in Africa. Eventually, AISII action framework was adopted by Ministers of Economic and Social Development and Planning and

endorsed by the then Organization of African Unity (OAU) in 1996 (Hennessy, Onguko & Harrison, 2010; NICI, 2015; UNESCO, 2017). Also, according to (OSND, 2004; InternetSociety; 2012), African Virtual University (AVU) initiatives, with headquarters in Nairobi since 2000, had great impact in establishment and motivation for ICT education in Africa from its beginning. AVU, initially launched in 1997 as a World Bank project, is tertiary education network that uses blended Open Distance and e-Learning (ODEL) programs to facilitate quality tertiary education dissemination. It operates through established African Universities to increase access for a wider array of learners, including traditional students, life-long learners and active workers and professionals.

Many scholars have written literature dealing with electronic information resources access institutional oriented challenges. They highlighted causative agents of poor access to electronic information resources as they run network infrastructure. They investigated electronic resources access challenges associated with institution and the findings revealed that policies, guidelines, procedures, standards, practices and specifications regarding selection, acquisition, development and maintenance of electronic information resources have challenging factors (Kay, 2019, ALA, 2019; Coghill, 2019).

Institutions should be in good positions to join consortia which eventually subscribe electronic or digital information from subsidized publishers and commercial databases. For instance, the management should make sure that subscription and followup on availability of electronic information resources provision by consortia are reliable. IFLA, eIFL, INASP, PERii and Research4Life are organizations which

enable channeling of printed and electronic resources which are subsidized to library institutions which have subscribed information resources through consortia. In Tanzania most academic institutions subscribe electronic information resources via Consortium of Tanzania University Libraries, (Katabalwa, 2015; Acanit, 2016; Mwantimwa, 2017)

Thus, academic library institutions need appropriate feedback mechanisms, organizational structures, and planning processes for measuring growth and handling change in the network. The responsible persons need to have broad institutional perspectives and be good communicators, consensus builder, and pragmatic visionary; (Lefuma, 2017; Moberg, 1999; ALA, 2018; Oyieke, 2008; Ashiq, Rehman & Batool, 2018)

Findings explaining how funding for electronic information resources in academic libraries are critical challenges which are stated in the papers by (Mawere, 2018; Singh, 2013; Moberg, 1999; Mosha & Bea 2014; GESCI, 2017; Ghuloum, 2012; Sanjeeva, 2018) the main types of funds are capital funds, support funds, and maintenance funds. They conclude that funding is essential for sustainable of electronic information resources availability from purchasing of hardware, software and peripherals, and the beginning of installation of network, selection and acquisition, maintenance and overall management of effective access to electronic information resources in academic libraries (Osei Bugyei, 2017). Also, high cost imposed on ICT tools, lack of government direct funding it was found among obstacles to managing network infrastructure and electronic information resources access.

With regards to institutional challenges towards access to electronic information resources it was found that staffing is a considerable factor to ensure effectiveness of e-resources services to library patrons. The institution should be capable of staffing workers of various knowledge and skills concerning ICT and computer networking such as computer systems and network administrators, computer programmers, and librarians. In some institutions, librarians have become true partners in the delivery of instruction, working with faculty, technologists, and instructional developers to create new learning communities (Lefuma, 2017; UNESCO, 2015; Ghuloum, 2012)

2.2 Supporting Technologies

2.2.1 Infrastructure Installation Challenges

The first notable attempt to connect computer network was done in late 1950s when the US military radar system was networked (Cooper & Piumarta, 2014). However, most significant endeavors to establish computer networks were done in 1960s such as; The National Physical Laboratory in United Kingdom which in 1967, under Donald Davies and Paul Baran, implemented the Local Area Network of computers by packet switching (Proceedings of IEEE, 1978) Likewise, the Advanced Research Projects Agency Network (ARPANET) in USA enabled connection of first four nodes of computer workstations using 50kbit/s.

The first important step towards installation of computer network infrastructure is planning the ideal network in *Physical dimensions*. The ideal campus network is an information channel that reaches *every place* on campus where "knowledge workers" live and work, including offices, classrooms, laboratories, studios, student residences, student activity areas, and so forth. It includes a physical infrastructure that consists

of high-grade copper and fiber cable; junction and termination boxes; communications devices such as fiber hubs, bridges, routers, terminal servers; and wiring closets to house equipment and termination panels (Moberg, 1999; Redmond, 2009; Wang, 2016; De Kok, 1997).

The ideal network should be of desired choice of networking mode such as Local Area Network (LAN), Wireless Local Area Network (WLAN), Wide Wireless Area Network (WWAN), Virtual Local Area Network (VLAN) and Campus Area Network (CAN). It should comprise of ICT hardware, software, connections such as Media Access Unit (MAU), Media Access Control (MAC), repeaters, bridges, gateways, switches, hubs, but also storage servers such as proxy servers and Network Attached Servers (NAS) attached with Digital Living Network Alliance for Universal Plug and Play (DLNA/UPnP) according to suitable capacity and standards set by networking professionals such as Cisco, IETF and IEEE. OSI-model and underlying protocols of network workability are essential guides to ensure effectiveness and efficiency of computer networks and thus should be adhered to. (Dordal, 2020; Cisco, 2020)

Reliable ICT infrastructures are keys to successful computer networking in academic areas. It is for this reason we learn that schools in the Western World invested a lot for ICT infrastructures since 1980s and students use computers more often and for a much larger range of applications (Volman, 2005). The most challenging condition to implement ICT strategy in African schools and universities is inadequacy, poor existing infrastructures and access to content that is jeopardized by changing technologies (Mikre, 2011; Hennessy, Onguko & Harrison, 2010; Hare, 2007;

Kihoza et al., 2016; Kiilu, 2011; URT/TETP, 2014; URT/NICTP, 2016; GESCI, 2017; Oji, 2016; Oyieke, 2008; Adamou & Ntoka ,2017; Wessels, 2000). In the research conducted in Tanzania in 2014 it indicated that universities and other higher learning institutions do not have adequate ICT facilities and bandwidth to meet real demand although there are some initiatives by the government (NICTP, 2016).

2.2.2 Network Connectivity Challenges

Connectivity Theory-(Connectivism) popularly known as a learning theory of the digital age. The connectivism theory states that, learning is a process that occurs within nebulous environments of shifting core elements not entirely under the control of the individual, (Siemens, 2005; Shidi, 2013). As the theory above elucidates, it becomes obvious that network connectivity in academic environments is of great importance. So many literatures have been written indicating how network connectivity is highly challenging. Connectivity depends on the mode of networks and type of network.

The ideal campus network handles multiple network protocols. Network operating systems will need regular management, maintenance, and upgrading. Someone will have to run cable, make and maintain network connections, trouble-shoot problems, install routers, and ensure that all hardware and software licensing agreements applicable to electronic information resources are executed by appropriate institution authority (Moberg, 1999; Hennessy, Onguko & Harrison, 2010; Kiilu, 2011; Byanyuma et al., 2018; Redmond, 2009; Adamou & Ntoka, 2017; Wessels, 2000; Toby 2017; Wang, 2016; Barfi, 2016; Cisco, 2020). However it is learnt that some challenges that persist are; Portal not readily accessible, poor Internet connectivity,

delays in downloading information, resident (no off campus access), no access to rights protected journals and back files, Electricity cutoff as supportive infrastructure and effect of packet losses.

2.2.3 Multimedia streaming Technical Challenges

Streaming multimedia digital information resources are effective in impacting knowledge to students and other learners because of media mixture therefore they are quite important in academic libraries. Dealing with streaming digital resources requires high expertise. Thus it is highly recommended that librarians responsible for the media resources program should have a graduate degree in library/information science or equivalent degree or experience and should have specialized media training and technical expertise and the library should fund continuing education and conference attendance.

An academic library media operation may encompass a variety of activities such as Ethernet installation and managing the delivery of audiovisual equipment to classrooms, operating distance education television studios, offering instructional development and production of audiovisual materials and supporting multimedia production offering instructional development and the production of audiovisual materials, and supporting multimedia production. (Adamou & Ntoka, 2017; Barfi, 2016; Khatri, 2019; Coghill, 2019). Some multimedia streaming technical challenges that face many academic libraries in developing countries are such as inadequate number of graduate librarians, lack of enough funds to sponsor continuous education of librarians. A study conducted by Ministry of Communication Science and Technology of Tanzania in 2014 showed that there had been little progress in

developing local content over the last ten years of NICTP 2003 implementation. The country still depends on foreign importation of content, software and hardware (NICTP, 2016) Other challenges are continuous changes in hardware, software and devices innovations which render obsolescence to old devices, databases creations, and data streaming online sources by aid of DLNA/UPnP.

2.3 Research Gaps

In my preliminary literature search I have identified the following research gaps which are not fully addressed especially in Tanzania and in Africa in general concerning network infrastructure and access of e-resources in academic areas/libraries. First GAP is absence of thorough research on formation of a consortium in Tanzania which is inclusive of other types of libraries and information centers such as public libraries, school libraries, and special libraries to work along with Consortium of Tanzania University and Research Libraries (COTUL). Second GAP is absence of thorough researches on creation of commercial local electronic/digital information resources databases to serve library patrons. For this will reduce cost of subscription costs

And the third GAP is lack of thorough researches addressing a need of deployment of network infrastructure with advanced technologies like Third Generation 3G using the Datamax+ HSPA 4-Port Ethernet Router with RS232. Fourth Generation using F3825 LTE&WCDMA Router which supports RS232 (or RS485/RS422) form LANs and WWAN (Wide Wireless Area Network) and Fifth Generation network using in academic premises. These further researches for this matter will improve speed and accessibility of electronic information resources

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Design

A research design is a step-by-step strategic plan of action which integrates various components of the study in a coherent and logical way to effectively conduct research systematically and on schedule to produce quality results and detailed reporting. As the research problem states; “Challenges of Computer Network Infrastructure in Accessing Electronic Information Resources in Academic Libraries” Case study was used in this study so as to involve empirical data with contemporary phenomena using multiple sources. These mixed approaches are mainly known as triangulation.

