Integrating e-learning technologies into conventional teaching and learning in the school and higher education system with scarce resources: a case study of Mzuzu University

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Abstract

The main aim of this study was to investigate how secondary schools and tertiary education institutions in Malawi can sustainably integrate e-learning technologies into traditional teaching and learning environments. The study was conducted in Malawi at Mzuzu University (MZUNI) and four secondary schools within Mzuzu City.

Data were collected in two phases. Phase-one was a baseline study of the status of technology at MZUNI and in four conveniently sampled secondary schools in Mzuzu City. The rationale for conducting the baseline study was to ascertain the status of e-learning before conducting the intervention study. This phase used self-administered questionnaires, focus group discussions (FDGs) and in-depth individual interviews as tools for gathering data. Phase Two was interventional in nature because the researcher tried to implement some solutions which were observed during baseline study.

This study used a longitudinal qualitative research approach. A mixed methods approach was used because the nature of the research questions required the use of different data gathering strategies.

Study findings revealed that educational institutions that have limited resources can integrate technology in education by using resources they have. This study discovered that the following five media were sustainable and the most used technologies: The Internet, Facebook, memory sticks, personal computers and ordinary cell phones. Furthermore, challenges that institutions are likely to face when implementing technology integration included: intermittent electrical power supply; lack of resources for e-learning; resistance to use recorded e-resources; challenges with e-module production and using WhatsApp for educational purposes. The study recommends the following strategies to ensure that electronic technologies are integrated into the teaching and learning environment: MZUNI and other institutions which have limited resources for teaching and learning purposes should integrate technology in education using the most ubiquitous teaching and learning resources around them by making use of the Teaching and Learning Using Locally Available Resources (TALULAR) concept instead of solely relying on proprietary resources.

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I dedicate this thesis to my late my late sister, Sibo, who departed on the eve of my viva, my late mum (Ama Nyazyovu) and my late dad (Ada Wezi). May Their Soul Rest in Peace.

Author's Declaration

I declare that, except where explicit reference is made to the contribution of others, that this thesis is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

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Acronyms

ARS	Audience Response System
ATT	Attitude
AVI	Audio Video Interleave
BI	Behavioural Intention
CAL	Computer Assisted Learning
CD-ROM	Compact Disc - Read Only Memory
CDSSs	Community Day Secondary Schools
CFS	Classroom Feedback System
CMS	Course Management System
CODL	The Centre for Open and Distance Learning
CPD	Continuing Professional Development
CRS	Classroom Response System
CSE	Computer Self-Efficacy
C-TAM-TPB	Combined TAM and TPB
DACS	Door Access Control Systems
DECs	Distance Education Centres
DETA	Distance Education and Teacher Education in Africa
DoI	Diffusion of Innovation
DTPB	Decomposed Theory of Planned Behaviour
DVC	Deputy Vice Chancellor
DVDs	Digital Versatile Discs
ESCOM	Electricity Supply Corporation of Malawi
ESRC	Economic and Social Research Council
EVS	Electronic Voting System
eXe	E-learning XHTML Editor
FAIR	Fair Allocation of Infotech Resources
FLOSS	Free/Libre Open Source Software
FPE	Free Primary Education
GIT	Green Information Technology
GNI	Gross National Income
GNU	GNU's not UNIX

GoM	Government of Malawi
HDI	Human Development Index
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
ICT	Information and Communication Technology
ID	Identification
IDT	Instructional Design and Technology
IPRI	Intellectual Property Rights Index
IT	Information Technology
JCE	Junior Certificate Examination
LCD	Liquid Crystal Display
LIS	Library and Information Science
LMS	Learning Management Systems
LRS	Learner Response System
LTS	Long Term Support
LUANAR	Lilongwe University of Agriculture and Natural Resources
MACRA	Malawi Communications Regulatory Authority
MoEST	Ministry of Education, Science and Technology
MOODLE	Modular Object-Oriented Dynamic Learning Environment
MP3	Moving Pictures Experts Group Layer 3
MP4	Moving Pictures Experts Group Layer 4
MPEG	Moving Picture Experts Group
MSCE	Malawi School Certificate of Education
MUST	Malawi University of Science and Technology
MZUNI	Mzuzu University
NCHE	National Council for Higher Education
ODL	Open and Distance Learning
OERs	Open Education Resources
OLAT	Online Learning and Training
OSRSs	Online Student Response Systems
PC(s)	Personal Computer(s)
PCU	Personal Computer Utilisation

PDF	Portable Document Format
PEOU	Perceived Ease of Use
PhD	Doctor of Philosophy
PHP	Hypertext Pre-processor
PSLCE	Primary School Leaving Certificate Examination
PU	Perceived Usefulness
PWQ	Perceived Web Quality
RDBMS	Relational Database Management System
RIFF	Resource Interchange File Format
RSS	Really Simple Syndication
SCT	Social Cognitive Theory
SMEs	Subject Matter Experts
SMS	Short Message Service
SN	Subjective Norm
CSS-1	Conventional Secondary School 1
CSS-2	Conventional Secondary School 2
SQL	Structured Query Language
SRS	Student response system
TALULAR	Teaching And Learning Using Locally Available Resources
TAM	Technology Acceptance Model
TEL	Technology Enhanced Learning
TESS India	Teacher Education through Schools Based Support in India
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TWCU	Tokyo Woman's Christian University
UK	United Kingdom
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNIMA	University of Malawi
URLs	Universal Resource Locators
UTAUT	Unified Theory of Acceptance and Use of Technology
VC	Vice Chancellor

VLE	Virtual Learning Environment
WAMP	Windows, Apache, MySQL, PHP
WYSIWYG	What You See Is What You Get
XHTML	Extensible Hypertext Markup Language

