

**ADOPTION AND DIFFUSION OF INFORMATION AND COMMUNICATION
TECHNOLOGY INFRASTRUCTURE ON ELEARNING: CASE OF ELEARNING
CENTRE AT CHANCELLOR COLLEGE**

MASTER OF SCIENCE (INFORMATICS) THESIS

BRIGHT JOSHUA

UNIVERSITY OF MALAWI

CHANCELLOR COLLEGE

OCTOBER 2021

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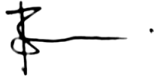
**SUBMITTED TO THE FACULTY OF SCIENCE, DEPARTMENT OF
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**University of Malawi
Chancellor College**

OCTOBER 2021

DECLARATION

This thesis is my own original work and it has not been submitted to any other institution for similar purposes. Acknowledgements have been duly made where other people's work have been used. I bear the responsibility for the contents of this paper.

Signature: 

Bright Joshua

Date: 15th December, 2021

CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents the student’s own work and effort and has been submitted with our approval.

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Name

Main Supervisor

Signature: Gregory Date: 15/12/2021

Name Gregory Kunyenje, PhD.

Second Supervisor

DEDICATION

I dedicate this thesis to my dear wife Matilda Chunga Joshua for her untiring support and encouragement throughout the period of this research.

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I thank the Almighty God for His guidance, grace and faithfulness throughout the study. I would like also to express gratitude to my supervisors, Professor Elias Kaphesi and Doctor Gregory Kunyenje, for their guidance and support throughout this study.

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My gratitude extends to staff and students of the eLearning centre who took part in this study.

ABSTRACT

This study aimed to investigate how adoption and diffusion of eLearning infrastructure such as hardware and software may be the solution to increasing access to higher education in Malawi using the eLearning centre based at Chancellor College as a case study. It sought to identify challenges affecting adoption and diffusion of eLearning and establish how availability, accessibility and usability of the ICT resources affects students' learning. The study was prompted by the report that eLearning could be a solution to the problem of increasing number of students who qualify for higher education in a given year but fail to get into college due to the limited available bed and classroom space (USAID, 2019). The study used a combination of United Theory of Acceptance and Use of Technology (UTAUT) and Information Infrastructure (II) theory to analyse effects of ICT resources on students' eLearning. The research used qualitative research method approach to get an in-depth understanding of the phenomenon from multiple angles. The researcher conducted in-depth interviews with 25 respondents and document analysis supplemented data collection. A convenience sampling technique was used to collect data from 3 staff within the eLearning centre and 22 students pursuing various programmes at certificate, diploma and degree levels. Data was collected between December 2020 and February 2021. Interviews were conducted with staff of the eLearning centre and a physical ICT infrastructure assessment for eLearning was undertaken. The study finds that delivery of programmes using the eLearning approach under the Pan African Project based at Chancellor College faces a myriad of challenges, which include lack of internet connectivity, financial constraints, inadequate computers and inadequate support for infrastructure. These challenges in turn affect the performance of students at the eLearning centre. However, the results of the findings of this research indicate that although the eLearning centre based at Chancellor College has inadequate eLearning ICT infrastructure, there is room for improvement if support was increased towards training of staff, procurement of equipment and increasing bandwidth. The results indicate that eLearning can be used as a solution to increasing intake of students who qualify to get admitted in higher education institutions in Malawi.

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LIST OF ACRONYMS

AU	African Union
ELEARNING	Electronic Learning
F2F	Face-to-Face
HEIs	Higher Education Institutions
ICT	Information Communication Technology
IGNOU	Indira Ghandi National Open University
AUN	Amity University Nodia
UOM	University of Madras
IT	Information Technology
MDGs	Millennium Development Goals
UNIMA	University of Malawi
UTAUT	Unified Theory of Acceptance and Use of Technology
WWW	World Wide Web
II	Information Infrastructure Theory

CHAPTER ONE: INTRODUCTION

1.1. Introduction

The importance of higher education in world economies cannot be overemphasized. Education is a means of eradicating poverty and promoting economic development (Omoniyi, 2013). ELearning and face-to-face are the most common methods of learning (Barindra, 2018). *ELearning* is the use of electronic technologies to access education outside a traditional classroom (eLearningNC, 2019). Information and Communication Technology (ICT) infrastructure is a key element for successful implementation of eLearning; it denotes all the facilities necessary for effective eLearning (Mulwa & Kyalo, 2011). Face-to-face (f2f) instruction, on the other hand, is a type of teaching approach where the instructor and students of an educational institution are in a place devoted to instruction and the teaching and learning take place at the same time (Blankson et al., 2019).

Academic performance is a measure of the indicative and responsive abilities that express, in an estimated way, what a person has learned as a result of a process of education or training (Pizarro, 1985). Academic performance involves factors such as the intellectual level, personality, motivation, skills, interests, study habits, self-esteem or the teacher-student relationship. When a gap between the academic performance and the student's expected performance occurs, it refers to a diverging performance (Lamas, 2015).

This chapter presents the background to the study, the research purpose and the research problem. The chapter also outlines the research objectives of the study in addition to providing the research approach that the study adopted and highlighting the significance of the study. The last section provides the structure of the thesis.

1.2. Background

ICTs play a big role and bring changes to how humans perform tasks, including how education is taking place. And teaching and learning in institutions of higher learning depends on usage of ICTs (Sife et al., 2007). One advantage of eLearning is that it allows learners to attend classes from any location of their choice without being restricted by geographical boundaries. It also provides reduced costs of learning as it eliminates costs such as for transportation, and real estate (Gautam, 2020). However, higher education institutions (HEIs) in Malawi are facing the challenge of

enrolling high numbers of students including those people working due to lack of ICT infrastructure.

Some countries around the world also face challenges in providing higher education. Among the common challenges are low levels of public support for higher education institutions, increased demand for higher education due to high population growth rates and subsequent shortage of teaching staff to meet such a demand (Guthrie, 2019). For example, India faces a shortage of faculty and poor infrastructure (Nadaf & Bhat, 2016). Similarly, it is reported that Nigeria's higher education sector faces challenges that include inadequate public financing and poor infrastructure, and a rapid population increase which forces higher education institutions to fail to absorb all qualified applicants (Mahabub and Garba, 2018).

The examples above show that demand for higher education in the world is on the increase as population is also growing. There are around 200 million higher education students in the world, up from 89 million in 1998 (World Bank, 2019). Equatorial Guinea and Sierra-Leone are other countries which have lower higher education enrolment rate of 2% (UNESCO, 2020).

Malawi has not been an exception. There is increased demand and enrolment for tertiary education in the country due to rapid population increase. And this has come with some challenges including the need for additional classrooms, increased work-load for faculty, increase in operational costs, and increased demand for teaching and learning materials (Maere, 2010). Public and private universities potentially enrol student numbers between 40,000 and 50,000 (Sharra, 2018). Malawi's four public universities have a total student population of about 20,000 where 13,000 are enrolled in the University of Malawi (Zezeza, 2018). There are just over 25 private universities in Malawi and each of these institutions only admits, on average, 800-1500 students (UNESCO, 2016). In 2019/2020 academic year, only 3,327 out of 24,745 applicants eligible for higher education were admitted into public higher education institutions (UNIMA, 2019). Although private universities are playing an increasingly important role in improving access to higher education, many youths from disadvantaged socio-economic backgrounds are unable to enrol due to exorbitant fees charged by the private institutions (USAID, 2019). These challenges require consideration of using other modes of delivery such as eLearning, which is cheaper, surpasses

typical time and space barriers, and allows wider access to higher education opportunities (Mtingwi, 2012).

ELearning is an effective, convenient and flexible way of delivering courses online by making resources available from anywhere and at any time for everyone (Clover, 2017). Although this is the case, problems such as poverty, poor infrastructure, and electricity breakdowns hold back developing countries particularly those in Africa from utilising ICTs (Fares, 2007). Despite these challenges some higher education institutions in developing countries such as College of Nairobi in Kenya and University of Zambia have implemented eLearning education. Research conducted in Saudi Arabia by Almegren *et al.* (2013) on learning object repositories in eLearning: challenges for learners in Saudi Arabia, concluded that most challenges faced in eLearning can be dealt with by latest global learning networks. These networks should offer culturally rich and highly diversified learning environments that facilitate better learning albeit existence of poor infrastructure, internet connectivity and poverty. This is because eLearning improves the quality of education by providing improved informational content and learning approaches, addresses the shortage of learning materials such as textbooks and provides students information and communications technology skills (Elson et al., 2011).

In 2007, the Government of Malawi (GoM) assigned Chancellor College, a constituent college of the University of Malawi (UNIMA), to be a host for tele-education under the Indian Pan-African eLearning project. Subsequently, an eLearning centre was established at the Chancellor College campus. Although Chancellor College agreed to host the eLearning centre, Amity University Nodia, Indira Gandhi National Open University (IGNOU) and the University of Madras in India facilitate the delivery of lessons, administration of examinations and award of degrees and certificates, among others. The first eLearning programmes were offered in September 2009 after a memorandum of understanding was signed between Chancellor College and the three Indian Universities. To date, there is no known study that has assessed how adoption of eLearning at the centre can be an alternative and effective tool for attaining students' performance in higher education.