This strategy was deemed to be most suitable in order to gain in-depth insight of the research problem. Hence, triangulation strategy in case study of three Lake Zone of Tanzania academic institutions libraries was opted, in which there was a mixture of both qualitative and quantitative measurements, so as to obtain high validity and reliability of data. Therefore, this exploratory social science research was undertaken to study the population variables with cross-sectional research approach. The sampling strategy followed basic principles of sampling. Survey design was used whereby devised semi-structured interviews, questionnaires, documentary (empirical data) and direct observations were used to obtain data from respondents.

To ensure that data obtained would be trustworthy some issues were regarded during the research process. These issues were; submission of ethical concern statement, collection of research permits from responsible authorities and asking respondents

consent for their participation. In this research design other things which were elaborated in details were tools and measurement procedures, data analysis and presentation of findings, Demographic characteristic for each population, and study population results. During presentation of data texts, graphs, tables and charts were used.

3.2 Study Population

The population of about 10350 was subdivided into three Lake Zone Academic institutions namely; Catholic University of Health and Allied Sciences (CUHAS) comprised about 1750 population, St. Augustine University of Tanzania (SAUT) comprised about 6800 population and Institute of Rural Development Planning (IRDP) comprised about 1800. Demographically, the study population was composed of sampling units of students of variety levels study which were; certificate, diploma, undergraduate degree, and postgraduate degree and members of staff of various professions. Further, I identified them according to: Gender, Age, Status, and Level of Education. Due to the nature of study variables which were under investigation I opted to use semi-structured interviews and questionnaires to obtain qualitative and quantitative data.

3.3 Sampling Procedures and Sampling Size

Both probability and non probability sampling techniques to select sample units within the entire population were applied. In probability sampling technique simple, systematic and stratified random sampling were used to obtain required sample respondents to answer both questionnaires and semi-structured interviews. In non-probability sampling technique purposive sample was taken to answer semi-

structured interviews. Provided that a sample is a subset of the population from which data are collected therefore expected maximum of a hundred respondents from the entire population of about 10350 persons was taken. Samples for qualitative studies are generally much smaller than those used in quantitative studies RITCHIE, LEWIS and ELAM (2003). In order to get reliable sampling units the principle of statistical regularity from which theory of probability was used. But also because principle two suggests “Inertia of Large Numbers” therefore a hundred respondents could bring saturation for better results of the study. Finally, due to variability of the sampling units in order to get more accurate and generalizable results, principle three which suggests putting units into clusters and strata was used. With this triangulation of methods of collecting data then data were collected, analyzed data and eventually presented a report.

Semi-Structured Interviews: With semi-structured interviews the researcher met with each respondent at a convenient time to conduct interview. 16 student respondents who were selected randomly answered semi-structured interviews and 3 library or ICT personnel respondents of high rank within the office who were selected purposively to answer semi-structured interviews. Respondents were identified by their levels of study and location of respective institutions for both students and staff members.

Table 3.1: Respondents who Responded to Semi-Structured Interview Questions

	IRDP	SAUT	CUHAS	Total
Students	11	2	3	16
Staff members	1	1	1	3
Total	12	3	4	19

Source: Field Data, 2019

Questionnaires: During data collection the selected respondents were supplied with questionnaires with limited time to fill them and return them to the researcher. The respondents were 69 student respondents who answered survey questionnaire, 18 library and ICT personnel respondents who answered survey questionnaire. Respondents were identified by their levels of study and location of respective institutions for both students and staff members.

Table 3.2: Respondents who responded to Survey Questionnaires

	IRDP	SAUT	CUHAS	Total
Students	28	22	19	69
Staff members	6	9	4	19
Total	34	31	23	88

Source: Field Data, 2019

3.4 Data Collection Tools

Tools which would aid in collecting data were devised. Provided this was a qualitative and quantitative social science research which was going to study phenomena, status and trend of effectiveness of network infrastructure and access of electronic information resources in academic, therefore the exploration of the problem was to be done by observations, semi-structured interviews, documentary (empirical data) and questionnaires. Tools which were used are notebook, pen, pencil, camera and audio recorder to facilitate recording of data were used.

Objective and Purpose of using each Data Collection Tool;

Observations: Direct observation as a tool for collecting field data was used instead of participant observation because it was a cross-sectional survey type of research approach. The objective and purpose of using observation was to go at field to

observe and gather primary data or facts corresponding to the variables under investigation.

Semi-structured Interviews: Semi-structured interview was used in this study as a tool to gather data because it is considered to be very effective in qualitative surveys as it allows a respondent to express ones attitude, phenomenon, ideas, and opinion regarding the research problem at hand. Therefore, the objective of using semi-structured interviews was to collect insightful data, and eventually, information concerning challenges of computer network infrastructure in accessing electronic information resources in academic libraries.

Documentary (empirical data): Documentary or empirical data were used whereby each of the three institutions involved in the case study produced to the researcher some of the documented data to suffice the requirement of the study. The objective and purpose of using empirical data was to search for the already documented facts which related to the research problem under investigation.

Questionnaires: Questionnaires with close-ended questions were used to test phenomena, attitudes, opinions, and collect demographic data. Another purpose of using questionnaires was to use them to collect reliable and valid qualitative and quantitative data in a relatively large sample population of about 10350 persons.

3.5 Data Analysis

This being mainly a qualitative and partly a quantitative research, therefore, qualitative and quantitative data analysis procedures were utilized to provide explanation of the whole process. In this context the qualitative and quantitative data

were collected, processed, analyzed, interpreted and presented to produce the result of the study. In order to explain phenomena of data measurement scales which were used are Nominal scales, Ordinal scales, and Interval scales.

Processing of raw collected data was done manually and automatically by using SPSS to produce meaningful information by following data processing stages which involved data collection, data preparation, data sorting and coding, data input validation, data processing, data output, data interpretation, and data storage. During data sorting all relevant questions in the questionnaires and interview schedules which seek to obtain explanation of certain phenomena according to the research questions were put together. Also, observation data were highly considered. By doing so all research questions which were derived from the research objectives were tested during investigation.

Descriptive statistics were used instead of inferential statistics due to fact that research questions were tested rather than research hypotheses to get insight into the research problem. In the descriptive statistics which is the general summary describing and presenting collected research information some concepts which were included to present findings were measure of central tendency, variability and measure of shapes.

- i. Measures of Central Tendency which are mean, mode, median and range. The Central Tendency Theorem was studied.
- ii. Variability or spread in a set of data which are the, inter-quartile range, standard deviation, and variance
- iii. Measures of shape in the distribution which are the kurtosis and the skewness.

3.5.1 Analysis

During analyses of data each case objective was treated separately so as to make it easy to comprehend. In order to explore into that objective several related questions in a form of questionnaire, interview schedule, observation, or documentary facts were to be answered. First of all, data related to access challenges obtained through various methods were collected and grouped together. Access challenges had two sides. The first side was that pertaining to patrons and the second one pertained to institutions. Secondly, data related to challenges of network supporting technologies obtained through various measurement methods were collected and grouped together.

3.5.1.1 Access Challenges Linked to Experience and Skills of Users

The major aim was to collect data which highlight the problem and challenges associated with experience and skills of utilizing electronic information resources.

Table 3.3: Summary of Questions which were Asked

No	Questions asked	Respondents type
1	“How they value computer science and applications subject which is taught as module in their course”	Students
2	How they started to learn computer science and applications skills	Students
3	How easy they find the task of accessing digital/electronic information through computer network	Students
4	Whether they “have a desktop computer/laptop/ or Smartphone they possess”	Students
5	Whether students seek assistance from the staff	ICT & Library staff
6	Whether they get assistance from parents and friends on issues concerning computer knowledge and skills	Students

Source: Field Data, 2019

In this group of questions, question number one, that was aiming at exploring attitudes towards value of ICT studies in colleges had four multiple answers which had variable levels of feeling. In the next second question they were asked to recount

their previous first encounter of computer science and technology. This was aiming at knowing their knowledge and skills background in order to determine digital divide amongst various levels of studies. This could lead to know some challenges and problems which are patron-centered.

At the third place they were asked to tell how easy they find the task of accessing electronic information materials in the computer databases. Another challenge and problem sought to be examined was the possession of the electronic devices. Availability of staff is very important in enhancing electronic information resources access and thus they were queried to know whether they seek assistance from them in open ended semi-structured interviews likewise; in the last interview question one should tell whether she/he get assistance from friends and parents.

3.5.1.2 Access Challenges Linked to Financial Capability of Library Patrons

In order to know about financial cases all student respondents were questioned to know whether their parents and guardians assist in the process of accessing electronic information resources by paying bundle recharge bills. Another question was asking to know whether Internet recharge bundle price is a challenge when they want to find information on the Internet by using your Smartphone. Furthermore, the students were asked if they get Internet students' offer when they recharge bundle in their SIM cards. Mobile digital handsets are nowadays crucial appliances which facilitate access to digital information resources via the Internet or through the institutional networks via WiFi and hence mobile phones are secondary in importance by students seeking and accessing electronic information resources in repositories the first one is still the Ethernet and optical fibre network.