Chapter 1: Introduction

1.1 Introduction and need for the study

Mzuzu University's main challenges concern infrastructure, human resource and finances (Mzuzu University, 2014). Many institutions of higher learning in Malawi face similar challenges. The number of students admitted at Mzuzu University (MZUNI) is increasing every year but teaching staff and infrastructure alike are not. Limited infrastructure has thus negatively impacted on the University's ability to cost effectively deliver courses. Due to small-sized classrooms and laboratories, same lectures have been held several times just to accommodate every student. This would nonetheless be cost effective if a lecture was held in one big classroom. More so, infrastructure problems make timetabling an extremely difficult task. Again, lack of Information Technology (IT) infrastructure means that MZUNI cannot take full advantage of the innovations and new technologies that come along with them (Mzuzu University, 2014). Such advantages include improved e-learning and distance learning delivery modes that are not only cost effective but also flexible. An *innovation* as defined by Rogers (1995) is *"an idea, practice or object that is perceived as new by an individual or other unit of adoption"* (p. 11). It does not matter whether the idea, practice or object is objectively new or not, but rather, it is the perception of novelty that is important (Straub, 2009). The particular type of innovation that this research focusses on is computer-based technologies.

This chapter provides a general introduction to the research project. It describes a general introduction to Malawi, and her education system. It also presents the aim of the study, objectives and research questions. Furthermore, the chapter describes technology acceptance theories in general and Roger's Diffusion of Innovation (DoI) Theory, which guided the study, in more detail.

Malawi is a landlocked country situated in southeast Africa. It is bordered by Mozambique to the East and South, Zambia to the West, and Tanzania to the North. Lake Malawi occupies most of the country's eastern border and covers about 20% of the country. According to Sandbox Networks (2015), Malawi has a total area of 45,745 square miles (118,480 square kilometres) of which 36,324 square miles (94,079 square kilometres) is land and the rest is covered by the lake. Malawi has a population of 16,777,547 (2013 figures), growth rate of 3% of and birth rate of 40.42/1000. The infant mortality rate is 79/1000 and life expectancy is 52 years. Malawi is ranked amongst the poorest countries in the World. According to the 2014 United Nations Development Programme (UNDP) report, Malawi's Human Development Index (HDI) for 2013 was 0.4, positioning the country at 174 out of 187 countries and territories. According to UNDP (2014), the HDI for Malawi has increased by 53% between 1980 and 2013 giving an annual increase of about 1%. The Malawi HDI trends from 1980 to 2013 based on consistent time series data show an increase in all indicators; for example, Malawi's life expectancy at birth increased by 11 years, mean years of schooling increased by 2 years and expected years of schooling increased by 6 years. Malawi's Gross National Income (GNI) per capita increased by about 16%.

1.2 Education system in Malawi

The Ministry of Education, Science and Technology (MoEST) has administrative, financial and academic control of the education sector in Malawi (UNESCO, 2011). The education sector operates on an 8-4-4 system: eight years of primary, four of secondary and four of university education (Classbase, 2012). Primary school education starts from Standard one to Standard eight. Pupils register for the Primary School Leaving Certificate Examination (PSLCE) when they reach Standard eight. This examination is used for selecting pupils into secondary school education. While primary school education is free, it is not compulsory. One of the reforms that was introduced in the education system soon after the dawn of multiparty democracy in 1994 was the introduction of Free Primary Education (FPE). This then increased access to primary and secondary education, hence placing additional stress on the education system that was already constrained by lack of human and financial resources (Ng'ambi, 2010).

Secondary school education runs from form one to form four. Up to 2016, the first two years used to prepare students for the Junior Certificate Examination (JCE) and the last two years continue to prepare them for the Malawi School Certificate of Education (MSCE) examination. Students who passed JCE proceeded to form three and form four. Students register for the MSCE when they reach form three. The MSCE is the entry requirement for admission into university education. Malawi has public secondary schools which are run by the state and private secondary schools are run by the private sector. Prior to 1999, secondary school education was mainly offered through conventional secondary schools and Distance Education Centres (DECs). Later on, DECs were converted to Community Day Secondary Schools (CDSSs) in 1999 through a government policy directive (UNESCO, 2011).

The education policy in Malawi aims at developing a high-quality education system that is efficient and appropriate for the political, social and economic landscape of the nation with the resources that are available (UNESCO, 2010). In response to this policy, the Government of Malawi (GoM) established four public universities which included the University of Malawi (UNIMA), in 1965, MZUNI in 1997 through 1999, Lilongwe University of Agriculture and Natural Resources (LUANAR) in 2012, and Malawi University of Science and Technology (MUST) in 2012. The University of Malawi, until Friday, 15th March 2019, had four constituent colleges, namely, Chancellor College (CHANCO), The Polytechnic (POLY), College of Medicine (COM) and Kamuzu College of Nursing (KCN). Parliament on 15th March, 2019, passed three bills that sought to delink University of Malawi colleges to become separate universities. Under the new legislations, Malawi Polytechnic University is now Malawi University Business and Applied Sciences while College of Medicine and Kamuzu College of Nursing will be under Malawi University of Health Sciences. Chancellor College will be called University of Malawi.

The public universities are regulated by separate Acts of Parliament, which make them autonomous entities, though they are generally overseen by the MoEST's Department of Higher Education. Concerned with issues of quality assurance and validation, the GoM established The National Council for Higher Education (NCHE) in 2015 following the passing of the 2011 Act of Parliament No. 15. According to the Malawian Foreword published in the 2015 edition of Scotland-Malawi Further and Higher Education Directory, NCHE was specifically established to:

> *"Promote and coordinate education provided by higher education institutions; design quality assurance systems and determine, maintain and regulate standards for teaching, examinations, qualifications and facilities; register, de-register and accredit higher education institutions; determine framework for funding public higher education and provide guidance on terms and conditions for awarding students' grants, loans and scholarships; and harmonise student selection into public higher education institutions"* (Chithila-Munthali, 2015, p. 3).