The centre has two technical ICT personnel, a secretary and a Director. Based on the MoU, Chancellor College provides two of the technical staff while the Pan-African eLearning project provides two technical experts. In addition, the project installed the ICT infrastructure that is used for delivery of lessons through Telecommunications Consultants India Limited, the implementing agency for the Pan African e-Network (UNIMA, 2017). This research, therefore, aims to investigate how adoption of eLearning technologies could be the solution to increasing access to higher education in Malawi using the eLearning centre based at Chancellor College as a case study.

eLearning has been accepted globally as an effective medium of delivery of quality education (Sarker, 2019). Incentives for universities to offer online programs include reduced buildings for classrooms, offices, cafeterias, dorms, libraries and increase in non-traditional students that are working full time (Palvia, 2018).

Previous work suggests that ICT infrastructure is a basic requirement for adoption of eLearning in learning institutions. The studies identify several challenges that affect the adoption of ICT infrastructure in eLearning. These include, lack of eLearning policy guidelines (Zozie & Chawinga, 2018), electricity challenges, lack of expertise to run the operating systems, shortage of computers, high cost of internet charges and negative attitude towards use of technology in teaching and learning (Chaputula, 2012). A study in Malawi by Zozie and Chawinga (2018) suggests that teachers and lecturers need to adopt and be taught on how to deliver lessons using ICT infrastructure. Another study by Odora and Matoti (2015) found that although the majority of lecturers had access to a wide range of digital technology, they did not adopt the use of the technologies in learning and teaching. Similarly, a study at Kamuzu College of Nursing in Malawi found that ICT infrastructure improvements in Malawi have been made for use in eLearning but using the eLearning platforms requires investments in lecturer's education in ICT, availability of ICT resources like computers, and students' accessibility to ICT use (Masache, 2016). However, it appears these studies did not explore how adoption and diffusion of eLearning platforms in Malawi could be a solution to increase intake of students in higher education institutions.

1.3. Problem Statement

This research sought to investigate how adoption of eLearning could be a solution to increasing access to higher education in Malawi using the eLearning centre based at Chancellor College as a

case study. The study was undertaken on account that eLearning could be a solution to the problem of increasing number of students who qualify for higher education in a given year but fail to get into college due to the limited available bed and classroom space.

1.4. Research Objectives

The main objective of this research was to investigate how adoption and diffusion of eLearning infrastructure such as ICT hardware and software may be the solution to increasing access to higher education in Malawi.

1.4.1. Specific Objectives

The specific objectives for this study are to:

- a) Identify challenges faced in the delivery of lessons using the eLearning infrastructure such as ICT hardware and software at Chancellor College eLearning centre;
- b) Assess the effects of challenges faced in the delivery of lessons using the eLearning infrastructure such as ICT hardware and software at Chancellor College eLearning centre;
- c) Analyse how availability, accessibility and usability of the ICT infrastructure such as ICT hardware and software can affect enrolment of students in higher education institutions.

1.4.2. Research Questions

To reach the study objective, research questions to be answered are:

- a) What are the challenges affecting delivery of lessons using ICT infrastructure such as ICT hardware and software?
- b) How do challenges faced in using eLearning infrastructure such as ICT hardware and software affect the delivery of lessons?
- c) How does availability, usability and accessibility of ICT affect eLearning in HEIs?
- d) How can eLearning be used to increase enrolment of qualifying students in HEIs?

1.5. Research Approach

The study adopted a qualitative approach to investigate how adoption and diffusion of eLearning infrastructure such as hardware and software may be the solution to increasing access to higher education in Malawi. The eLearning centre based at Chancellor College has been used as a case study. Purposive sampling technique was used and interviews and document analysis informed

data collection. The study used the theories of Information Infrastructure (II) and Unified Theory of Acceptance and Use of Technology (UTAUT).

The selection of the eLearning Centre at Chancellor College as the study area was influenced by the fact that evaluation of the eLearning centre has not taken place to see if the adopted technology is helping to improve education in Malawi.

1.6. Significance

The study findings should give direction to policy makers and administrators in higher education institutions on how challenges associated with eLearning approach to education can be addressed. The findings will also show how eLearning may be used as a tool for increasing student intake in institutions of higher learning. The study should also add knowledge to the domain of eLearning education.

1.7. Structure of the thesis

Chapter 2 gives a review of literature related to eLearning, history of the World Wide Web, types of teaching and learning models. Furthermore, Chapter 3 gives out a description of the research approach through elaborating on the research area, sample and data collection methods used to gather data. Chapter 4 presents results and discusses the findings. And finally, Chapter 5 concludes the study and presents some recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This study aims to investigate how adoption and diffusion of eLearning infrastructure such as hardware and software may be the solution to increasing access to higher education in Malawi. The study was prompted by the report that eLearning could be a solution to the problem of increasing number of students who qualify for higher education in a given year but fail to get into college due to the limited available bed and classroom space.

This chapter reviews the relevant literature related to the research problem and consists of the following sections: the first section presents teaching and learning approaches. The next section reviews literature on eLearning infrastructure. Then a review of eLearning developments follows. Challenges of eLearning, models used in other studies, and gaps in knowledge are then presented. These sections are followed by literature on the conceptual framework that the study adopted and the last section is a summary.

2.2. Teaching and learning approaches

There are two common teaching and learning approaches which sometimes complement each other. These approaches are online and face-to-face methods. A teaching approach is defined as a set of principles, beliefs, or ideas about the nature of learning which is translated into the classroom (Doliente, 2014). Teaching and learning approaches have a bearing on students' performance in learning. Academic performance is the measurement of a student achievement across various academic subjects typically measured using classroom performance, graduation rates and results from standardized tests (Ballotpedia, 2020). The next sections review literature related to face-to-face, online learning and blended learning approaches.

2.2.1. Face-to-face learning approach

The traditional classroom or face-to-face (f2f) instruction is a type of teaching approach where the instructor and students of an educational institution are in a place devoted to instruction and the teaching and learning take place at the same time (Blankson et al., 2019). This setting allows for a live interaction between a learner and an instructor. Face-to-face learning is essentially a teacher-centered method of education, and tends to vary widely among cultures. The popularity of f2f has

dwindled significantly as modern education systems have largely shifted away in favour of individual student's needs (Tophat, 2013).

According to Sacob (2017), some of the advantages of f2f are that notes are given in class and additional notes can also be taken by learners and compared with those of classmates, sharing of information with classmates is more efficient. The questions are also answered in real time, and there is no need to create a schedule to know when classes are and assignments are handed in by hand providing security of knowing that the assignment has been received by the lecturer. However, the approach also has some disadvantages. These disadvantages are that lecturers only have a certain amount of time to get through certain areas even if they are broad, questions are asked but not every student gets to ask their question due to fixed lesson time, if study materials are forgotten somewhere they cannot be referred to easily until the physical location where the materials are is visited, receipt of feedback from class test and exams may take quite long as there are many physical papers to be marked and textbooks can often be costly as compared to e-books (Sacob, 2017).

Raghav (2010), states that the advantages of face-to-face learning are that it provides a point of getting started to understand a subject as compared to eLearning which produces a lot of hints with a lot of new technical terms that may lead to confusion, f2f enhances group engagement and discussions especially for a discipline that is hard to achieve when studying alone, the approach provides an open environment where practical work goes deep through physical engagement like study tours. Some of the disadvantages of f2f include that this approach does not enable students to achieve professional and educational aims in a manner that fits their schedule as they have to physically be present at a place of learning, f2f is costly because students have to commute to a physical location to attend classes.

2.2.2. ELearning approach

Another approach to learning is eLearning which is used interchangeably with online learning. This approach involves the use of Interactive multimedia, Internet-based learning, and computer-mediated learning and campus portal access to institutional processes and resources (Taylor, 2001). This type of learning applies synchronous and asynchronous methods to deliver lessons. In synchronous learning, learners and the instructor interact with each other in real-time from

different locations, while in asynchronous learning, learners complete self-paced online training without being online at the same time with the instructor (commmlab, 2020). Online learning or eLearning has now become a modern way of learning in a wide range of disciplines through online courses that are available to anyone with adequate access to the Internet and the right motivation to follow their passions (Little, 2017).

The eLearning strategy has advantages and disadvantages that come with its usage. Some of the strengths of using eLearning include ability to allow potential for interactivity amongst and between learners and teachers, it provides access to information from a remote location therefore extending geographical access to education, provides timely and consistent material with potential for usage at ones' free time, and it makes management of students and tracking students' progress easier (Unwin, 2008). Weaknesses of eLearning include that lecture videos can use up a lot of data making them expensive, there is no real human interaction between students and lecturers making it to become unsatisfactory for those who prefer physical interaction during learning (Little, 2017).