3.5.1.3 Access to Free and Commercial Databases

The question asked whether the three institutions namely; IRDP, CUHAS and SAUT have “subscribed to any free electronic information resources databases such as Research4Life (ARDI, OARE, HINARI)” consortium. And, also according to the survey data it needed to whether all three institutions are members of Consortium of Tanzanian University Libraries (CoTUL) which on behalf of the members subscribe to various commercial electronic information resources databases.

3.5.1.4 Resources Selection and Acquisition Policy and Pricing

Many questions were asked to investigate whether resources selection and acquisition policy and pricing. How do the electronic information resources selection and acquisition policy and standards affect services to users was the first question which was posed to the staff respondents. Another explored into financial assistance policy to know whether individual students and central government contribute any money, grants or subsidies to support establishment and running of network infrastructure. And the study also needed to explore whether the staff think that electronic multimedia information resources are cost-effective as compared to conventional printed books as well as budgeting process in the institutions whether networks are provided with enough shares of finance for development.

3.5.1.5 Availability of Skilled Workers of ICT and Library

Availability of skilled workers of ICT and library was one of the issues which were investigated to understand available manpower.

3.5.1.6 Availability of Effective Network Infrastructure

Through observation of the computer network infrastructure it was found that the

modes of connecting devices were two. The major mode of connecting devices was through Ethernet wires and the minor means of connecting was through WiFi (wireless connections). The question asking about user satisfaction on the available computer devices compared to the needs of user community was posed. Also the issue “continuous changes in hardware, software, and networking devices due technological advancements affect performance, practice and management of the network infrastructure” was explored.

3.5.2 Financial Challenges of Managing Installed Network Infrastructure

One of the challenges of managing electronic resources is source of financing. Three variables concerning financial challenges were investigated by using survey questionnaires to staff also respondents were questioned by semi-structured interviews to investigate computer and network annual budget do satisfy needs. Also the question was asked to know whether “students contribute any expenses in the running of institution's network infrastructure”.

3.5.3 Network and Internet Connectivity Challenges Due to Institutional Infrastructures

In order to explore these challenges observations were undertaken in the in the computer rooms and around the campuses and also questions were posed to respondents. Observations in this case regarded network infrastructure and Multimedia streaming tendency. Meanwhile, the following questions were posed to respondents:

Table 3.4: Summary of Questions which were Asked

Number	Question asked	Respondents type
1	What mode of network connectivity do you use to connect computer devices?	ICT & Library staff
2	Do you get connected by WiFi wireless network connection available in the college campus?	Student
3	What are the most critical challenges facing you when you process and manage computer network.	ICT & Library staff
4	Do continuous changes in hardware, software, and networking devices due technological advancements affect your performance, practice and management of the networking infrastructure?	ICT & Library staff
5	How can you rate the speed of downloading electronic information document from the internet?	Student

Source: Field Data, 2019

The above were the questions asked purposely to know the magnitude of challenges concerning network connectivity. First of all, the question was posed to staff to know modes of connectivity. This question was open for free discussion and they were required to answer in their interview. Expected modes of choices in LANs were Ethernet, WiFi, and Optical. The second one was asking the students respondents to implore into the immensity of WiFi connectivity challenges in individual university and whole case study at large. This question asked whether they were already connected to institutional network by wireless mode.

In the third question we wanted to get aware of the critical challenges when the working staff process and manage computer networks. Fourth consecutive question needed to know effects of technological advancements tendency in relation to performance, practice and management of library and ICT organizations. At last stage of examining the challenges of network connectivity respondents were asked to rate speed of downloading/downlink the electronic information documents from the databases to know whether they were satisfied with the contemporary speed.

3.5.4 Challenges of Connectivity and Retrieval of Electronic Information Resources Due to Speed

Mode of connectivity was observed. Bandwidth speed of Internet provided by Internet services providers was investigated. Also mobile Smartphones used by individual students and staff members were explored whether they used 2G and 3G. Another speculative interview question wanted to know availability of 4G LTE SIM card or Smartphone or connectivity from the service providing companies. The question was put forward to explore the rate institutions' downloading speed of Internet to electronic information documents. In this sense the respondents were also asked to speak how they are satisfied with the speed of the network/Internet.

3.5.5 Challenges of Network and Internet Connectivity Due to Services Providers

Data about "Internet Service Providers" were collected and obtained issues concerning price rates, speed of downloading materials satisfaction, and bandwidth from broadband. Questions asked in this instance were;

- i. What SIM card do you prefer to use when you connect to internet?

Individual SIM card owners are one who subscribes to ISPs via their smartphones hence this question meant to explore whom one possess great share in SIM cards.

- ii. Who are your Internet Service Providers?

This question needed answers so as to know who are ISP of each individual internet subscriber as in Tanzania there are several ISPs this aimed at knowing the broadband market shares.

iii. Does price of internet bundle affect your network connection?

Prices of internet subscription fees was another factor considered as a challenge to the internet users. This challenge affects individuals and institutions.

iv. Do you get internet students offer when you recharge bundle?

One of the issues which stimulate usage of internet services are offers. In this case a question was posed to student respondents to know whether they get any offers from ISP student offers, specifically.

v. Are you satisfied with the speed of the internet/network when you surf and or download electronic/digital documents?

Speed of Internet and network when surfing is key challenge in many perspectives. Institutions and individuals are affected greatly by slowness. Fast speed is very useful compared by slow speed because delaying in downloading rate results into much time consumption as well as frustration thus in this case a question was asked to know satisfaction.

3.5.6 Challenges of Processing Multimedia

Library and ICT were asked how they feel the challenges of processing multimedia. Processing of multimedia involves many activities such as planning for multimedia resources requirements, analyzing them, designing, preparation, utilization and storage. Some challenges facing staff when they process and manage computer network according to the survey data were viewed. These challenges included knowledge and skills gap due to inadequate professionals as well as shortage and or lack of some tools and equipments suitable according to the recommended Open

Systems Interconnection (OSI).

3.5.7 Challenges of Maintaining Computer Devices

Staff respondents were asked how they feel the challenges of maintaining “computer devices. Most critical challenges facing staff members when managing computer networks were revealed according to the survey data as it will be shown latter in this chapter.

3.5.8 Preference of Types of Media Resources

There are various types of electronic information resources which can be streamed through the network and Internet therefore a question which was asked to know their preferences was provided. Thus, they were asked which source of information reference do they normally prefer to use when they answer their class assignments and do self study.

3.6 Validity and Reliability

The research study was conducted by following every step required in conducting qualitative and quantitative social researches. First, research problem was formulated. Secondly, the topic was introduced. Then, all necessary relevant literature was sought. Methodology of research was designed. Data were collected analyzed and presented. All necessary tools of data collection were utilized fully. The findings were discussed and finally the conclusion and recommendations were given out. Validation was ensued by using past data collected in previous researches. Reliability of research was also considered crucial by ensuring that measurement instruments, questions, techniques and interpretation were done in reliable and applicable

standards. Both validity and reliability were regarded to avoid biasness, increase accuracy of findings and to maintain neutrality, trustworthy and integrity.

CHAPTER FOUR

PRESENTATION OF FINDINGS

4.1 Introduction

Exploratory approaches were used in this study. First, the background of study was explored followed by thorough literature review. The background of the study and review of literature were conducted to ensure consistency, validity and reliability of the study. Secondly, methodology was designed to fit the kind of the research which was a mixture of qualitative and quantitative.

In this chapter there is presentation of findings obtained in this research. The descriptive statistics techniques were used in this research. Statistical Package for the Social Sciences (SPSS) software was used to identify relationships and differences between variables and to compare variables so as to present findings. Modes of variables were put into consideration for being the cores of central tendencies in the provided descriptive data to describe the variables and their respective cases.

Survey questionnaires, semi-structured interviews and observations were used to enhance reliability and validity. During treatment of cases, nominal and ordinal measurement scales were used to describe them and summarization of relationships between two categorical variables presentation was done by using graphs and tables by displaying modes and means. Where simple explanation was deemed good enough to explain the phenomenon then textual data presentation has been used in that stance. Hence, due to the features of the data which were to be presented, chosen methods of data presentations were texts, figures and tables. The presentations of the findings followed an order of precedence arrangement according to the research

objectives and research questions as shown in the data presentation stage. Each objective was subdivided into smaller parts for better and easy tackling of the issues which were under investigation. Each indicated what questions were concerned and what findings were revealed.

4.2 Presentation of Findings

Table 4.1: Levels of Education of the Student Respondents

Levels of Education of Student Respondents		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	certificate	6	8.7	8.7	8.7
	diploma	18	26.1	26.1	34.8
	undergraduate	42	60.9	60.9	95.7
	postgraduate	3	4.3	4.3	100.0
	Total	69	100.0	100.0	

Source: Field Data, 2019

The mode was undergraduate staff members who answered questionnaire. This was 31.6% and the mean was postgraduate staff members who answered questionnaire and it was 15.8%

Table 4.2: Levels of Education of Staff Respondents

Levels of Education of Staff Respondents		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	certificate	5	5.9	26.3	26.3
	diploma	5	5.9	26.3	52.6
	undergraduate	6	7.1	31.6	84.2
	postgraduate	3	3.5	15.8	100.0
	Total	19	22.4	100.0	
Missing	System	66	77.6		
Total		85	100.0		

Source: Field Data, 2019

As stated in the statement of the problem, in the introduction three specific objectives of the study were aimed to be achieved. In order to gain more insight into these objectives these objectives were subdivided into more specific objectives.