For the first time in the history of Malawi's higher education since the establishment of the University of Malawi in 1965, selection of students into public higher education institutions was done centrally by the NCHE in 2015 to eliminate double selection of candidates that characterised the decentralised selection model. Since selection to universities in Malawi is very competitive (Classbase, 2012) because of the limited infrastructure and other resources, many qualified candidates cannot be admitted. For example, in the 2015/16 academic year, there were a total of 17,664 applications received by the NCHE for consideration, nonetheless, only 1,919 applications were considered successful for university education (NCHE, 2015). Out of these, 572 candidates were sent to MZUNI, 896 were sent to LUANAR and 302 were sent to MUST (NCHE, 2015). These statistics show that only about 11 percent of the applicants were selected for public university education in 2015. Note that selection to universities is based on the score of the MSCE examination results. Equivalent scores from other examining boards such as the Cambridge "O" Levels also qualify students for entry to the universities.

Mzuzu University is located in Mzuzu City about 350 kilometres north of the Capital City, Lilongwe. It was established as a second national public university to train secondary school teachers after the government observed that the UNIMA failed to address problems associated with issues of increasing and broadening access to tertiary education. The Vision of MZUNI is to be a leading provider of tertiary education, research and outreach locally, regionally and the World (Mzuzu University, 2014). Its mission is *"to provide high quality education, training, research and* *complementary services to meet the technological, social and economic needs of individuals and communities and the World"* (Mzuzu University, 2015, p.2). As of 2015/16 academic year, MZUNI had a total population of 3,817 registered students across its five faculties namely: Education, Information Science and Communications, Health Sciences, Environmental Sciences, and Hospitality Management and Tourism (Mzuzu University, 2015). MZUNI has two delivery modes: the face-to-face and open

Figure 1-1 Map of Malawi here showing location of public universities

and distance learning (ODL). The face-to-face delivery mode predominantly utilises the lecture methods with limited use of Information and Communication Technology (ICT) applications such as PowerPoint. Conversely, the ODL delivery mode uses printed modules that are distributed to the students.

Students who are unable to be enrolled in public universities find their way into Private universities (Catholic University of Malawi, n.d.; Nkhoma University, 2018; Malawi Adventist University, n.d.; Malawi Assemblies of God University, 2018), and vocational education institutions run by the Technical, Entrepreneurial and Vocational Training Authority (TEVETA) which has been mandated to facilitate professional training in Malawi (Classbase, 2012) among other institutions of higher learning. Candidates enrolled at TEVETA-run institutions do vocational training at technical colleges such as Mzuzu, Lilongwe, Livingstonia, Salima (Salima Technical College, 2018), Soche Technical Technical College and Don Bosco Youth Technical Colleges. Apart from technical education, candidates also get admission into accountancy (Malawi College of Accountancy, 2018), health (Christian Health Association of Malawi, 2017; Saint John of God Hospitaller Services, 2016), environmental (Malawi College of Forestry and Wildlife, n.d.) and teacher training (Emmanuel Teacher Training College, 2018; Development Aid from People to People (DAPP), n.d.; Teacher Training DNS, 2018) fields.

Internationalisation of higher education

Malawi has the lowest number of students accessing higher education in the world. Only 64 per 100,000 people have access to higher education (The World Bank, 2010). The situation is improving gradually as the number of private institutions offering higher education is increasing as is the contribution to enrollments and new programs. A more economic option to increasing access that is currently being considered in Malawi is establishing an open university using the distance learning delivery mode. Apart from enrolling in public and private universities, Malawian students access university education elsewhere in the world. There is cross border movement of students seeking higher education in the Southern African Development Community (SADC) region. For Malawi, the movement is mainly outbound. In the SADC Region, South Africa is the major exporter of education to Malawi. Some students who pass MSCE but are not selected to pursue higher education in the country's universities seek enrollment into foreign institutions of higher learning in the following disciplines among others: business administration (Association of Business Executives (ABE), n.d.) and The Management College of Southern Africa (MANCOSA), 2013), human resource management (Institute of Commercial Management, 2018), marketing (CIM - The Charterd Institute of Marketing, 2017), and purchasing (Chartered Institute of Purchasing and Supply, n.d.). According to The World Bank (2010) the SADC has the highest outbound mobility ratio (6%) worldwide and about 50% of these mobile students are choosing to study in South Africa. The most popular fields amongst these students are social science, business and law. Factors that may influence this crosborder mobility of students include apeal for better education opportunities abroad and inadequate educational opportunities in the home country. The 1997 SADC protocol on Education and Training recommended that that higher education institutions should reserve at least 5% of their admissions for learners from other SADC countries in order to promote internationalisation of higher education within the SADC Region. Countries that have small populations, including Malawi, have a large proportion of learners abroad. It is assumed that these countries take advantage of the wide availability of tertiary education opportunities in South Africa or other countries. Malawi is among countries which have a relatively high dispersion index (UNESCO Institute of Statistics, 2012). More than 5% of students enrolled in South African universities and technikons in 2002 were from SADC. Kwaramba (2012) noted that after United States, South Africa was the second destination for students from the English-Speaking Sub Saharan African countries. This may be so because South Africa has the highest number of internationally rated universities in the SADC Region. Another explanation for South Africa being a major exporter of education services may be that some universities charge home-level fees to students from the rest of Africa.

MZUNI e-Learning initiative

The e-learning mode has the potential of supplementing the traditional face-to-face residential delivery mode as well as the current ODL delivery mode that is predominated by print based modules. This is particularly true when we consider that e-learning materials are much cheaper to produce and distribute than paper-based modules. In addition, electronic content is much more interactive and responsive to users than printed modules are. Students using the e-learning delivery mode do receive more immediate feedback on quizzes than do their counterparts.

Above this, multimedia files enhance student motivation and learning experiences. Secondary schools and universities in Malawi stand to benefit greatly if e-learning were introduced to supplement the face-to-face residential mode.