Trends show that more than 60% of students are choosing to study using eLearning (Meyer, 2003). O'Donoghue, Singh and Green (2004) contend that eLearning approach is suitable because of its increased flexibility in terms of study time and location. Although, there are opposing views that f2f is better than eLearning (Bannah, 2014), a study by Meyer (2003) suggests that more students are choosing to study online because of its many advantages. For instance, eLearning accommodates both synchronous and asynchronous modes of learning which provides flexibility for both the tutor and the learner (Sacob, 2014). In Malawi, f2f delivery of lessons supported by tutorials, remain the dominant method of teaching in higher education institutions (UNESCO, 2019). The use of eLearning is still relatively underdeveloped, and is only used to improve the quality of instruction but not as a mainstream method of teaching and learning (Mambo, 2010).

Successful implementation of eLearning is dependent on the needs and concerns of stakeholders (Wagner et al., 2008). Key stakeholders are technology providers and developers who supply the eLearning enabling technologies and are motivated to provide learning environments that will result in effective learning for students. But since educational institutions often have different solutions implemented by various departments, adherence to common standards that facilitate

interoperability are usually not taken into account (Friesen, 2005; Young, 2001) and this attributes to the shortcomings of eLearning to technological issues (Woodill, 2004).

A study in Yemen found that the main challenges affecting implementation of eLearning are low bandwidth and connectivity, lack of quality e-content, poor ICT infrastructure and language barrier as the content is written in English (Muniandy, Ghazaland & Aldowah, 2015). Another study in India found that technological challenges for development of eLearning resources and new knowledge facilities to support rapid increase in the size and variety of data for learning support are the main eLearning challenges (Rajiv, Rana & Lai, 2015). It is imperative that an assessment of adoption and diffusion of eLearning infrastructure such as hardware and software used for eLearning in Malawi be undertaken.

2.2.3. Blended Learning

Blended approach is the type of instructional method that combines online and face-to-face instruction (Rooney, 2003). It is a type of multichannel method that incorporates tutor-led activities, images, video, digital tasks and face-to-face discussion. Digital learning elements are often open to self-pacing by each individual student and can usually be logged into at any time and in any place (Young, 2002).

Like any other learning strategy, blended learning also has positive and negative aspects. According to Muravlov (2018), advantages and disadvantages of blended learning include the following:

- It provides round-the-clock access to training resources as it involves online and digital resources which can be accessed at any time,
- It allows room for a personalized training experience for every individual by catering to their learning needs,
- It makes the tracking participants' skill and performance development using incorporated tools in the blended courses easy,
- It provides better communication and collaborative learning as participants can constantly connect with instructors using online communication tools such as email and instant messaging

The disadvantages of blended learning are that:

- It attracts high maintenance cost when incorporating advanced technology infrastructure in the blended learning projects,
- The approach is inclined to technological dependence as it depends on availability of good internet connectivity and IT gadgets to achieve learning objectives,
- There is wastage of offered resources due to the fact that if the learners are unaware of technology used desired results may not be attained.

2.3. ELearning infrastructure

ELearning infrastructure requires three components which are ICT hardware, software and support team (Hussain, 2016). ICT hardware refers to the physical parts of a computer and related devices (PCNet, 2021). These include mobile phones, speakers, printers, monitors for viewing content, computer with plenty of memory and hard-drive for processing software and storage of materials (Aslanian, 2021). A software is a type of program which enables users to perform specific tasks on a computer by directing peripheral devices on the computer system on what to do and how to do it (Nagar, 2019). Using internet connection, ICT hardware with appropriate software installed on it is used by lecturers and students to communicate and share course materials. Support team exists to provide support services before the eLearning course begins to attract and prepare the learners, during the eLearning course to enhance learning and after the eLearning course to have an online learning community of professionals with same interests (Pappas, 2011). The three components have been summarised in Table 2.1.

Table 2.1 Main components of eLearning infrastructure and their descriptions

Component	Description
ICT hardware	The main piece of hardware needed is a server. There are many options such as a cloud server, dedicated server, or shared server with varying processing speeds, storage space and response time each with its advantages and disadvantages. When selecting or configuring the server, it is important to ensure a good bandwidth to help users' access eLearning courses seamlessly.
Software	Learning management software (LMS) is the main software required that requires other supporting software to be available on the server. Hundreds of LMSs are available on the market; some of them are commercial and some are open-source applications such as MOODLE. There is need to study the features of each LMS and compare against the training needs.
Support team	If an institution has the required hardware and excellent LMS but no support team, it is not going to work. Learners will get de-motivated if they don't receive proper support service. No matter how good the LMS, learners will still face some common and basic issues such as not being able to reset passwords, access trainings, etc. Support also includes administration training.

2.4. E-learning developments

As access to computers is increasing across the globe, eLearning is becoming progressively more viable and accessible. And as Internet connection speeds are improving, chances for more multimedia training methods have emerged (Adewale *et al.*, 2019). ELearning has proven to be a successful training method and is becoming a way of life for many people (Whappy, 2019). Although eLearning faces a number of challenges, the method is becoming a critical issue, especially for those organisations that want to optimize the use of their workforce by using eLearning as a method for distributing training programmes at anytime, anywhere, and at a cost that is economically advantageous (Whappy, 2019). With the enormous improvement of mobile networks in the past few years and the increase in telecommuting, taking all the overwhelming features of eLearning on the road is a reality with smartphones and other portable devices making access to education possible (Adewale *et al.*, 2019). ELearning has the potential to play a pivotal role in the transformation of the African continent by ensuring accessibility of quality education

through increasing students' enrolment in higher learning institutions. The education delivery approach in Africa needs to shift from one that is highly dependent on physical infrastructure (Nhando, 2015).

Over the past decade Africa has had the highest growth rates in eLearning in the world (AI, 2018). The continent is utilising self-paced eLearning products and services, including packaged content, custom content development services, cloud-based authoring tools, learning platform services, installed authoring tools, and installed learning platforms. The great news is that some other developing countries from other parts of the world, like Asia and Latin America, have also started to consider eLearning as the perfect way to give more people the right to education, while reducing the costs of implementing it (Piletic, 2018).

The concept of eLearning is on the increase in Malawi. At Kamuzu College of nursing, eLearning is being used to manage the pressure of intake increases in student numbers (Masache, 2016). With support from the African Development Bank, a number of Malawian Universities have benefited from major ICT infrastructure developments. At Mzuzu University, a new two-level open and distance learning (ODL) centre comprising of three science laboratories with the latest equipment, six attractive lecture theatres, staff offices and a new ICT and business centre has been established (AFDB, 2019). A four-storey building housing state-of-the-art infrastructure has been built at The Malawi Polytechnic, a constituent college of the University of Malawi (Kutengule, 2018).

2.5. Empirical review

Previous work reviewed suggests that ICT infrastructure is a basic requirement for adoption and diffusion of eLearning approach to provide quality education. A study carried out in Malawi on Mapping an open digital university in Malawi: Implications for Africa by Zozie and Chawinga (2018) suggests that teachers and lecturers need to adopt and be taught on how to deliver lessons using ICT infrastructure. The main finding of the study was that students and lecturers at Mzuzu University are conversant with ICTs that can be adopted and customised to create a digital university and concludes that a digital university is possible in Malawi. The study was informed by a qualitative approach and questionnaires were used to collect data. Odora and Matoti (2015) carried out a study to investigate the level of digital technologies acceptance at University of

Technology in South Africa and how lecturers perceive as their new roles in the digital age. The study found that although the majority of lecturers had access to a wide range of digital technology, they did not fully adopt the use of the technologies in teaching and learning. This is because lecturers still prefer traditional teaching approach and it is also not helped by lack of training in the usage of technology. Similarly, a study on the state, adoption and use of ICTs by students and academic staff at Mzuzu University by Chaputula (2012) found that adoption and use of ICTs was high despite the state of ICTs at the University being poor. The research identified that the main challenges affecting eLearning adoption were poor network infrastructure, the limited number of computers, and the high cost of internet access, persistent power outages, and the lack of relevant ICT skills. The study used survey method where data was collected using interviews and questionnaires. It appears the scholars did not go beyond assessing how adoption and diffusion of eLearning infrastructure such as hardware and software may be the solution to increasing access to higher education in Malawi. These studies seem to suggest that it was not the intention of the scholars to investigate how eLearning may be used as an alternative to accessing higher education in developing countries.

2.6. ICT adoption and Academic Performance

Academic performance is the knowledge gained which is assessed by marks by a teacher and/or educational goals set by students and teachers to be achieved over a specific period of time (Narad & Abdullah, 2016). Teachers and education officials typically measure achievement using classroom performance, graduation rates and results from standardized tests (Ballotpedia, 2014). ICT is an information system including all hardware, software and peripheral equipment operated group of users (europeyou, 2020).

According to the findings of a research carried out by Basri et.al. (2018) on “ICT adoption impact on students’ academic performance: evidence from Saudi universities” there is a relationship between ICT adoption and academic performance. An additional finding also stated that ICT adoption resulted in the improvement of the performance of female students more than the male. Another study by Johari et.al. (2020) on “The effects of information and communication technology on the academic performance of accounting students” found that educational ICT facilities have a significant positive relationship with the academic performance of students. It further found that attitude towards IT has a significant negative relationship with academic

performance and indicated that a positive attitude towards IT can adversely affect academic performance. These findings suggest that ICT hardware and software has an effect on student's performance.