4.2.1 Library Patron-Centered Problems and Challenges

4.2.1.1 Access Challenges Linked to Experience and Skills of Users

According to the table below network users who possess digital devices such as laptops and Smartphone's are 82%. This is an indication that largest portion of the academic population possess digital devices.

Table 4.3: Users Possessing Digital Devices

Responses		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes. I have	57	82.6	82.6	82.6
	No. I don't have	9	13.0	13.0	95.7
	I will buy one	3	4.3	4.3	100.0
	Total	69	100.0	100.0	

Source: Field Data, 2019

From figure 4.1, data presentation shows skills and experience of the network users as they were asked how they started to learn computer science and applications skills. Findings showed that computer network users who acquired ICT knowledge and skills while in college is about 40% and only 6% were able to learn ICT when they were in primary schools. It was estimated that the number of patrons who use Internet connection services to access electronic information resources amount to about 1500 persons each week

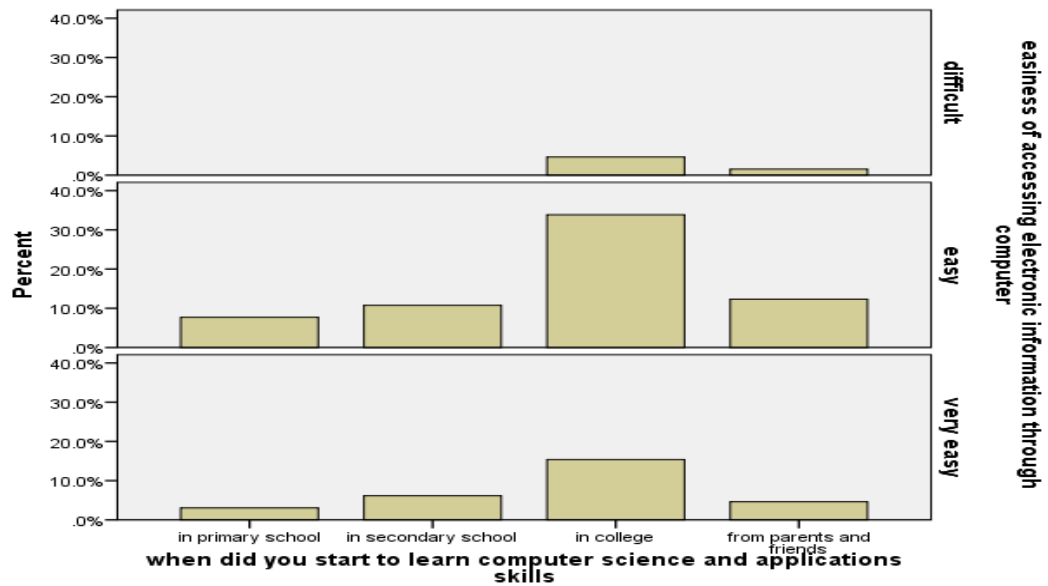


Figure 4.1: Relationship between Background of Knowledge and Skills of ICT to Easiness of accessing Electronic Information Resources through Computers

Source: Field Data, 2019

4.2.1.2 Access Challenges Linked to Financial Capability of Library Patrons

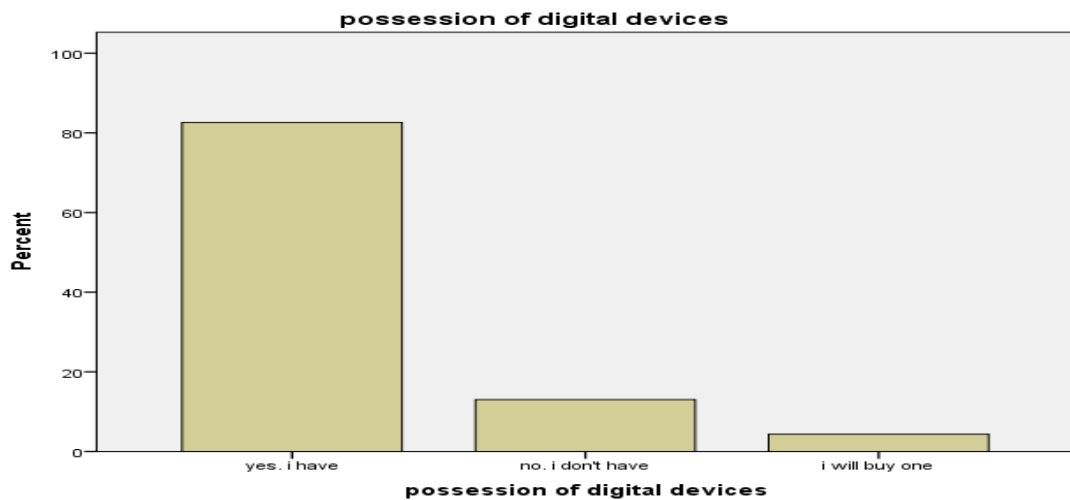


Figure 4.2: Cases Possessing Digital Devices within the Population

Source: Field Data, 2019

All respondents agreed that parents and guardians assist in the process of accessing electronic information resources by paying bundle recharge bills. All respondents agreed that they are subscribed to Internet students' offer.

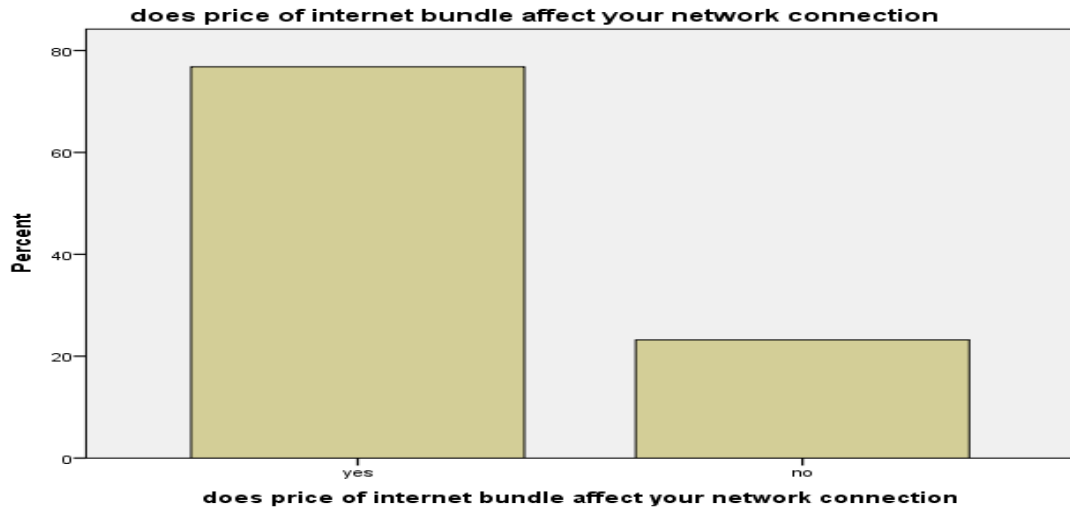


Figure 4.3: How Mobile Phone Internet Users Are Affected by Subscription Charges

Source: Field Data, 2019

Findings showed that about 78% of network and Internet users are affected by subscription charges

4.2.2 Institutional Electronic Information Resources Access Challenges

4.2.2.1 Access to Free and Commercial Databases

And also due to the survey data it showed all the above three institutions are members of Consortium of Tanzanian University Libraries (CoTUL) which on behalf of the members subscribe to various commercial electronic information resources databases. Evidence showed that those databases were not effectively utilized.

4.2.2.2 Resources Selection and Acquisition Policy and Pricing

From the data collected in the field 90% of staff revealed that the students don't contribute directly to the cost of running network infrastructure of the institutions due to absence of regulations embodied within the library policies. Also it was found that 85% of the staff respondents inquired said that the institutions do not contribute in the expenses of running the networks through direct subsidies and or grants.

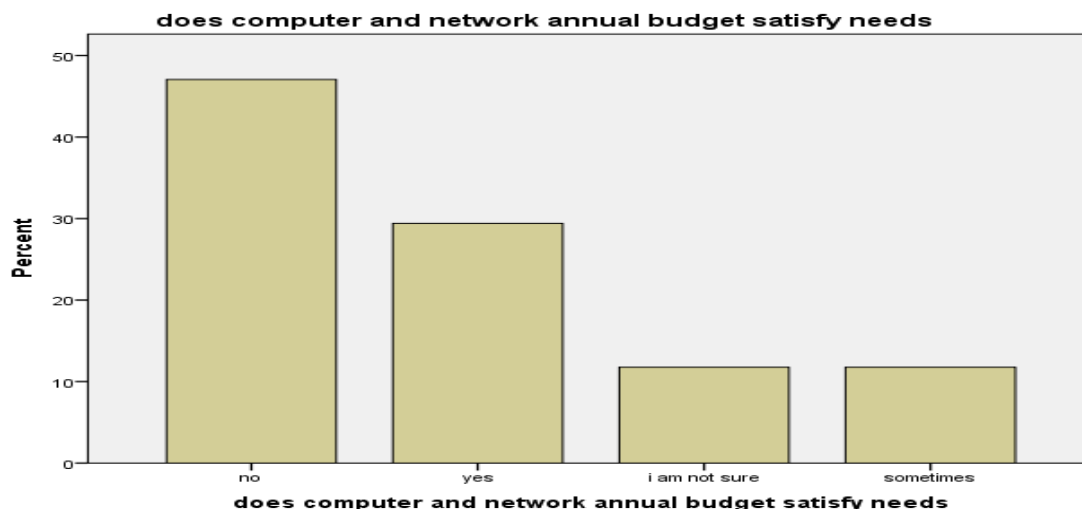


Figure 4.4: Institutional Annual Budget Satisfaction for Computers and Network Subscription

Source: Field Data, 2019

4.2.2.3 Availability of Skilled Workers of ICT and Library

Availability of skilled workers of ICT and library was one of the issues which were investigated to understand available manpower. The study revealed that in IRDP – Lake Zone Center, Mwanza, the number of workers ranged from 4 to 7 as indicated in green colour. In CUHAS- Bugando, Mwanza, the number of workers ranged from 8 to 11 as indicated in gray colour and In SAUT – Mwanza, the number of workers ranged from 16 to 19 as it is shown yellow colour in the Figure 4.5.