There was a general interest in Malawi in 2009 to integrate open source software in the teaching and learning process at university level as a way of beating the high cost of commercial software. The expectation of Mzuzu University management at that time was that the ICT department would help in solving some of challenges like lack of teaching space, that the University was facing by using technology. One major problem that required immediate intervention was teaching of large classes. Mzuzu University did not have auditoria to accommodate large numbers of students. Lecturers in ICT Department, including the author of this thesis, saw the need to do something about the problems of large class sizes, high cost of Internet services and deficiencies in teaching and learning resources such as libraries, laboratories and computer hardware and software. They started the MZUNI e-learning Centre with one old refurbished computer, which was used as a server using open source software. They took advantage of the University's Local Area Network (LAN) to enable many students to have access to the teaching and learning resources that were uploaded on this server. The 2014 report of the Economic and Social Research Council (ESRC) on the Technology Enhanced Learning (TEL) Programme, which ran from 2007 to 2013 in the United Kingdom (UK) described a creative innovation process of bringing available resources together and working out how to use them to achieve a desired goal as 'bricolage'. Accordingly, the lecturers who started the e-learning initiative at MZUNI have best been described as bricoleurs. They installed Claroline, an Open Source Learning Management System, as a platform for uploading instructional materials. The implementation of this e-learning strategy was done on a pilot basis using a few selected courses. The courses that were piloted were Mathematics and ICT because these bricoleurs were subject matter experts in these areas of study. Later, lecturers who got interested in this new idea joined the project. Majority of the lecturers who uploaded instructional materials on this platform were from Mathematics and ICT departments. Seminars and induction sessions were conducted with the faculties on how to use Claroline in order to increase patronage and efficiency. Ironically, many lecturers did not utilise this facility. One reason this innovation was not fully adopted could be that the bricoleurs did not consider the perspectives of different stakeholders such as lecturers, learners and policy makers when implementing this novel idea, as suggested by the Economic and Social Research Council (2014) report. There was no interdisciplinary collaboration when the innovation was being initialised. This was compounded by the lack support systems at the onset that would allow the users some time to test the innovation under-wraps before its adoption. Certainly, for any innovation to be successful, it needs to be well aligned with the present systems available in the area of introduction. Moreover, Economic and Social Research Council (2014) observed that policy and funding should support changes in pedagogy and practice, as well as the technological developments that will support these. A possible solution to this slow adoption of the technology was to effectively use one on more theories or models of technology acceptance with the hope of increasing the implementation and application of inventive instructional products and practices (Yates, 2001).

Given these concerns, the Claroline Learning Management System was later changed to Moodle, another Open Source system, in 2012. Still, many lecturers did not fully utilise the system in spite of increasing the levels of orientation on how they could best use the new system. Relative to this, out of 175 academic members of staff, only 10 staff utilised Moodle (Mzuzu University, 2013). Moodle was underutilised since most of its capabilities remained untapped. Up until today, the e-learning platform is still being used only as a repository of electronic course materials by few lecturers. The documents that were uploaded on this platform were predominantly in Portable Document Formats (PDF). Multimedia formats like graphics, audio and videos were not used despite the availability of many Free/Libre Open Source (FLOSS) educational resources. The most common mode of teaching used by majority of lecturers at MZUNI was the traditional lecture method. In other words, technology has not been fully integrated into teaching and learning at MZUNI and is almost nonexistent in many secondary schools. Most learners in both secondary schools and tertiary institutions solely depend on teachers as content providers. The institutional libraries do not have adequate resources where learners can get extra tuition. When class time is over and libraries are closed, students simply go back to their halls of residence and wait for the next class in order to access instructional materials and this increased the number of dead hours.

1.3 The Problem

There are many instructional materials at MZUNI in print format that can be repurposed for e-learning. This includes lecturers' class notes and instructional modules for the Centre for Open and Distance Learning (CODL). During lessons, lecturers write lecture notes on chalkboards for students to copy. Sometimes they do dictate the notes to the students although it is time consuming. When classes are cancelled due to the absence of the teacher, students suffer as they do not have access to information either because lecturers lock their class notes in their offices or indeed did not present the face-to-face lectures when they are not on campus. However, if such notes or lecture materials were readily available on the Internet, intranet or podcasts, students could have access to the materials anytime and anywhere. This would also enable them do their research electronically and use class time as discussion forums thereby reducing dead-hours. More so, the massive proliferation of mobile phones in Africa as well as in Malawi is also an opportunity that can be utilised to promote e-learning. Learners would have easy access to the e-resources because, as the Economic and Social Research Council (2014) emphasised, nowadays learners have access to handheld computing devices that are powerful and affordable which include, among others, smartphones and tablet computers. These devices can potentially be used to add value to the teaching and learning processes. Today, mobile phones have become ubiquitous in schools (Gerson, 2015) and almost every student at MZUNI has access to one. Moreover, today's students do discuss various academic topics in both formal and informal forums though such discussions are not recorded just like class proceedings. These, of course, are but a few lost opportunities for capturing content for e-learning. With instructional materials stored on the Internet, hard drives, flash disks, compact discs and mobile phones, learning can take place "anytime, anywhere" (Traxler & Kukulska-Hulme, 2005). As observed by Traxler and Kukulska-Hulme (2005), mobile learning or m-learning is becoming a credible and cost-effective element of the distance learning delivery mode although there is need to analyse and adapt this learning mode to suit local needs and contexts. Much as m-learning can enhance education, mobile devices can be disruptive and distracting as they are owned by students (Traxler & Kukulska-Hulme, 2005). Educational institutions need to modify how this technology can be used for educational purposes since they have little or no control over how these devices are used by students. Most students as well as faculty members at Mzuzu University actively use electronic technologies for purposes other than instruction. Where electronic technologies have been used for instructional reasons, it has been mainly for accessing information for teaching (Nyirongo, 2009). The potential for integrating mobile technology in education in Africa to access and create information is huge as most schools have limited access to electricity and wired telecommunications (Glasson & Evans, 2018). In the context of m-learning, the teachers' roles will shift from being content providers and judges to mere facilitators. Before this can be achieved though, there is need to summount challenges in integrating mobile learning in tertiary education institutions in Africa such as poor technological infrastructure, lack of access to modern mobile devices, lack of mobile learning pedagogical skills among lecturers and poor attitudes among students and lecturers (Kaliisa & Picard, 2017). As observed by Kaliisa and Picard (2017), there is need to have policies to guide the implementation of mobile learning.