2.7. Models used in previous studies

There are many models that have been used to assess effectiveness of eLearning infrastructure in previous research. A study in the United Arab Emirates by Salloum and Shaalan (2018) on factors affecting students' acceptance of eLearning system in higher education, used UTAUT and Structural Equation Modelling Approaches. UTAUT theory was used in predicting student's and behavioural intention to use eLearning by assessing and looking at social influence, performance expectancy and facilitating conditions of learning. The research revealed that developing countries have failed to fully implement and adopt eLearning education because students do not utilize eLearning systems to satisfactory levels. In this study UTAUT model was used to assess students' intention to use eLearning. Another study by Mehta et al., (2019) used UTAUT to assess the influence of values on eLearning adoption. The study applied the UTAUT2 as the base model to develop a new model called Values-Enhanced Technology Adoption (VETA) by integrating values relating to conservation of the status quo and self-enhancement from Schwartz's Theory of Human Values. The study found that performance expectancy, price value and habit primarily influenced intention to adopt and use eLearning.

2.7. Conceptual Framework

This study used Information Infrastructure and United Theory of Acceptance and Use of Technology theories. Information infrastructure is a shared, evolving, heterogeneous installed base of IT capabilities based on open and standardized interfaces. Such information infrastructures, when appropriated by a community of users offer a shared resource for delivering and using information services in a (set of) community (Lyttien & Hanseth, 2008). The information infrastructure theory proposes a framework for doing sociological analysis of large socio-technical systems where there is an interest in describing issues related to power, standards and complexity (Øgland, 2008). Unified Theory and Acceptance Use of Technology is used to answer the question: what are user's attitudes towards accepting ICT solution? (Alqudah, 2015). UTAUT has four independent concepts Performance Expectancy (PE), Effort Expectancy (EE), Social Influence

(SI), and Facilitating Conditions (FC) concepts which influence dependent variables, behavioural and usage. Behavioural and usage are further dependent on gender, age, experience, and volunteerism of system use (Venkatesh, 2003).

The UTAUT is a theory that was developed to study how people accept the technology (Alshehri, 2019) and Information Infrastructure (II) theory to assess politically and technically complex and usually quite large information systems (Øgland, 2008). II and UTAUT theories were selected for this study because they provide for comparison of f2f and eLearning by assessing IT capabilities, applications and platforms used (Omwenga, 2016). To assess the IT capabilities, applications and platforms concepts from the theories, the research looks at availability, accessibility and usability of IT infrastructures as a means of assessing adoption and diffusion of eLearning infrastructure.

Therefore, to achieve adoption and diffusion of eLearning there is need for access to information using ICT tools through application of skills and knowledge. This means that perceived availability, accessibility and usability of computers to access information which are variables from UTAUT are crucial to achieve academic performance. Information Infrastructure looks at heterogeneous base of IT capabilities based on open and standardized interfaces for delivering and using information resources. These resources include the internet and mobile technologies which are key in using eLearning.

To achieve the main objective of assessing adoption and diffusion of eLearning infrastructure such as hardware and software as the solution to increasing access to higher education in Malawi using the eLearning centre based at Chancellor College, the researcher developed a conceptual framework by combining concepts from UTAUT and II theories. Accessibility, usability and availability concepts from UTAUT were combined with ICT infrastructure and Delivery platforms concepts from II. This framework is shown in Figure 2.1.

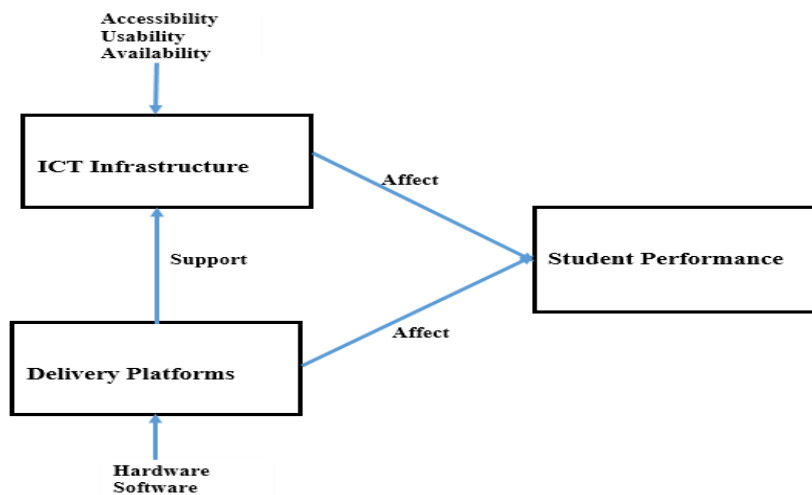


Fig. 2.1. Conceptual framework showing relationship between ICT infrastructure, delivery platforms and students' performance.

2.8. Chapter summary

This chapter has reviewed literature on teaching approaches, eLearning infrastructure, eLearning developments, challenges of eLearning and models used in other studies. The chapter has also identified existing gaps in knowledge. The key gap identified is that existing studies did not assess how eLearning may be used as a tool for increasing student intake in institutions of higher learning by assessing effectiveness of eLearning infrastructure such as hardware and software on the performance of students. The next chapter discusses the research methodology used in the study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

This chapter discusses the research approach, research design, and data analysis techniques that were employed in the study. The chapter further describes how the research was conducted to achieve the objective by presenting the details on the research process and approach adopted for the study.

3.2. Research approach

Qualitative and quantitative techniques are two main research approaches that researchers adopt in research. These two approaches can be integrated in one study (mixed methods) or used separately. Qualitative research methodology helps in exploration of a phenomenon within some particular context using various data sources and variety of lenses to reveal multiple facets of the phenomenon (Baxter & Jack, 2008). On the other hand, quantitative research method is used to test theories and assumptions using experiments, observations recorded as numbers and surveys with closed-ended questions (Streefkerk, 2020). Quantitative approach is mostly applied in research with large samples as it helps to identify patterns and averages, make predictions, test causal relationships, and generalize results to wider populations (Bhandari, 2020). This study adopted the qualitative research methodology because it is suitable for acquiring in-depth understanding of a phenomenon of interest and reveals how humans interact in social space.

3.3. Case Study Strategy

A case study is a detailed study of a specific phenomenon (McCombes, 2020). According to Crowe *et al.* (2011), case studies are good for describing, comparing, evaluating and understanding different aspects of a research problem.

The selection of eLearning centre at Chancellor College as the case study area was influenced by the fact that evaluation of the eLearning centre has not taken place to see if the adopted technology is helping to increase enrolment of students into HEI's in Malawi and it was easier for the researcher to conduct an in-depth study of the site. A total of 25 respondents were involved in this case study because the researcher was working against strict deadlines to submit research results

for assessment and students involved were selected based on their availability at the centre since they mostly study away from campus.

3.4. Research Design

A research design facilitates smooth research operations by making study findings as efficient as possible (Kothari, 2004). This was a cross-sectional study as it involved looking at data from a population at one specific point in time where participants were selected based on particular variables of interest (Cherry, 2019). Cross-sectional study design is a type of observational study design where the investigator measures the outcome and the exposures in the study participants at the same time (Setia, 2016). The respondents in this study were all technical and administrative staff of the eLearning centre, and students pursuing eLearning courses.

3.4.1. Sampling strategies

Convenience sampling was used to identify the staff and students that formed part of the study. This was because the staff and students were relatively few in number and most times unavailable at the centre.

3.4.2. Study population

The study involved three staff members and twenty-two students undertaking different programmes at the eLearning centre at Chancellor College in Zomba. Two of the staff members are technical and one is an administrator. The eLearning centre staff members formed part of the study because they are in charge of managing the ICT resources. The staff members were considered policy implementers and closely related to the effect of ICT on eLearning. The students were considered the true representative population since they were the main target of this investigation.

3.4.3. Data Collection

The researcher used semi-structured interviews and document analysis techniques to collect data. These tools were carefully chosen to ensure that data collected is in line with achieving the research objectives. Data were collected between December 2020 and February 2021. A summary of respondents that participated in the semi-structured one-to-one interviews is provided in Table 3.1.

Table 3.1: A list of respondents for one-to-one semi-structured interviews

ID No.	Respondents	Group	Main focus of interviews
Administrator 1	Admin-1	eLearning staff	Availability, accessibility, usability of ICT infrastructure, how it affects students' performance and its associated challenges
Technical Officer 1	Tech-1	eLearning staff	Availability, accessibility, usability of ICT infrastructure, how it affects students' performance and its associated challenges.
Technical Officer 2	Tech-2	eLearning staff	Availability, accessibility, usability of ICT infrastructure, how it affects students' performance and its associated challenges.
Student	Student-1 to 22	Students	Availability, accessibility, usability of ICT infrastructure, how it affects their performance, perception towards eLearning.