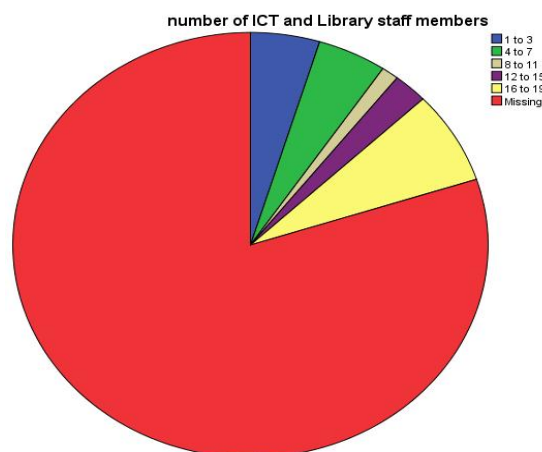


Figure 4.5: Availability of ICT and Library Staff Members

Source: Field Data, 2019

Skills were measured by levels of education at which each case has attained as it is indicated in the bar chart below. With high number of ICT and library staff acquainted with various knowledges and skills when other conditions remain constant then the number of users become relatively high. Therefore the electronic information resources use was investigated and findings showed that average number of users in a week were about 1500.

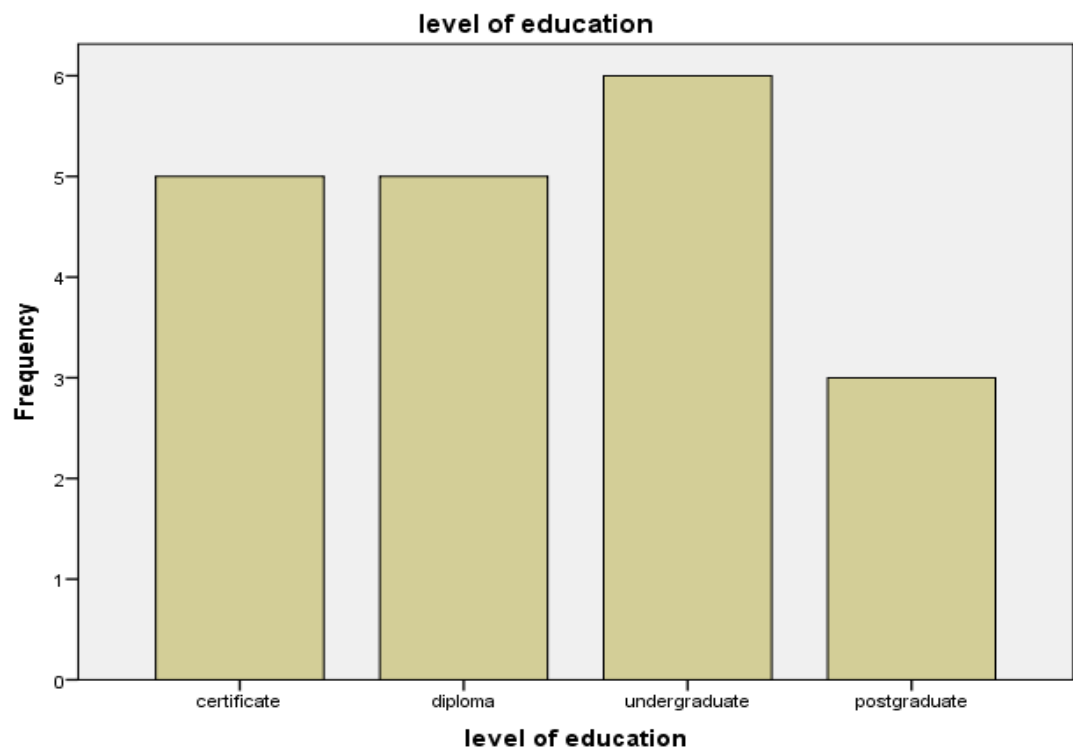


Figure 4.6: Levels of Education reached for each ICT and Library Staff Member Respondent
Source: Field Data, 2019

4.2.3 Network Infrastructure Challenges

4.2.3.1 Availability of Installed Effective Network Infrastructure

The question was asking about user satisfaction on the available computer devices compared to the needs of user community. Collected data showed amongst the 69 students who responded to the survey questionnaire about that question as follows.

Table 4.4: Satisfaction Level of Computer Devices to the user Community

Are Available Computer Devices Satisfying the User Community					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	19	27.5	27.5	27.5
	No	14	20.3	20.3	47.8
	somehow	36	52.2	52.2	100.0
	Total	69	100.0	100.0	

Source: Field Data, 2019

Through observation the major modes of connecting devices were through Ethernet wires and through WiFi (wireless connections) and observation also found that in the computer room/library of IRDP – Lake Zone Centre, Mwanza, which is part of the library utilities, there were 52 desktop computers of Dell and HP brands and of Windows 7 version. SAUT which is part of the library utilities there were 44 desktop computers of HP brand and of Windows 7 version. The data collected showed Ethernet Local Area Network and Wireless Local Area Network were the main “modes of network connectivity in the campuses”. Although the data revealed most students are not yet connected to the MAC so as to enable them to access resources by wireless mode by using their Smartphone handsets. According to the interviews made to staff and students aided by direct observation at SAUT, IRDP and CUHAS it was found that some computer pieces were either obsolete or in urgent need for maintenance.

From the data collected in the survey the results indicated that 76.47% of the total number of 18 staff members who were involved in the survey from IRDP, CUHAS and SAUT, admitted that “continuous changes in hardware, software, and networking devices due technological advancements affect performance, practice and management of the network infrastructure”. In interview and questionnaire it was found that library management software which was used to manage information in

library of IRDP – Lake Zone Centre, Mwanza, was Koha while library of Saint Augustine University of Tanzania Mwanza main campus was Koha and Library of Catholic University of Health and Allied Sciences was OTHER than the mentioned multiples.

4.2.3.2 Financial Challenges of Managing Installed Network Infrastructure

Three variables concerning financial challenges were posed by survey questionnaires and semi-structured interviews to investigate whether computer and network annual budget do satisfy needs. Also the question was asked to know whether “students contribute any expenses in the running of institution's network infrastructure”. The data collected in the three institutions ultimately showed that, students, and government don’t contribute directly to the financial expenses of running the institution’s network infrastructure and thus the annual budget is not satisfactory.

4.2.3.3 Challenges of Connectivity and Retrieval of Electronic Information

Resources Due to Speed of Internet

Generally, two modes of network connectivity were Ethernet and WiFi. In this research it was found that most mobile Smartphones used by individual students and staff members who responded to questions use 2G and 3G. No 4G LTE SIM card or Smartphone was found amongst involved cases. The mode was “Good” rate of downloading speed according to total 69 student respondents.

4.2.3.4 Challenges of Network and Internet Connectivity Due to Services

Providers

ISP shares among three institutions: Tigo holds 75%, TTCL holds 25% due to

collected data which indicated that; IRDP Internet Service Provider is currently TTCL, CUHAS- Bugando Internet Service Provider are currently TTCL and Tigo, and SAUT – Mwanza Internet Service Provider is currently Tigo. On the other side of the individual users of handsets and laptops who uses modems and SIM cards the table below shows how they subscribe to the ISP.