Mobile technology is increasingly being used to support teaching and learning in this digital era. The mobile phone is a potential solution to the problem of shortage of computers in most education institutions in Malawi for accessing online materials. Mayisela (2013) conducted a study seeking to establish how the use of mobile phone technology could enhance accessibility and communication in a blended courses. The results showed that blended learning using mobile phones provided an opportunity for students who missed classes to access courseware outside the class. The study further showed that many students with mobile phones and laptops had an increased opportunity to interact with courseware. However, some students indicated that it was difficult for them to access content on Blackboard using smartphones. Therefore, Mayisela (2013) stressed the importance for educational institutions to ensure that Blackboard is easily accessible on smartphones. The study also found that students accessed courseware and Facebook much easier when using laptops and phones than desktop computers. Mayisela (2013) therefore, recommended that institutional decision-makers should consider mobile technology as potential solution to the problem of shortage of computers.

After considering this situation, one is tempted to ask: *Can't we use locally available resources to repurpose the existing print instructional materials so that they can be delivered electronically? Which electronic media can we use to sustainably integrate digital technology in secondary schools and higher education in Malawi? What would be the effect of the repurposed instructional materials on staff and students' performance?*

In response to these questions, this research focused on technology integration in secondary and tertiary education in Malawi. This was so because many teachers rely on the chalk-and-talk teaching methods. Since use of computers and e-resources in education is a new phenomenon in Malawi, are there ways of integrating classroom face-to-face learning experiences with online learning delivery with the goal of providing effective and efficient learning experiences by taking the best from each mode (Kumar, 2012)? However, learners should be ready to accept technology if online delivery is to be successful. In addition, organisational infrastructure should be ready to support learner-centred instructional provision (Mehta, 2014). Blended learning (Valiathan, 2010 & Singh, 2003) has been adopted in some parts of Africa such as Tanzania where technologies like learning management systems, video conferencing and multimedia facilities complement face-to-face and distance learning delivery modes (Mtebe, 2013).

1.4 Aim of the study

The aim of the research was to study how secondary schools and MZUNI could sustainably integrate e-learning technologies into traditional teaching and learning environments and implications for institutions of higher learning in Malawi. This case study was conducted by studying two conventional secondary schools, two community day secondary schools in Mzuzu City and MZUNI.

Specifically, the study intended to:

- investigate if learning institutions can use locally available resources to repurpose existing paper-based instructional materials for electronic delivery;
- find electronic media that can be used to sustainably integrate digital technology in secondary schools and universities in Malawi;
- identify challenges that resource challenged institutions meet when integrating digital technology and;
- investigate the effect of the repurposed instructional materials and digital technologies on faculty's teaching and students' learning experiences, with a special interest on interactivity.

1.5 Research Questions

The main research question was: How can education institutions with limited resources sustainably integrate e-learning technologies into traditional teaching and learning environments? The researcher also proposed to address the following subsidiary questions:

1. How can education institutions with limited resources sustainably use locally available resources to repurpose existing paper-based instructional materials for electronic delivery?
2. Which electronic media can resource-challenged institutions use to sustainably integrate digital technologies in secondary schools and universities in Malawi?
3. What challenges do education institutions with limited resources meet when integrating digital technologies in education?
4. What are the effects of repurposed instructional materials and digital technologies on staff's teaching and students' learning experience?

1.6 Outline of the thesis

Chapter one outlined background information and education system in Malawi. Aim, objectives and research questions are also presented. Finally, the chapter presents outline of the thesis.

Chapter two presents a review of literature on technology acceptance models. Major technology acceptance models such as the Theory of Reasoned Action (TRA), Model of Personal Computer (PC) Utilisation (PCU), Technology Acceptance Model (TAM), Diffusion of Innovations (DOI), and Unified Technology Acceptance and Use of Technology (UTAUT) are examined. The Diffusion of Innovations theoretical framework, which guided this study, is also explored in detail. Other aspects that are covered in this chapter are social systems, student response systems (SRS), content management system (CMS) and technology integration.

Chapter three presents the research methodology for the study. It further presents the research paradigm, the research design, the researcher's standpoint and motivation. The type of research undertaken, the methods, and the preparation for data collection are also described. The chapter then outlines the processes of e-Modules production, the phenomena studied in Phase One, the way study sites were selected, as well as the sampling and data collection tools and data analysis.

Chapters four and five present findings of the study. More specially so, chapter four describes findings for Phase One, which include the following: characteristics of the respondents, the availability of resources, the electronic media that respondents found sustainable and opportunities and challenges institutions are likely to face when integrating technology in teaching and learning. The findings of Phase One were then used as the basis for Phase Two of the study. Chapter five examines the results for Phase Two. These include findings on C Programming Classes, Physical Science Classes, ODL e-Module production processes, Moodle Learning Management System and Turnitin anti-plagiarism software.

Chapter six presents general discussions of both Phase One and Two findings. It discusses the findings based on the four research questions presented herein.

Chapter seven finally presents a summary of the conclusions, the recommendations, and states the study limitations and suggests areas that call for further research.

Chapter 2: Review of Literature

2.1 Introduction

This chapter presents a review of literature on technology integration, technology integration in Malawi, locally available technologies for learning, student response systems (SRSs), learning theories, theories and models of technology acceptance and the theoretical framework. The main objective of this literature review is to examine the theoretical perspectives that can be adopted or adapted in order to facilitate adoption and diffusion of technology in secondary and higher education systems in Malawi. Emphasis of the review is placed on literature that deals with factors that facilitate the diffusion of innovation, which is the focus of this study. As stated in Chapter One, the aim of this study was to investigate how secondary schools and institutions of higher learning in Malawi can sustainably integrate e-learning technologies into traditional teaching and learning. The study proposed to address the following subsidiary questions:

1. How can education institutions with limited resources sustainably use locally available resources to repurpose existing paper-based instructional materials for electronic delivery?
2. Which electronic media can resource challenged institutions use to sustainably integrate digital technologies in secondary schools and universities in Malawi?
3. What challenges do education institutions with limited resources meet when integrating digital technologies in education?
4. What are the effects of repurposed instructional materials and digital technologies on staff’s teaching and students' learning experience?