3.4.4. Interviews

This study used interviews to collect primary data. Semi-structured interviews are a common method of data-collection in qualitative research (Savin, Baden & Major, 2013). A semi-structured interview is a meeting in which the interviewer does not strictly follow a formalized list of questions and instead asks more open-ended questions, allowing for a discussion with the interviewee (Doyle, 2020). Interviews are meant to gather information on a specific set of topics (Harrell & Bradley, 2009). Face-to-face interviews were used to collect data from the staff and

students of eLearning especially on the ICT infrastructure which they use. The semi-structured interviews were set up with sets of outlined open-ended questions about issues to be explored. Two sets of interview guides were used, one was for interviewing students (Appendix 4) and another for staff of the eLearning centre. The outlined questions were meant to guide the researcher to ensure that all the relevant topics are covered. Interview guides permitted the researcher to probe and guide the respondents for detailed information and help keep interaction focused.

3.4.5. Document Analysis

To complement primary data, secondary data was collected using document analysis. The documents were collected from the eLearning centre and Chancellor College library. These documents (Table 3.2) were then interpreted to give voice and meaning to the topic under study (Bowen, 2009). Researchers commonly use written documents for analysis (O’Leary, 2014). This study analysed the written documents in Table 3.3 to supplement primary data

Table 3.3: Description of documents analysed

Document Type	Source	Focus
Reports	eLearning Centre	Enrolment trends in eLearning courses
Official records	National Archives of Malawi, Legal deposit Library	MOU between Malawi Government and Pan-African Project
Published data	World Wide Web	Malawi and India eLearning partnership

3.5. Data analysis

The choice of data analysis method is dependent on the research problem and the aims of the research (Syyskuuta, 2016). The study used thematic analysis, which is used to identify common themes in topics, ideas and patterns of meaning that come up repeatedly (Caufield, 2020). Four themes that emerged during data analysis in this study are as follows: Effect of availability of ICT resources on learning; effect of accessibility of ICT resources on learning; effect of usability of

ICT resources on learning; effect of administrative and technical challenges on eLearning. Hermeneutic research was applied to gain an in-depth understanding of the researched phenomenon using subjective interpretations in the research of meanings of texts, social phenomena and thinking (McCaffrey, 2012). Data analysis involved transcription of recorded interviews, typing of all field notes and cleaning of the dataset. The data cleaning process was done to maintain anonymity and confidentiality of participants. Microsoft Excel software was used to analyse and summarize data in graphs.

3.6. Data Validation and Reliability

Data validation is a method for checking the accuracy and quality of data (Alley, 2019). It can also be considered as a form of data cleansing. Data validation ensures that data is complete and contains distinct values that are not duplicated. There are four common types of validity: triangulation, construction of a research corpus, a clear, rich and detailed description of the research performed, and communicative validity (Paiva, Leao & Mello, 2011).

Triangulation looks at interrelationship between the information obtained from the data that was collected from different sources to increase the understanding of the study in question, thus improving the reliability of the results (Hayashi, Abib & Hoppen, 2019). According to Patton (1999), triangulation makes it possible for researchers to assess consistency of data by comparing and cross-checking research information collected from different sources. With triangulation, transparent description of data can be achieved (Jick, 1979). According to Noble & Heale (2019), there are four basic types of triangulation: (1) data triangulation: the use of multiple data sources in a single study; (2) investigator triangulation: the use of multiple investigators/researchers to study a particular phenomenon; (3) theory triangulation: the use of multiple perspectives to interpret the results of a study; and (4) methodological triangulation: the use of multiple methods to conduct a study.

This study used triangulation as a tool for validating findings of the research. The researcher used semi-structured interviews and document analysis, peer debriefing, researcher's reflections and rich descriptions (Creswell & Miller, 2000). The researcher applied method triangulation in the research design, data triangulation during data collection, and theory triangulation during data

analysis. In applying method triangulation, the researcher used Semi-structured interviews and document analysis. The interviews involved developing open-ended questions based on the research objectives to guide the researcher. A list of documents to explore were listed by the researcher after which he considered and identified sources from where and how these documents could be accessed. The process of accessing the documents, credibility and ethical issues surrounding the documents were checked by looking at authenticity, reliability and integrity qualities of the records. Strategies for acknowledging and addressing biasness were also applied through reviewing of findings with peers. Findings obtained from these two methods were then checked to establish validity.

3.7. Ethical Consideration

The data collected was and will be used for academic purposes only. As a matter of ethics, the researcher accepted responsibility for maintaining confidentiality, anonymity, protection, and rights of respondents and understanding during the process of data collection. With this understanding in mind, the researcher sought out consent and permission from all participants and relevant stakeholders before carrying out the research. An introductory letter (appendix 1) for the researcher was acquired from the Principal of Chancellor College through the Computer Science department.

In addition, participants trust was maintained by not mentioning their names in this research as per our prior agreement. Only those respondents that were physically available and accepted to give informed consent to be interviewed were involved in this study.

3.8. Chapter summary

This chapter has looked at the research methodology, approach and design that were adopted in the study. The chapter has also looked at research instruments used in data collection, data analysis methods, validation techniques and ethical consideration used. The following chapter presents results and discussion of the study.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1. Introduction

The overall objective of the study was to investigate how adoption and diffusion of eLearning infrastructure such as hardware and software may be the solution to increasing access to higher education in Malawi using the eLearning centre based at Chancellor College as a case study. The specific objectives were as follows:

- a) Identify challenges faced in the delivery of lessons using the eLearning infrastructure;
- b) Assess the effect of challenges faced in the delivery of lessons using the eLearning infrastructure;
- c) Analyse how availability, accessibility and usability of the ICT infrastructure can affect enrolment of students in eLearning programs.

In order to achieve the main objective of the study, the researcher developed a conceptual framework using a combination of accessibility, usability, availability concepts from UTAUT and ICT infrastructure, Delivery platforms concepts from II. The conceptual framework enabled the researcher to assess How accessibility, usability and availability of ICT infrastructure affects students' performance; how hardware and software of eLearning delivery platforms affects students' performance; and how hardware and software of delivery platforms affects accessibility, usability and availability of ICT infrastructure.

This chapter presents and discusses the findings of the study. The results of the study are presented and discussed based on specific objectives of the research. The last section answers the main objective. This section starts with discussing general findings of the study then presents summarised key findings that follow the arrangement of specific research objectives and questions.

4.2. Challenges faced in the delivery of lessons using the eLearning infrastructure and their effects

The study found lack of internet connectivity, financial constraints, inadequate ICT equipment and lack of technical support for eLearning infrastructure as key challenges in the delivery of lessons using eLearning. This section presents and discusses these challenges.

4.2.1. Lack of Internet connectivity

The study revealed that internet connectivity affects delivery of eLearning courses. All the 22 students (100%) said Wi-Fi internet connectivity at the eLearning centre is not available. Admin-1 agreed with this finding and attributed it to inadequate funding. The centre is not allocated adequate funds to run its operations. Admin-1 told the researcher that the Pan-African eLearning project ended in 2015 after which support was stopped and management of the eLearning centre was handed over to the Government of Malawi, which does not provide adequate funds to the centre. Tech-2 mentioned that they would like to have dedicated Wi-Fi connectivity in the eLearning centre for students but this cannot happen because network provider subscription costs in Malawi are very high. As an alternative, students in the centre sometimes use the Wi-Fi provided by Chancellor College to access the internet, which should not be the case because these students are not registered under Chancellor College. Despite this unauthorised access, it was also noted that: *“The Chancellor College Wi-Fi is slow and is not working most of the times”* (Student-10). The slow speeds of the Wi-Fi connection could be as a result of bandwidth and number of users connected since the College has a population of over 4,500 students (Chanco, 2017). Challenges in accessing the internet for use in learning may be a recipe for failure (Hayat, 2020).

4.2.2. Financial Constraints

The study also exposed financial constraints as a problem that affects eLearning activities in the centre. The eLearning centre initially used to receive funding from the Pan-African and Amity projects. However, the Government of Malawi took over the project at the expiry of the Pan-African project in 2015. It is at this point that the centre started experiencing financial challenges in sustaining the eLearning facilities and programmes. The study revealed that the Government of Malawi only pays salaries of the staff but does not provide funding for the running of the centre: *“The eLearning centre is self-sustaining through fees that are collected from students and staff salaries are paid by Government. Finances at the eLearning centre cannot allow the institution to meet all its demands”* (ADMIN-1). The study revealed that the lack of financial support also affects eLearning activities as the centre struggles to procure, maintain and upgrade ICT equipment for the running of the programmes. The administrators revealed that there is a huge need for finances

for ICT facilitation so as to increase the number of technology accessories in the eLearning centre and in turn provide for increased access to the ICT resources. This finding suggests that lack of financial resources may hinder the development of the centre and may affect the adequacy and quality of training provided to the students. This finding is consistent with Chua et al. (2020) who found that lack of resources leads to unsuccessful eLearning classes.