Table 4.5: ISPs Customers Share

Telecommunication Company preferences	Vodacom	Tigo	Airtel	Halotel	TOTAL
SIM card user cases interviewed	7	4	3	2	16
Percentage of shares	43.75%	25%	18.75%	12.5%	100%

Source: Field Data, 2019

4.2.3.5 Multimedia Streaming Technical Challenges

In order to describe the challenges mentioned this objective was subdivided into two subsections as indicated below;

4.2.3.5.1 Challenges of Processing Multimedia and Maintaining Computer Devices

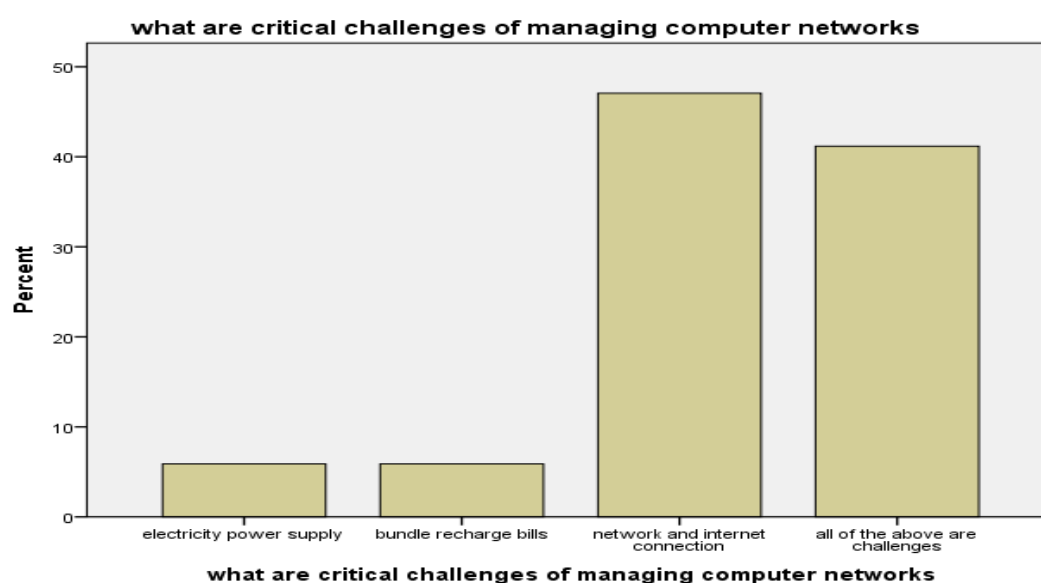


Figure 4.7: How challenges affect managing of Computer Networks

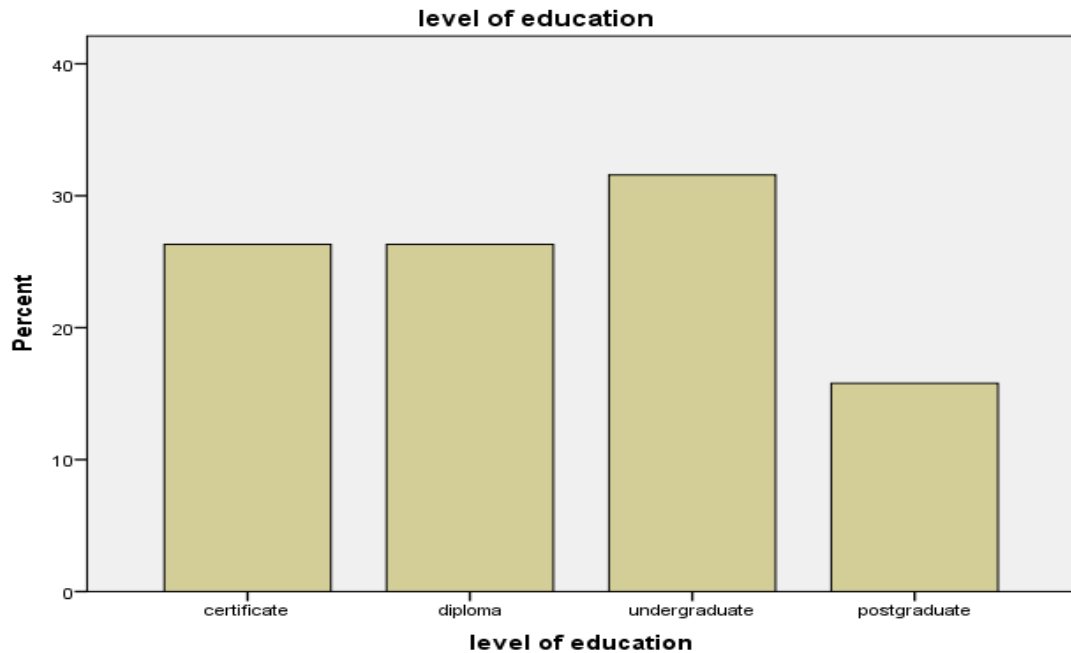


Figure 4.8: How Multimedia Processing is Affected by low Number of Available Highly-skilled Staff

Source: Field Data, 2019

Most critical challenges are facing staff when they process and manage computer network according to the survey data. As the research data showed that multimedia resources were very scarce in the repositories and their usage was low compared to textual documents. As shown in the graph the postgraduate worker were the least in terms of numbers in spite of the fact that according to the literature surveyed the number of graduate workers should be as many as possible so as to facilitate managing, processing and retrieving system of multimedia electronic resources which are core resources in the digital libraries whose nowadays are overtaking conventional printed resources in utilization.

As a result of staff skills and knowledge deficiencies it was observed that only few electronic resources could be processed and made available to library patrons. In the institutional databases only few resources could be processed, produced, reproduced,

stored and stored and made accessible to information users. Technical challenges are obvious to junior staff members. Activities such as programming are problematic issues to juniors.

4.2.3.5.2 Preference of Types of Media Resources

The study revealed that source of information reference they prefer to use when they answer class assignments and do self study are electronic text documents. About 62% prefer electronic texts to multimedia resources this might be due to simplicity of access and use of electronic texts compared with the complexity nature of multimedia. In this instance also the findings showed that printed books and journals which are found in the library takes the second place in importance. 34% only said they use printed books and journals.

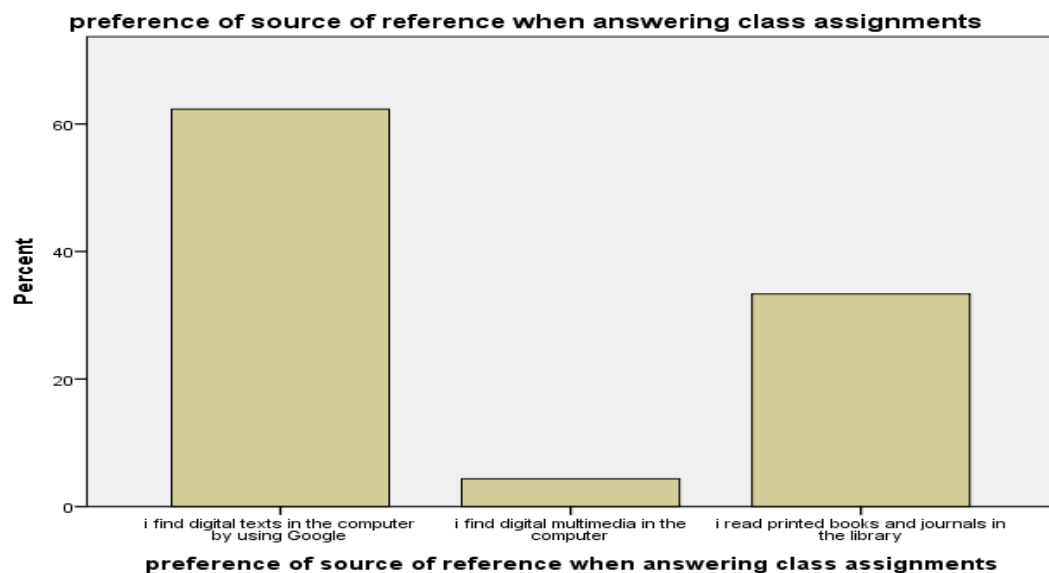


Figure 4.9: Preferences of types of Media Resources

Source: Field Data, 2019

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.1 Introduction

The process of assessing network infrastructure in supporting access to electronic information resources in academic libraries is a vital task which can lead institutions to improve provision of sufficient and reliable library services in this fast changing paradigm in terms of dissemination systems. This study has focused on the challenges and problems of establishing and running computer network infrastructure so as to provide digital information resources in academic libraries in Lake Zone of Tanzania. Three specific objectives were set to be achieved at the end of this study.

In the background some literatures were reviewed to ensure that the problem of study was viable. Through the specific objectives specific questions were composed to keep the researcher on the right track and focused during literature search as well as during collection of the field data. Full search of sufficient and relevant literatures were reviewed to pave enough light to each research question at hand and at last methodology of research was designed to fit the research study. In this discussion of findings, presented findings to each of the research question is going to be digested according to the already analyzed data.

5.2 Discussion of Findings

5.2.1 Library Patron-Centered Access Problems *and* Challenges

This objective aimed at measuring and determining the constrictions which hinder optimum utilization of electronic resources in academic premises from the cases chosen. From the literature obtained it is shown that library patrons are likely to face

two major challenges which are access challenges linked to experience and skills of users and challenges linked to financial capability of library patrons.

5.2.1.1 Access Challenges Linked to Experience and Skills of Users

ICT skills seemed to be a big challenge and impedance to effective use of electronic resources available in the networks and Internet in general. One reason which results in low skills of ICT is the background education of the students. Most of the students did not acquire ICT knowledge in primary schools. Only a little portion of the cases selected showed they learnt computer when they were in secondary schools and it was found that 40% of the cases, which is the biggest portion, showed that they started to learn ICT when they entered colleges. Although 82.6% of the cases involved said that they possess digital appliances they can't use them effectively in accessing electronic resources due lack of enough knowledge and skills.

Findings from (Siddiquah & Salim, 2017; Omeluzor, 2016; Ugwu & Orsu, 2017) also reveal that patrons are less skilled or poor on skills like using digital library, browsing skills, discussion forums, and Blogs. Also they lack of awareness, lack of training, unreliable Internet connectivity, insufficient e-resources in various study areas, unavailability of e-resources on 24/7 and difficulty of identifying relevant information to meet users' needs are challenges hindering use of e-resources.