2.2 Technology integration

Technology integration looks at use of technology resources such as computers, mobile devices such as smartphones and tablets, digital cameras, social media platforms, software applications, and the Internet in the management of educational institutions (George Lucas Educational Foundation, 2018). Use of these digital and hardware tools should aim at facilitating the process of teaching and learning in as well as outside the classroom. They should be used to enhance and support learning processes across all subject areas in daily classroom practices, and in the management of a school. The purpose of using technology in education should be to enhance, extend, or enrich learning. Technology integration should enable students to apply computer and technology skills to learning and problem-solving and to show their understanding of content. Technology should be a seamless (Hertz, (2011) integral part of the learning process. When this happens, technology integration is at its best. It is worth noting that it is the curriculum that drives the use of technology and not vice versa. Technology should be used to support the curricular goals, and help students to reach their goals effectively.

Teachers play a crucial role in technology integration. For technology integration to be possible, teachers' existing beliefs about technology should match their practices regarding technology integration. A study that was conducted by Chen (2008) in Taiwan, to investigate why teachers did not practice what they believed regarding Technology Integration revealed that inconsistency between teachers' expressed beliefs and their practices was one of the reasons technology integration was not happening. Chen (2008) recommended that administrators should take teacher beliefs into account when integrating technology. He further suggested that it was essential that researchers considered teachers' beliefs and other related factors when considering an educational innovation because teachers choose specific teaching strategies and materials based on their beliefs. Apart from teachers' beliefs, all participants in Chen's (2008) study identified external factors such as lack of access to computers and software, insufficient time to plan instruction, and inadequate technical and administrative support that contributed to low uptake of innovation. Participants reported that large class sizes with students who had differing ability levels prevented them from paying sufficient attention to individual students' learning requirements. Another factor that made teachers not to use technology in their classes was that they were under pressure to cover all content in order to prepare students for examinations hence they were uncomfortable to allow students to spend valuable class time to explore content on their own using technology. All participants' in Chen's (2008) study used PowerPoint presentations.

In order to identify reasons that technology integration in some schools in the United States has not happened, Bauer and Kenton, (2005) examined the classroom practice of 30 teachers who were technology experts and used computer technology in their instruction. They found that the teachers who were very educated and skilled technologically, innovative and proficient at overcoming obstacles, did not integrate technology consistently in their classes. Two main issues that were found to contribute to this phenomenon were that their students did not have enough time to use computers, and that teachers needed extra time to plan for using technology in their lessons. Other reasons that the teachers gave for not integrating technology were out-dated hardware, lack of appropriate software, technical difficulties, and low student technology skill levels. Another hurdle that needed to be surmounted was the changing role of the teacher with the advent of classroom computers in the late 1980s and early 1990s. The teacher's role has shifted from the content provider to facilitator of the teaching and learning process. This scenario has put teachers in a predicament in that the integration of computer technology into the curriculum was not planned properly, and that teachers were poorly trained to fulfil this new role. Fuller (2000) noted that a further complexity with the coming of the computer into the classroom was lack of understanding by teachers the role computers should take. To improve integration of technology in the classroom, Bauer and Kenton (2005) suggested that schools need to have a tech-savvy member of the administrative team who would devote time to Computer Technology issues such as ordering of computer software.

When due attention to pedagogy has been given, curriculum delivery can be enhanced and quality of education can be improved with the use of Information and Communication Technology (Louw, Muller, & Tredoux, 2008). Use of ICTs has the potential of improving teaching and learning when used properly. However, it must be noted that ICT skill levels are critical for the successful integration of ICT in educational institutions (Drent & Meelissen, 2008). Sustainable integration of ICTs in under-resourced institutions, especially in developing countries where there is rampant poverty, unemployment and lack of resources, is yet to be realised. For meaningful integration of ICTs in developing countries to be achieved, there is need to align the intention of funders of projects and the attitudes of the would-be implementers towards use of technology in education. Other issues that may hinder successful integration of technology into the teaching and learning process include technological, pedagogical and social factors (Chigona, Chigona, Kausa, & Kayongo, 2010). In addition, policies and methods also have an impact on the adoption of technology in schools (Anderson, 2007).

Provision of physical ICT infrastructure alone may not be enough to ensure successful technology integration. Lecturer's attitudes towards technology greatly influence acceptance of use of technology in education. This assertion is supported by a study that Hart and Laher (2015) conducted at the University of the Witwatersrand in South Africa. In their study they found that teachers' attitudes were generally positive. Strong predictors of attitudes were *Perceived Usefulness* and *Perceived Cultural Relevance*. They concluded that for technology integration to be successful it was crucial to pay attention to teachers' perceptions of the use of technology in education when integrating technology into schools. In addition to attitudes of learners, Cantrell and Visser (2011) argued that the successful integration of educational technology depends on the attitudes and aptitudes of the instructors as well.

Other challenges that need to be solved to ensure successful technology integration in tertiary institutions in Malawi include limited access to the Internet and exorbitant Internet bundles (Chawinga, 2016). A study by Ramorola (2013) which was undertaken to investigate the challenges faced by senior secondary school teachers and learners in integrating technology in schools in South Africa revealed the following as the major challenges affecting the effective integration of technology at school level: unavailable technology policy, insufficient technology equipment, lack of teachers qualified in technology integration, and maintenance and technical problems. Ramorola (2013) further noted that integrating technology effectively requires planning, sufficient time, dedication and enough resources.