4.2.3. Inadequate Computers

The evidence showed that the centre had a few computers meant for students' access. The existence of a few computers may negatively affect the diffusion of ICT in learning at the eLearning centre. The majority of the students, 19 out of 22 students representing 87%, said that access to computers at the centre was a serious problem because the computers were few compared to the number of students registered for the different programmes: *"When we were under the Pan-African project one lab was dedicated for eLearning students and it had 20 computers for internet. When the project ended the laboratory was handed over to Chancellor College"* (Tech-1). The absence of a dedicated computer laboratory reveals that the eLearning centre has poor ICT infrastructure for students' use which may negatively affect adoption of ICT in learning. This finding is similar with Muniandy et al. (2015) who found that poor infrastructure is a challenge affecting implementation of eLearning. ELearning infrastructure consists of ICT hardware, software and support team. ICT hardware, which includes computers, is a key component that is required for eLearning (Hussain, 2016).

4.2.4. Inadequate Technical support for the eLearning infrastructure

The technical support at the eLearning centre was inadequate. The centre has a Director and two local technical staff. Before the Pan-African project ended, the centre also had two Indian technicians who helped in providing eLearning infrastructure support. Although the two local technicians were trained in India as part of the Pan-African project, the evidence showed that the training was inadequate: *"the training I attended in India only focused on particular elements of the eLearning infrastructure and not all of the technical operations"* (TECH-2). Successful implementation and delivery of eLearning requires technicians that have competencies in learning management system administration, hardware and software management (Hussain, 2016). The

study showed that two technicians from India were employed under the Pan-African project to help the administrators in providing technical support at the eLearning centre. However, at the time of this study the technicians had left for India since the project support period had ended hence the need to have the local technicians trained further to enable them provide adequate support. As a result of this challenge, technical support is sometimes provided direct from India: *“when signal is affected during broadcasting of lessons because of bad weather, we try to fix the fault. Sometimes it is fixed at night from India when we report the fault and leave our computers on overnight”* (TECH-1). This finding agrees with what Nawaz and Khan (2012) who found that every eLearning system needs well-trained ICT professionals who can consistently maintain and upgrade the infrastructure, train the users and continuously provide technical support as and when required by them. This suggests adequate technical support is needed to ensure that users are able to use ICT infrastructure.

4.3. Effects of challenges faced in the delivery of lessons using the eLearning

The second objective of the study was to assess how challenges faced in the delivery of lessons affect eLearning education. This section presents and discusses the effects of challenges identified under the first objective. The section assesses the effect of internet connectivity, financial constraints, inadequate computers and inadequate technical support on eLearning.

4.3.1. Effect of internet connectivity on eLearning

Lack of internet connectivity affected students seriously. The study revealed that students sometimes fail to submit assignments on time because of difficulties in connectivity: *“I remember failing to submit my assignment on time because of a damaged fibre optic cable that disrupted mobile internet connection across all mobile internet services. I was penalized for this”* (Student-19). Internet connectivity is one of the key elements of eLearning implementation (Ouma, 2013). The findings of the research suggest that students at the eLearning centre generally face difficulties in accessing the internet for use in learning, which in turn affects their performance. The effect of this challenge on diffusion of eLearning may be severe because eLearning relies on online resources and students need internet-enabled devices to access these resources.

The study also noted that even when students access the Chancellor College internet, it is slow and unreliable. This situation may frustrate students and affect their performance. Most often, the students resort to using personal devices which need to be connected to the internet provided by mobile service operators. Twenty of the 22 students (90%) felt that the current setup where the centre does not have a dedicated internet connectivity was affecting their performance and making eLearning expensive since they were forced to spend extra on internet connectivity to access course materials and complete learning tasks.

4.3.2. Effect of financial constraints on eLearning

Inadequate financial support has affected performance of the eLearning staff and students' adoption of eLearning. Financial resources determine obtainability of required resources for integrating ICT in learning. These resources include human resource and ICT infrastructure. The study found that lack of financial resources hinders the development of the eLearning centre cannot manage to provide training for the staff and procure some essential equipment. *“Finances at the eLearning centre cannot allow the institution to meet all its demands”* (Admin-1). The lack of financial support also prevents the center from growth. The centre has been using old equipment that was acquired under the Pan-African project. The problem with using old equipment is that it is prone to breaking down which eventually may affect adoption and diffusion of ICT in learning as the students may lose trust in using the infrastructure.

4.3.3. Effect of inadequate computers on eLearning

The data showed that the centre had inadequate computers: *“Students doing online courses study on their own. They have a portal where content is uploaded like slides, notes and videos. They use computers to watch videos that have questions at the end and if they fail they don't progress to the next module. Students have to submit assignments eight hours after they open them”* (Tech-1). The effect of this inadequacy of computers on students is that they have to spend more especially on internet to download lecture videos and upload assignments when submitting them making eLearning expensive. It was discovered that both full-time students at Chancellor College and eLearning students compete for usage of the few (20) computers in the laboratory. This means that the students have to compete for the limited available ICT resources which may never be sufficient

to carry out academic work. *“We mostly access computers in laboratories during break time and if the laboratories are left open with no classes in session”* (Student-9); *“we are given limited time to practice because we are always competing with students from other faculties [of Chancellor College] when we want to use computers in laboratories and resource centre”* (Student-3). This situation negatively affected students who do not have personal gadgets because the students had to wait for their counterparts to finish using the computers in the laboratories before they could get a chance. The reliance on Chancellor College laboratories was not effective either as the laboratories are only open when a supervisor is available as a security measure to prevent vandalism and theft of equipment. Subsequently, it was noted that availability of ICT equipment at the eLearning centre is limited and this in turn affects students’ adoption since they have limited time and difficulties in using the available computers for learning purposes. The inadequacy and rare availability of ICT infrastructure means that prospective students who cannot afford personal ICT devices and plan to rely on the infrastructure provided by the eLearning centre to complete their course work, would be reluctant to enrol. This data supports the finding by Kisanga and Ireson (2015) who showed that poor infrastructure is one of the key factors that affects adoption of eLearning in HEIs as well as Mutisya and Makokha (2016) who found that inadequate computer laboratories affect the adoption of eLearning.

4.3.4. Effect of inadequate technical support on eLearning

Generally, students complained about inadequate technical support: *“One time I failed to submit an assignment within given dateline because the student portal refused to upload my documents”* (Student-15). The researcher learnt that this happened late at night and technicians could not be contacted to assist the student who eventually was penalised. Tech-2 agreed with the student that: *“The student portal is not always available for access”*. It was established that the unavailability of the portal was intermittent and usually happened when system upgrade was being undertaken. Student-17 said: *“When I face challenges with accessing online course material, I contact course coordinators using email but they take [too] long to reply”*. This means that in the absence of a hotline where students can report faults relating to the portal, students are given no choice but to wait until the challenge is identified and rectified by the administrators. This lack of timely technical support may affect students’ adoption of ICT when they face technical difficulties in

using the eLearning platforms to do course work. The finding is consistent with Sun et al., (2008) who found that appropriate assistance to students for solving their curriculum and technical difficulties, can decrease e-Learners' uncertainty and frustration with eLearning leading to better learning experiences.

4.4. Analysis of how availability, accessibility and usability of ICT infrastructure affects performance of Students in HEIs

The overall objective of the study was to investigate how adoption and diffusion of eLearning infrastructure such as hardware and software may be the solution to increasing access to higher education in Malawi using the eLearning centre based at Chancellor College as a case study. The study found that lack of internet connectivity, financial constraints, inadequate computers and lack of technical support are challenges affecting students' performance at the eLearning centre. The study also found that internet connectivity affected delivery of lessons as students had difficulties in accessing course materials, and the eLearning centre does not have its own dedicated Wi-Fi connectivity and students take advantage of the free Wi-Fi provided by Chancellor College. Financial constraints are affecting eLearning students' performance because the eLearning centre is having difficulties in sustaining ICT infrastructure for effective delivery of programmes, failing to train its staff and procure essential equipment. The findings of this study do not support adoption and diffusion of eLearning at Chancellor College eLearning centre. This is because the eLearning infrastructure is lacking a lot in terms of critical components like computers, internet connectivity, technical and financial support which are key to eLearning education adoption. The study also discovered that the availability of ICT equipment at the eLearning centre is limited, the equipment is not easily for students as due to shortage of computers and no dedicated laboratory, and is partially usable as evidenced by students' ability to complete course work using the infrastructure.

Although the study identified challenges in delivery of eLearning, the results showed the opposite that many students are supporting eLearning. Nineteen (19) of the 22 respondents (86%) said eLearning could be used as a solution to increasing enrolment of eligible students in institutions of higher learning in Malawi. For example, a respondent said that: *"eLearning education is what the country needs to increase access to college education for eligible students who were not enrolled"* (Student-3). The study discovered that more people are becoming aware of the benefits

of eLearning. Tech-1 said: “*When the project was introduced, not many people were aware of the benefits of eLearning but as time goes more people are becoming aware*”. Because of this increase in the awareness of the benefits, the study discovered that the number of people enrolling in online courses between 2015 and 2017 has been increasing. This was backed by Tech-1 who said that “*We have more people graduating from secondary school who want to join tertiary schools*”.