5.2.1.2 Access Challenges Linked to Financial Capability of Library Patrons

Parents and guardians assist in the process of accessing electronic information resources by paying bundle recharge bills but the Internet recharge bundle price a challenge when they want to find information on the Internet by using Smartphones

although they get Internet students offer when they recharge bundle. Findings showed that about 78% of network and Internet users are affected by subscription charges.

In the survey it was found that about 82.6% of the total cases agreed that they own a desktop, a laptop or a Smartphone which means that the gap of destituteness of digital appliances is closing. This means that most of students are using the digital appliances in their studies. Due to high inability to pay Internet bundle subscription charges the only hope is WiFi and Ethernet which they can get around the campus. But the established computer network infrastructures in all three institutions were not sufficient enough to cover demands. WiFi were secured and patrons needed much time for registration on the Machine Access Control so as to get permission to access electronic information resources. The findings in studies carried out by (Ugwu & Orsu, 2017 Mawere & Sai, 2018) also revealed that lack of internet access at home, absence of online assignments, lack of motivation to use online information and majority of the students not having personal laptops, lack of resources among the students and exorbitant data charges by Internet Service Providers (ISPs) are still challenges.

5.2.2 Institutional Electronic Information Resources Access Challenges

In this objective the roles which the respective institution plays in order to ensure availability of resources were put into considerations. The creation of electronic resources databases, indexing and subscription of free e-resources databases and subscription to commercial databases are key functions and obligations of the

academic institutions. The policies and procedures of selection and acquiring electronic resources is another factor considered. Skilled workers equipped with ICT and Library knowledge is another prerequisite in provision of high quality services as well as managing of network infrastructure. The above factors are discussed here below.

5.2.2.1 Access to Free and Commercial Databases

The three institutions are members of Consortium of Tanzanian University Libraries (CoTUL) which on behalf of the members subscribe to various commercial electronic information resources databases. Other free databases are subscribed too but the challenge again seems to be low knowledge and skills login in the addresses to access the materials stored. As it showed these databases are not effectively utilized. Only a little percent of the population are capable of enough skills to access institutional databases.

Another challenge with these databases is that they cannot contain electronic information materials which fit for all faculties available in the institutions. Some subject areas in certain programmes miss. Not only that but also the commercial databases are expensive hence there is delay in subscription as well as failure to subscribe due to lack of finance. The study by (Okogwu & Achebe, 2018) found that the overall mean showed that cost of acquisition of e-resources (mean = 3.05) is ranked highest, while a periodic review by selectors is time-consuming (mean = 2.51) is ranked lowest as challenges faced by the library in e-resources collection development practices.

5.2.2.2 Resources Selection and Acquisition Policy and Pricing

Electronic information resources selection and acquisition policy and standards affect services to users because information stored in different organizational databases require adhering to rules and regulations set apart by creators. These practices require high expertise and enough time to select and acquire. Pricing of the information items is a major constriction to subscription and acquisition because copyrights and commercial loyalties imposed on the documents make them expensive to disburse.

In comparison persons who were involved in the study said that they think electronic multimedia information resources are not cost-effective as compared to conventional printed books because electronic information resources need effective network infrastructure as well as enough skills of service providers and information users. They are also more expensive than printed ones because they include a lot of computer hardware and software, inclusively. The above matters can enter into malfunction status which results into big loss compared to printed books which need little energy to access, and are readily available and needs little maintenance. From the data collected in the field 90% of staff revealed that the students don't contribute directly to the cost of running network infrastructure of the institutions due to absence of regulations embodied within the library policies.

Also, 85% of the staff respondents inquired said that the central government of Tanzania doesn't contribute directly to the respective institutions the expenses of running the networks through direct subsidies and or grants. Findings explaining how funding for electronic information resources in academic libraries are critical

challenges which are stated in the papers by (Mawere, 2018; Singh, 2013; Moberg, 1999; Mosha & Bea 2014; GESCI, 2017; Ghuloum, 2012) the main types of funds are capital funds, support funds, and maintenance funds.

In Tanzania, schools and academic institutions do not get direct funding to support ICT infrastructures because the National Information Communication Technology Policy of 2003 and the recent 2016 do not state enhancement of ICT in schools and universities as its own objectives. Also challenges of policy and pricing of e-resources are studied in (Okogwu & Achebe, 2018; Radijeng, 2018) reveal that the overall mean showed that cost of acquisition of e-resources (mean = 3.05) is ranked highest, while a periodic review by selectors is time-consuming (mean = 2.51) is ranked lowest as challenges faced by the library in e-resources collection development practices. And also While Open Access has helped to free some money for other needs, there is still a lot of reliance on commercial databases.

5.2.2.3 Availability of Skilled Workers of ICT and Library

In the survey conducted in IRDP – Lake Zone Center, CUHAS- Bugando, and in SAUT – Mwanza, the ICT and library workers had different levels of education as it is indicated in the research findings. Most employees had undergraduate level compared to other levels whereby the least number of workers possessed postgraduate level of education. Because there are many tasks to be performed therefore even number of workers is expected to be good enough to suffice requirements of resources and resource users and those are reasons why managing and running network infrastructure requires close cooperation between the two departments.

In this era of digital revolution it is a noble idea to incorporate both departments as one but separately when it comes to services and management of information systems of the organization. In the survey it was found that the ICT units/departments and library units are working separately but they have some mutual cooperation in some activities. In the literature review it is suggested that the processing of multimedia and other electronic resources to enhance effective managing of computer networks and access to electronic resources the number of postgraduate professionals should be relatively high.

Integration of ICT and library units/departments as some literatures have revealed ensures computer networking and access and provision of electronic information resources services within given institutions to run effectively and efficiently due to coordination which the librarians, computer systems and networks administrators, programmers and other technologists can create. Though these departments can work independently but one policy which can be inclusive of both can be more productive in enhancing services because of shared knowledge and skills in aiming at one goal. (Khan & Bhatti, 2012) found that changing scenario of information, the librarians working in developing countries are facing common problems such as inadequate technical skills, advance searching skills, inadequate trained and skilled manpower, use of digital sources of information, different library soft-wares, poor fiscal condition of libraries, inadequate infrastructure, inadequate trainings, low rate of information literacy and professional status.

5.2. 3 Network Infrastructure Challenges

Network infrastructure seems to be a big challenge in many ways. Establishing,

running and maintaining effective infrastructure need a lot of components. Here below are the challenges which have been studied.

5.2.3.1 Availability of Installed Effective Network Infrastructure

According to the survey data collected it has shown that there is dissatisfaction on the available computer devices compared to the needs of user community. About quarter of respondents said they are satisfied and twenty respondents said they were not satisfied while about half said “somehow” they are satisfied. One of the problems which face institutions is obsolescence of hardware and software. According to the interviews made to staff and students aided by direct observation at SAUT, IRDP and CUHAS it was found that some computer pieces were either obsolete or in urgent need for maintenance.

Survey findings indicated that involved cases admitted that “continuous changes in hardware, software, and networking devices due technological advancements affect performance, practice and management of the network infrastructure”. (Tiwari & Sahoo, 2013) study found that lack of basic management and proper planning and frequently change in ICT are the basic hurdles for successful implementation and development of ICT.

5.2.3.2 Financial Challenges of Managing Installed Network Infrastructure

Financial challenges were investigated by survey questionnaires and semi-structured interviews to investigate whether computer and network annual budget do satisfy needs. Direct contribution from library users would enhance services but the data collected in the three institutions indicated that the electronic resources users are not

directly obliged to pay certain amount of money. As well the survey showed that the central government is not paying directly and purposefully the funds whether in terms of grants or subsidies for running computer network infrastructure which are available in the higher learning institutions. In fact, managing of utilities such as ICT hardware, software, connections such as Media Access Unit (MAU), Media Access Control (MAC), repeaters, bridges, gateways, switches, hubs, proxy servers and Network Attached Servers (NAS) needs considerable high amount of sums of money. The findings showed the institutions depend mainly on internally generated funds from various sources to budget for managing networks and e-resources as a result deficits are persistently obvious.

As it is shown in the literature reviewed in this case implementing ICT strategy in African schools and universities is affected by inadequacy, poor existing infrastructures and access to content that is jeopardized by changing technologies. (Baru, 2019) in the study identified challenges which included government fiscal policy, high foreign exchange, financial mismanagement by the academic administrators and library managers as well as inarticulate selection and acquisition development policy as well (Asogwa, Ugwu & Idoko, 2016) findings revealed that; readers' registrations, was among the physical services that are multiplying and exerting pressures on existing facilities in the library.

5.2.3.3 Challenges of Connectivity and Retrieval of Electronic Information Resources Due to Speed of Internet

In this research it was found that most mobile Smartphones used by students and staff members who were involved as cases in the survey entirely use 2G and 3G. No

4G LTE or 5G SIM card or Smartphone was found. Also, the question was put forward to explore to rate institutions' downloading speed of Internet to electronic information documents from the Ethernet and Integrated Services Digital Network (ISDN) of whom most mobile phones rely for transmission and connection of voice and data from the internet. The mode was found "Good" rate of downloading speed. The speed of internet was for both users of Ethernet and smartphones was investigated because speed of service to user is one of the key factors of consideration when it comes to library user effectiveness and efficiency as the Ranganathan 4th law of library insists to "save the time of reader". Normally, users of electronic information materials are busy finding relevant answers to respond to module queries at a reliable speed hence a relatively speedy internet could be more suitable.