2.3 Technology integration in Malawi

Using technology to improve teaching in Malawi (Adie, n.d.) and in Africa (d'Aiglepierre, Aubert, & Loiret, 2017; IT News Africa, 2017) is mainly focused in primary schools. For example, the Smart Classroom initiatives that have been introduced in lower income areas in South Africa target educationally marginalised children in primary schools. These projects help children who would not normally have access to tablets and computers to become computer literate from a tender age. Recently, there has been some movement towards using ICTs in tertiary education. For instance, In Malawi, some public universities use ICTs in their service delivery. For example, Malawi University of Science and Technology provides a number of ICT services to staff and students. Such services include Integrated Financial Management System, Integrated Student Management Information System, Library Management Information System as well as Human Resource Management System (Malawi University of Science and Technology, 2018). However, there is no evidence of an LMS from their website http://www.must.ac.mw. The Polytechnic has a Student Management Information System (University of Malawi - The Polytechnic, n.d.), which is an indication that the institution uses ICT. Chancellor College has a learning management system, a Students' portal (Chancellor College, 2018) and some lecturers use Google Classroom. College of Medicine and Mzuzu University have Moodle Learning Management systems. Kamuzu College of Nursing has electronic journals (University of Malawi - Kamuzu College of Nursing, 2017) but there is no evidence of LMS from its website (University of Malawi - Kamuzu College of Nursing, 2017). Some universities in the Sub Sahara region that have learning management systems include Kenyatta University (Kenyatta University, n.d.), Moi University (Moi University, 2018), University of Dar-es-Salaam (University of Dar es Salaam, 2015), Open University of Tanzania (The Open University of Tanzania, 2014), University of Zambia (The university of Zambia, 2018), Zambian Open University (Zambian Open University, 2018), University of Zimbabwe (University of Zimbabwe, 2018) and Zimbabwe Open University (Zimbabwe Open University, 2018). From the foregoing, it can be argued that universities in Sub Saharan Africa use some ICTs in teaching and learning but it is not evident whether technology integration has taken place fully in these institutions.

Although there is a growing body of literature on ICT in education, only a few studies have focused on use of locally available resources to repurpose print educational resources for e-Learning in Malawi and surrounding countries. The following section analyses technologies that are locally available in Malawi for learning. It presents selected media that are used in the educational sector worldwide. Some can be used in Malawi as they are while others can be adapted to suit the local environment. The technologies include social media, student response systems and mobile technology.

2.4 Locally available technologies for learning

People use technology for many purposes which include but not limited to solving problems, improving solutions to problems or achieving desired goals. Pierce and Karwatka (2000) define technology as a scientific method that makes practical use of human knowledge. It involves using knowledge of scientific principles to change resources into products needed by a society. Nowadays computer technology is changing traditional teaching and learning methods. The use of technological resources like computers, digital cameras, compact disc software applications, and the Internet in daily classroom practices and in the management of learning institutions is becoming the way of teaching and learning. E-learning is gaining ground in many education institutions and covers a wide range of systems, from students using e-mail and accessing course work online while following a course on campus to programmes offered entirely online (Organisation for Economic Co-operation and Development, 2005). E-learning is becoming increasingly prominent in tertiary education, with universities increasingly using virtual learning environments and more students signing up. This assertion is true even in developing countries like Malawi albeit at a slow pace.

Educationists define the term educational technology and many related terms differently. For Roblyer and Doering (2010) the term educational technology is *"a combination of the processes and tools involved in addressing educational needs and problems, with an emphasis on applying the most current tools"* (p. 8). The tools alluded to in the definition above include computers and other electronic technologies. Tools in educational technology refer to learning theories, which are based on sciences of human behaviour and applications of technology that help students prepare for the future. When integrating technology into teaching and learning, educators need to choose electronic tools and related methods of implementation that are appropriate to specific learning needs and problems. In developing countries, where access to technology is limited, teachers and learners should make use of TALULAR (Teaching and Learning Using Locally Available Resources) first, before they start lamenting of shortage of teaching and learning resources. When one looks around our educational institutions, one sees many technologies that we use in our daily lives that we could use for educational purposes. There is need to radicalise the way we view and utilise locally available resources in order to achieve sustainable development and quality education (Technical and Vocational Education and Training, 2010). If we look around our institutions today, we see technology tools like computers, smartphones, the Internet and social media which we can use in education. For example, many universities nowadays are using social media in teaching and learning. Instructional media can serve roles in both instructor-directed and instructor-independent instruction.

Mostly, media are used to support the “live” instructor in the classroom. Media can also be used effectively in formal education situations where a teacher is not available or is working with other students (Heinich, Molenda, Rusell, & Smaldino, 2002). Although the World Wide Web has not always given people the opportunity to interact in real time before, it is now possible to do so using social media such as Facebook (Ellefsen, 2016; Kanthawongs, Kanthawongs, & Chitcharoen, 2016), Skype and Twitter (Poore, 2013). The first version of the web (Web 1.0) was mainly a read-only web. The second generation of the Internet (Web 2.0), commonly described as ‘social media’, has given users the opportunity to publish their own material on the Internet and interact in real time. This is a great opportunity that teachers and learners can utilise for teaching and learning. For Heinich, Molenda, Rusell and Smaldino (2002), the term Web 2.0 or social media describes the tools, services and applications that the 'second generation' of the Internet provides. Social media that are used in education include blogs (Poore, 2013; Hong, 2008; Hussin, Aboswider, Ismail, & Yoke, 2016), wikis (Hadjerrouit, 2014; Craig, 2013; Aydin, 2014; Poore, 2013), podcasts (Koppelman, 2013; Poore, 2013; Phillips, 2017), Facebook (Mayisela, 2013), Twitter, Youtube and Google. Social media allow instantaneous and simultaneous commentary on, and or reaction to, material posted on the Internet. Social media also allow many-to-many communication as opposed to the Web 1.0, which is essentially a one-to-many medium. This opportunity for interactivity has not been utilised by education institutions in Malawi. From observation, the most commonly used teaching method in Malawian universities is the traditional lecture. As a result, many students do not participate actively in class. Section 2.4.1 below describes examples of innovative technologies that are used in some universities to ensure active participation by students which universities in Africa in general, and Malawi in particular could adopt or adapt.