Data on trends of enrolment of students obtained from the eLearning centre found that the number of students enrolling in eLearning courses (See Appendix 2) offered at the Chancellor College eLearning centre drastically increased to 220 students in 2016 where only four online courses were offered by the eLearning as compared to 2015 where five courses were offered and 60 students had enrolled. The trend is the same again in 2017 where although two online courses were offered, 69 students had enrolled representing a bigger number as compared to when five courses were offered in 2015. The reduction of the number of students enrolled in 2017 from 266 to 68 is attributed to the fact only two courses were offered. This trend suggests that if more eLearning courses were offered, more students would be enrolled. Figure 4.1. presents a summary of the trend in enrolment of students at the eLearning centre for a period of three years.

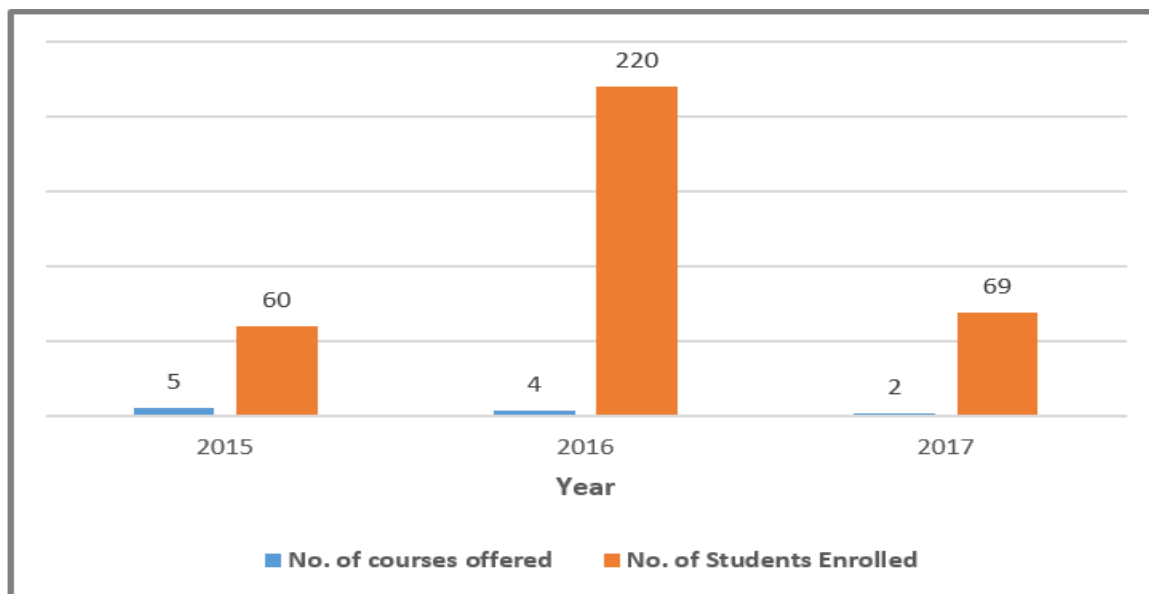


Fig 4.1. Trend of eLearning student enrolment at Chancellor College eLearning centre.

Three of the 22 respondents (14%) felt that eLearning could be a solution but were not sure if Malawi is ready to embrace technology for learning. A respondent said: *“Internet is not available in some places of the country where mobile network signal is low”* (Student-17). Student-11 said: *“Computers in Malawi are expensive and someone like me cannot afford to buy one”*. Student-22 said: *“Online learning is for rich people because computer equipment and Internet bundles are expensive to buy”* Tech-2 concurred that Malawi may not be ready to embrace eLearning methodology by saying that: *“Some lecturers in the University of Malawi undermine qualifications obtained from eLearning courses. They say that the course work that full time students undergo does not match that of eLearning students”*. The researcher discovered that lecturers undermine eLearning qualifications because they are comfortable using traditional teaching approaches making them resistant to change. *“The concept of eLearning is still new to most Malawian academics and they don’t understand what the students go through to obtain these qualifications, NCHE which accredits institutions of higher learning does not recognise the Indian institutions because the MoU came through another arm of Government where proper methods were not followed to assess the quality of education the Indian universities offer, and Lecturers’ at Chancellor College were mostly trained in Europe, Japan, South-Africa and America they don’t know the quality of education offered by Indian Universities which brings in negative perception towards eLearning”* Admin-1. This finding is supported by Kisanga and Ireson (2015) whose research found that resistance to change by teachers was associated with fear of adopting new technologies, fear of exposing one’s ignorance, poor mind-set, old age, subject discipline, low attitude towards eLearning and a perception that eLearning is an extra load. Tech-1 further stated that: *“Universities in the country need to have staff with specialised training in online courses for Malawi to realise full potential of eLearning”*. 19 of the 22 respondents (86%) said looking at the positive experience they have had, eLearning can be used to increase enrolment of students in HEIs. Three of the 22 respondents (14%) said they felt eLearning cannot be a solution to increasing enrolment of students in HEIs because ICT equipment is expensive. This finding is supported by Kigotho (2018) who wrote that African governments are upbeat about eLearning opportunities but often ignore the fact that information and communications technology infrastructure is expensive and out of reach of many schools and even universities.

Despite the technicians concurring that Malawi is not ready to embrace and adopt eLearning, the majority of the student respondents favoured the online delivery method. This is because eLearning allows individuals to study at anytime, anywhere, and at a cost that is economically advantageous. Although it is worrisome that Malawi's higher education enrolment is among the lowest in the world (World Bank, 2016), eLearning has proved in many countries to be a means of easing access to higher education and needs to be accommodated in Malawi by removing its deterrents through a process where Government should be in the forefront of supporting its implementation and full integration into the Malawian education system.

4.5. Chapter summary

This chapter has presented results and discussions of data collected based on the objectives of the study. The study has found that challenges students face in the delivery of lessons using eLearning may discourage prospective applicants from pursuing education using the eLearning approach. The study reveals that lack of internet connectivity, financial constraints, inadequate computers and lack of technical support are challenges affecting adoption and diffusion of eLearning at the centre. The study revealed that ICT infrastructure at the eLearning centre was rarely available, not easily accessible and was partially usable. These challenges had a bearing on adoption of eLearning education. Despite all these challenges, it has been concluded that eLearning can be the solution to increased enrolment of eligible students in institutions of higher learning in Malawi.

The next chapter concludes the study and makes recommendations for government and stakeholders of higher education institutions.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

5.1. Introduction

The overall objective of the study was to investigate how adoption and diffusion of eLearning infrastructure such as hardware and software may be the solution to increasing access to higher education in Malawi using the eLearning centre based at Chancellor College. The research used UTAUT and II theories to develop a conceptual framework that was used to carry out the study. A qualitative approach where data was collected using interviews and analysis of documents such as official records, reports and published data was applied.

This chapter provides summary of the research findings, conclusion of the study and recommendations.

5.2. Summary

The first objective of the study was to identify challenges faced in the delivery of lessons using the eLearning infrastructure in higher education institutions. It was established that internet connectivity, financial constraints, inadequate computers and inadequate support for eLearning infrastructure were the key challenges affecting delivery of lessons.

The second objective of the study was to assess how challenges faced in the delivery of lessons affect eLearning education. The study found that internet connectivity affected delivery of lessons as students had difficulties in accessing course materials. The eLearning centre does not have its own dedicated Wi-Fi because of high subscription rates and students take advantage of the free Wi-Fi provided by Chancellor College. Financial constraints are also affecting delivery of lessons using the ICT infrastructure because the eLearning centre is having difficulties in sustaining eLearning infrastructure for delivery of programmes. The centre is also failing to train its staff and procure essential equipment. The third challenge identified was inadequacy of computers which has led to students being given limited amount of time to access and use the computers on campus for course work. This was attributed to the eLearning centre not having its own laboratory, limited opening and closing hours of computer laboratories belonging to other faculties and the ICT resource centre, and few working computers in the laboratories. Inadequate technical support for eLearning infrastructure affected delivery of lessons as the administrators did not have all the

required and necessary skills to manage the ICT infrastructure. This was due to partial training they were given which focused only on particular elements of the eLearning ICT infrastructure as compared to the whole of it. This lack in skills affects provision of support to students when they face technical difficulties in using the eLearning platforms.

The third objective was to analyse how availability, accessibility and usability of the ICT infrastructure can affect enrolment of students in higher education institutions. The study found that availability of ICT equipment at the eLearning centre is limited which affects students' performance since they have limited time and difficulties in using the available computers for learning purposes. Although there is a shortage of computers, students prefer using the ICT resource centre in the library building as compared to computer laboratories owned by other faculties. This is because the resource centre is open and easily accessible most of the times than the faculty laboratories which students compete for access and have inflexible opening and closing times. This situation has resulted in students resorting to usage of personal devices for eLearning.

ICT infrastructure at the eLearning centre was found to be accessible for students despite having shortage of computers and no dedicated laboratory for the centre. Through usage of personal devices students are able to communicate and co-operate using a variety of tools that require internet. On usability, the research found that the ICT infrastructure at the centre is usable. This has been evidenced by the ability of students to complete course work using the infrastructure at the centre. The students also demonstrated their capability to use the ICT infrastructure and ability to judge the potential of using ICT in communicating and collaborating with others in carrying out course work.