The more the proximity to the WiFi and ISDN service area the higher the signals and connectivity to the network and internet and the reverse is true. This implies that people who live nearer can get good connectivity compared to those who live at remote areas. In the study carried out by (Ugwuanyi, Nwafor & Onoh, 2013) found that Even though some academic libraries have the basic infrastructure for telecommunication, because of low bandwidth, reliability of data transmission is low and transferring multimedia data such as audio, video, and images is very difficult.

5.2.3.4 Challenges of Network and Internet Connectivity Due to Services Providers

TTCL, Tigo, Zantel, Airtel, Halotel and Vodacom are the major Internet service providers according to the data obtained in the interviews. TTCL and Tigo

companies are the major preferred ISPs by educational institutions while personal users, especially those who use mobile phones are subdivided in preferences whereby Vodacom is taking a great share. Bandwidth prices vary from one company to another. Paying bills is a challenge because hesitation or delay to pay automatically the network ceases to function. It is pay as you use. The institutions keep keen eyes on the usage of Internet within the institutions in order to minimize use of unnecessary usages within the campus.

Authentication and login procedures are key measures taken into action. Systems administrators do register Smartphone handsets, laptops, and desktops to ensure no intruder can use network without permission. To individual users who want to access resources without using WiFi encounter bundle charges which most of them said can't afford easily. Mawere & Sai, 2018 states that some challenges are attributed to lack of resources among the students and exorbitant data charges by Internet Service Providers (ISPs).

5.2.3.5 Multimedia Streaming Technical Challenges

In order to describe the challenges mentioned this objective was subdivided into;

5.2.3.5.1 Challenges of Processing Multimedia and Maintaining Computer Devices

Most critical challenges facing staff when they process and manage computer network according to the survey data are electricity power supply, bundle recharge bills, network and Internet connection. Other challenges include shortage of professional workers. As shown in the findings, postgraduate workers were the least

in terms of number in spite of the fact that graduate workers should be as many as possible so as to facilitate managing, processing and retrieving system of multimedia electronic resources which are core resources in the digital libraries which nowadays are overtaking conventional printed resources in utilization. There are also budget deficit, devices becoming obsolete, delay in maintenance of devices, and lack of clear policies governing coordination between library departments and ICT departments.

Other factors which have also been expressed as challenges in the literatures surveyed are programming of data and network administration. All these matters in their totality impede effectiveness of managing networks as well as provision and access of e-resources. Research by (Khan & Bhatti, 2012) asserts that changing scenario of information, the librarians working in developing countries are facing common problems such as inadequate technical skills, advance searching skills, inadequate trained and skilled manpower, use of digital sources of information, different library soft-wares, poor fiscal condition of libraries, inadequate infrastructure, inadequate trainings, low rate of information literacy and professional status are still challenges.

5.2.3.5.2 Preference of Types of Media Resources

According to the data obtained it is clear that digital resources are becoming more popular than printed books. Most people owned handsets which they use to access electronic information resources especially texts when they do exercises and assignments in classes or self studies. About 62% prefer electronic texts to multimedia resources this might be due to simplicity of access and use of electronic texts compared with the complexity nature of multimedia and 34% only said they use

printed books and journals. In comparison the study by Jamson,2018 found that Majority of the respondents 118(50.2%) preferred print resources because of its accessibility, 107(45.3%) agreed that print resources was complete in itself, while 147(63.6%) asserted that they found it easy to use their preferred resources. In terms of accuracy majority of the respondents 115(48.9%) agreed print resources were more accurate than its counterpart

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

In this study the background of the problem was explored and the problem statement was given out which paved way to determine the objectives of conducting this research. From research objectives formulation of research questions to meet each objective of the study were composed to be used in data collection. In this research questions were opted instead of hypotheses, and hence, descriptive statistics were used instead of inferential statistics to describe population variables. In order to test the viability of the questions a deep study of related literatures were reviewed.

Research methodology had three main parts where at the first part of the methodology research design was devised. In the second part of the methodology research tools and measurements were elaborated and last part was concerned with explanation on how analysis and presentation of data would be done. Through various literatures surveyed it was found that rapid changes in Information and Communication Technology (ICT) academic libraries have been struggling to solve challenges so as to enhance effectiveness and efficiency in provision of electronic information services to users by creating favorable digital environment paralleled with conventional practices of utilizing printed books.

In academic libraries, where teaching and learning materials are compulsory to suffice requirements of the curricula and meeting the objectives and functions of the institutions, this task of coping with changes has been meeting with several challenges. Computer network infrastructure installation, managing, functioning,

maintaining and developing its size and quality were the main issues which were investigated in this case study which comprised of three academic libraries namely;

- i. Institute of Rural Development Planning at Lake Zone Centre (IRDPLZC)
- ii. Catholic University of Health and Allied Sciences (CUHAS) and
- iii. St. Augustine University of Tanzania (SAUT)

From the research conducted it was found that installations of network infrastructure are in good stages of development in all three institutions. But as the survey data showed challenges of running and maintaining them still persist. Availability and streaming of electronic information media through the network are good. But as the data revealed speed is not satisfactory as well limitations to access some databases and amount of electronic resources disseminated are quite few which demanded some purposeful improvements. Managing of the infrastructure and electronic information resources are done in a good way. But as the data obtained have indicated there are still some challenges of inadequate expertise as well as technological changes which affect normal practices and procedures of handling network infrastructure.

6.2 Recommendations

6.2.1 Practical Recommendations

In this research report there are recommendations which can improve the status quo. The first step is for these institutions to design of mechanism of registering Smartphones and laptops belonging to patrons on the Machine Access Control (MAC) address, especially at beginning of programmes' enrollment to ensure maximum Internet and network provision and access. One alternative is by

inculcating it in student admission and registration system and this can go in hand with some library materials subscription charges.

The second step is an urgent need for the government to enhance ICT education at primary and secondary school levels so as to equip pupils and students enough skills and knowledge of utilizing digital resources in earlier stages of education pursuance. In this respect teachers should acquire appropriate skills and knowledge during long courses training programmes, routinely seminars, conferences, workshops, and short courses programmes. In so doing there shall be high and improved transfer knowledge and skills of ICT which eventually will lead to high capabilities of students to fully utilize digital/electronic information resources from databases accessed via networks when they enter colleges and universities.

The third step is for the information and education stakeholders to form a consortium in Tanzania which is inclusive of other types of libraries and information centers to work along with COTUL. It should include public, school, private and special libraries. As it was observed in the literature this issue was found to be a research gap because there are no substantial literatures written to facilitate stakeholders to take actions

The fourth step is a need to increase a number of computer science and technology graduates to work in academic institutions so as to curb the challenge of inadequate ICT experts in colleges. This should be done by some more higher learning institutions in the country adding ICT programmes in their curricula because demand of ICT professionals is ever increasing. Fifth step is for the academic institutions to

develop network infrastructure with advanced technologies like Fourth Generation (4G) using F3825 LTE&WCDMA Routers and fiber optical networks which are faster in speed to enhance effectiveness and efficiency in provision and access of electronic information resources.

Sixth step is improvements of academic library policies to incorporate the issues of digital/electronic in a more dynamic way so as to address and solve some challenges facing network infrastructure, provisioning and access of electronic resources. And the last step is for academic institutions to enhance deployment of Digital Living Network Alliance for Universal Plug and Play (DLNA/UPnP) on the Network Attached Server (NAS) can help in tapping some digital resources which can eventually be stored in the institutional databases for clients provided they are free, licensed or subscribed.

6.2.2 Policy Recommendations

At national level, the government is considered to be in a good position to solve the scarcity of network establishment and running funds by providing required funds in terms of subsidies and grants. On the policy recommendation is that I would like to recommend inclusion academic matters in new National Information Communication Technology Policy of Tanzania which will be rewritten in the future because the current one does not aim at improving ICT direct support to schools, vocational training institutions and universities instead it states that its vision is “Tanzania with economically, socially and culturally enriched people in ICT-enabled knowledge society” The National Education Policy of Tanzania does not put great emphasis and aim at establishment of computer network infrastructure in schools. But computer

science subject is amongst the subjects in the learning curriculum. Students in most schools do not have computers therefore what is taught is theory without practical. At institutional level, library and ICT departmental policies should be revisited so that they bring mutual integrations in practice due to the fact that in the contemporary times libraries relies greatly on the use of digital/electronic resources and by doing so they depend substantially on the knowledge, skills and expertise of ICT managers.

6.3 Way Forward for Further Researches

This research dissertation has been undertaken to study computer network infrastructure in relation to provision and access to electronic information resources in academic premises. Several literature have been reviewed which were consistent with objectives of the study and research questions. Literature had highlighted the trend of the research problem at hand and methodology had enabled collection of required data which eventually yielded very valuable knowledge for generalization.

According to the findings from the research topic it has shown that the ICT education in our educational systems is still in its juvenile stages of development hence some researches should be done to know ways of solving problems accompanied with low knowledge of ICT in the Tanzanian society so as to accelerate it for betterment of the nation. From points of view resulted from this research I can point the following topics for future researches;

- i. Problem of financial support from government and parastatal organizations for betterment of computer network infrastructure in school and university areas
- ii. Problem of shortage of electronic information resources in academic

repositories

- iii. Roles of ICT professionals in increasing effectiveness and efficiency of academic libraries in provision and access of digital learning materials
- iv. Improvement of partnerships in digital resources sharing within academic institutions in Tanzania

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APPENDICES