The findings reported in chapter four agree with a research carried out by Zoroja, Skok & Bach (2015) in Croatia, where they investigated eLearning implementation in developing countries: perspectives and obstacles. The research found that lack of ICT infrastructure, management support, technical and financial support affected the adoption of eLearning. Poor internet connection was also found to be a critical issue affecting use of eLearning.

The findings in this research are also consistent with a research carried out by Omwenga, Mololo & Wagach (2004) in Kenya. Their research set out to develop a model for introducing and implementing eLearning for delivery of educational content within the African context. The study

found that the price of hardware and software, although constantly decreasing, remains considerable for many educational institutions' budgets in most developing countries and the rapid evolution of ICTs implies constant upgrading which most HEIs cannot manage. High costs and slow internet were also found to be affecting adoption of eLearning. Professional competence and teacher attitude were also identified to be the major causes of failure in delivery and adoption of eLearning in developing countries.

5.3. Conclusion

Information and Communication Technology (ICT) is a very important tool that can be used to develop education and decrease illiteracy by increasing number of students enrolled in education institutions under online programs. With the covid-19 pandemic and improvement in ICT, the education system has undergone a lot of changes where the system is gradually shifting from face-to-face to online learning. This study focuses on how adoption and diffusion of eLearning infrastructure such as hardware and software may be the solution to increasing access to higher education in Malawi using the eLearning centre based at Chancellor College as a case study. From the findings, it has been concluded that eLearning can be a solution to increasing enrolment of eligible students in institutions of higher learning in Malawi. The students agree with the administrators but most of them were not sure if Malawi is ready to embrace technology. The study also finds that internet connectivity, financial constraints, inadequate computers and inadequate support for infrastructure are the key challenges affecting performance of students at the eLearning centre. Adequate allocation of finances, training of staff members, provision of adequate and up-to-date ICT infrastructure should be ensured to facilitate adoption and diffusion of ICT in learning.

5.4. Recommendations

Basing on the findings of this study, in order to ensure there is adoption and diffusion of eLearning in Malawi, the following recommendations may be considered.

- 5.3.1. ICT infrastructure at the centre should be upgraded especially on access to faster internet for efficient and reliable connections. Upgrading of the infrastructure will lead to enhanced utilization of the system and increased adoption of eLearning.

5.3.2. Government of Malawi should allocate adequate finances to the eLearning centre for procurement and sustainability of ICT infrastructure. These finances should be invested in the procurement of computers for classrooms and setting up of a laboratory to ensure that more students have access to course materials at the same time and should also consider increasing the time these computers will be accessible to students. Staff of the eLearning centre should be trained to fully utilize ICT in learning as well as provide technical support.

5.5. Limitations of the study

Although the research has achieved its objectives, there were some limitations that could not be avoided. The main limitation was time limit and availability of respondents which made this research to be concluded on a small size of population selected from the eLearning centre based at Chancellor College. Therefore, to generalize the results for the larger group, the study should have involved more eLearning centres in the country.

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7.0. Appendices

Appendix 1

Letter of introduction from Chancellor College



PRINCIPAL

Richard Tambulasi, B.A (Pub Admin), BPA (Hons), MPA, Ph.D

CHANCELLOR COLLEGE

P.O. Box 280, Zomba, Malawi

Telephone: (265) 524 222

Fax: (265) 524 046

E-mail: principal@cc.ac.mw

TO WHOM IT MAY CONCERN

E-Learning Department,

Chancellor College

29 May 2017

REFERENCE FOR MR. BRIGHT JOSHUA (MSC/INF/19/15)

As per the subject matter, Mr. Bright Joshua registration number MSC/INF/19/15 is a student at Chancellor College pursuing an MSc in Informatics under the Computer Science Department. He seeks to collect data for his research titled "*Assessment of E-Learning Infrastructure on ICT Adoption: Case of Chancellor College*"

Any assistance rendered to him for the same would be greatly appreciated.

Yours faithfully,

A handwritten signature in black ink, appearing to read "K. Munthali".

Kondwani Godwin Munthali (PhD)

Programme Coordinator, MSc Informatics

Kmunthali@cc.ac.mw – 0999387701 / 0884 112 001

Appendix 2

List of online courses offered by Indian universities through the eLearning Centre based at Chancellor College

Name of Institution	Courses Offered
Indira Gandhi National Open College	Master of Arts in Business Administration (MBA)
	Diploma in Early Childcare & Education (DECE)
Amity College	Master of Finance & Control (MFC)
	Master of Arts in International Business (MBAIB)
	Bachelor of Finance & Investment Analysis (BFIA)
	Bachelor of Science in Information Technology (BSCIT)
	Diploma in Business Management (DBM)
	Diploma in Information Technology (DIT)
College Of Madras	Master of Science in Information Technology (MSCIT)
	Bachelor of Business Administration (BBA)

Appendix 3

Interview guide for eLearning staff members

CONSENT FORM

I am Bright Joshua, a Master of Science in Informatics student at Chancellor College of Malawi and I am conducting research on '*Adoption and Diffusion of Information and Communication Technology Infrastructure on eLearning: Case of eLearning Centre at Chancellor College*'. I need your participation in this study. Before you agree to participate you should read this form and sign at the end.

Participation in the study involves answering of questions through interviews and personal details of participants will not be disclosed to anyone. Participation in this study is voluntary. Results of the research will be published in the form of a research paper and may be published in a professional journal or presented at professional meetings. Interview recordings will be destroyed at the completion of the study. Knowledge obtained from this study will be of great value in helping policy makers involved in the implementation of future eLearning programmes.

I, _____ (name; please print clearly), have read the above information. I freely agree to participate in this study and understand that I am free to refuse to answer any question or withdraw from the study at any time. I understand that my personal information and responses will be kept anonymous.

Date _____

1. What is your post in the eLearning center?
2. What duties do you carry out under this post?
3. Can you give an overview of eLearning at Chancellor College?
4. What challenges do you face when using ICT infrastructure for learning?
5. How do these challenges affect delivery of lessons?
6. Do you have a computer laboratory dedicated specifically for eLearning students?
7. Does the eLearning center have Wi-Fi connectivity for its' students?
8. Is the eLearning portal available 24/7 for students' access?
9. Where is this portal hosted?
10. What are the challenges affecting use of this portal?
11. Does the eLearning section have a hotline where students can make phone calls to seek assistance when they face challenges in using the eLearning portals?
12. How has the trend in numbers of eLearning student's enrolment been for the past 5 years?
13. Why do you think the trend has been like this?
14. Does the eLearning centre get funding from Government or other no state owned institutions?
15. Do you think eLearning could be a solution to increasing enrolment of students in Malawian Universities?
16. Do you think Malawi is ready to embrace eLearning?
17. What do you feel is the general perception of lecturers at Chancellor College towards eLearning?
18. Do you have policy documentation regarding establishment, management and administration of the eLearning center? Can copies of this documentation be shared with the researcher?
19. Do you have any question or any additional information in relation to what has been discussed?

Appendix 4

Interview guide for eLearning students

CONSENT FORM

I am Bright Joshua, a Master of Science in Informatics student at Chancellor College of Malawi and I am conducting research on '*Adoption and Diffusion of Information and Communication Technology Infrastructure on eLearning: Case of eLearning Centre at Chancellor College*'. I need your participation in this study. Before you agree to participate you should read this form and sign at the end.

Participation in the study involves answering of questions through interviews and personal details of participants will not be disclosed to anyone. Participation in this study is voluntary. Results of the research will be published in the form of a research paper and may be published in a professional journal or presented at professional meetings. Interview recordings will be destroyed at the completion of the study. Knowledge obtained from this study will be of great value in helping policy makers involved in the implementation of future eLearning programmes.

I, _____ (name; please print clearly), have read the above information. I freely agree to participate in this study and understand that I am free to refuse to answer any question or withdraw from the study at any time. I understand that my personal information and responses will be kept anonymous.

Date _____

1. Are you pursuing an online course under the Chancellor College eLearning centre?
2. What made you choose to pursue an online course as opposed to full time program?
3. What ICT gadgets do you use for elearning?
4. How do you get access to course materials?
5. Is the ICT equipment for learning provided by eLearning centre adequate?
6. Is the ICT equipment available for students?
7. Are you able to access the eLearning ICT equipment at any time?
8. How usable is this ICT equipment for educational purposes?
9. How often do you use institutional ICT infrastructure to for learning?
10. What challenges do you face when using ICT infrastructure?
11. How do these challenges affect you as a student pursuing an eLearning course?
12. Do you think these challenges affect your performance?
13. Are you able to use the eLearning centre's internet connection?
14. Do you think eLearning could be a solution to increasing enrolment of students in Malawian Universities?
15. Do you think Malawi is ready to embrace and adopt eLearning?
16. Do you have any question or any additional information in relation to what has been discussed?