2.4.1 Student Response Systems (SRSs)

There are many systems that are used in education to encourage students to participate actively in class. Such systems include, among others, *clickers* (sometimes called *zappers*), Socrative, Participoll, Edmodo, Nearpod, InfuseLearning, and Google Forms. A student response system is variously known as SRS, classroom response system (CRS), learner response system (LRS), audience response system (ARS), classroom feedback system (CFS), or simply as clickers or zappers (Mork, 2014). This is an interactive technology that allows an entire class of students to respond to questions that an instructor poses to them. It immediately collects the responses of the class and displays them on a screen (Carnegie Mellon University, 2016 & Kay and LeSage, 2009). According to Caldwell (2007), the system consists of small transmitters, a receiver and downloaded software. Students respond to multiple choice questions that a lecturer creates using the software by pressing on the corresponding buttons on keypads of the hand-held devices. While the "polling session" is still open the electronic signals from the students are sent wirelessly, in form of infra-red or radio waves (Educause Learning Initiative, 2005; and Caldwell, 2007), to a receiver connected to a computer. The signals are then computed into descriptive statistics as percentage distribution, mean, variance and standard deviation. When the "polls" are closed, the results are automatically diplayed on a projection screen for the whole class to see along with the statistics. The projected results can be used as feedback to the students (Mork, 2014) and the lecturer can organise peer discussion about concepts being covered using feedback from the class. Once this feedback is obtained, an instructor can respond by changing the course of instruction (Gok, 2011).

Lecturers ask questions during lectures to which all students are expected to respond using clickers, laptops, tablets or cell phones via the Internet. The questions could be related to the content that is about to be covered or they could be used as a review of content that was already covered (Gok, 2011). Student response systems allow lecturers to create, share, administer, and grade quizzes using formats like multiple choice, true/false, and short answer questions. Gok (2011) also found that clicker technologies are a tool to pace and modify instructors' teaching practice. Additionally, the technology provides an opportunity for instructors to think about the questions they ask their students during lectures. According to Mork (2014), response systems using clickers have actually been around since the 1960s but it is only more recently that they have been considered as suitable tools to promote active learning.

There is a great deal of literature on the challenges that large classes pose in terms of student-to-student and lecturer-to-student interactions (Mayer, et al., 2009; Gok, 2011; Bullock, et al., 2002). Some of the difficulties lecturers face in such environments include huge numbers of students that hinder personalised attention to every student (Bullock, et al., 2002), inadequate time for administering and grading in-class quizzes and management of such large classes (Gok, 2011). (Bruff, 2009) observed that student participation and motivation are low in such learning environments. It is thought that use of Student Response Systems (SRS) would address this problem. Additionally, Bruff (2009) asserted that SRS implementation in large classes gave students chance to do self-assessment and conduct peer assessment by allowing them to compare their understanding and performance with the others. Bullock, et al. (2002) agreed with this assertion by adding that clicker technology was the all-digital, cost-effective solution to the problem of large classes (approximately 200 undergraduate students) that could provide personalised student engagement. In their study in the Department of Physics at the University of Arkansas, they found that this technology created a better learning environment in a setting where there were many students while reducing operating costs (Bullock, et al., 2002). To ensure that students participated in class activities, Bullock, et al. (2002) tethered each student's transmitter to his or her identification (ID) and graded in-class quiz responses. They gave two points for a correct answer, one point for a wrong answer and zero for no answer. In conclusion, Bullock, et al., (2002) asserted that in-class and Internet-based technologies increased attendance, class participation and pre-class preparation as well as the number of students attempting homework. They found that the overall average exam scores increased significantly. Clickers were also observed to have stimulated more interactions and discussions among students, promoted class attendance, and enabled both summative and formative assessment to be conducted (Cardoso, 2011 & Mork, 2014). In a study to evaluate student response systems from the viewpoint of instructors and students, Gok (2011) stated that students at Dokuz Eylul University in Turkey enjoyed peer discussions and asked for more use of clickers because they felt that they had improved their learning.

The use of student response systems in education may be likened to B. F. Skinner's Stimulus-Response Theory. Here, it is assumed that learning takes place when a stimulus elicits a learner's response, which is then reinforced by feedback (Mork, 2014). Student response systems facilitate collaborative and active learning when students are allowed to discuss and share ideas during an SRS session. The SRS can be used for testing purposes because it is possible for the teacher to map and associate SRS devices with individual students although responses are anonymous to peers. Student response systems have been used to improve student motivation, engagement (Hall, Thomas, Collier, and Hilgers, 2005), increase attention (Cain, Black, and Rohr, 2009), increase class attendance, pre-class participation, and out-of-class activities (Bullock, et al., 2002), stimulate peer class discussions (Penuel, Boscardin, Masyn, and Crawford, 2007), provide feedback to students and teachers, improve instruction (Caldwell, 2007; and Gok, 2011), increase students' interest in course activities and totally enhance students' learning (El-Rady, 2006).

While there has been tremendous successs relative to student response systems, there are many challenges that have been reported. These challenges concern technology, instructors and students as described below.

Technology: Regarding technology, signals from some remote control devices could not be registerd on the lecturer's computer. This happened because the receiver was not able to receive more than one concurrent signal, or the transimetter had been out of range of the receiver (Gok, 2011). When this happened it became stressful to students especially when grades were to be awarded for an assessment. In addition, Caldwell (2007) and Reay et.al. (2005) reported that some students forgot or lost their remote controls and could thus not participate in class. For some, their clickers did not function properly (El-Rady, 2006; Hatch, Jensen, & Moore, 2005; Sharma, Khachan, Chan, & O'Byrne, 2005; Siau, Sheng, & Nah, 2006). The clicker system limited the questions to be asked to multiple choice and true-false questions because the system could capture quantitative data only (Gok, 2011).

Instructors: Instructor-based challenges included inadequate responses by lecturers to students' feedback. More so, less experienced lecturers were unable to respond to unforeseen difficulties in the SRS (Abrahamson, 2006; Hu, et al., 2006). These lecturers were unable to assist students in areas they found difficulties. Another common challenge many such instructors faced was coverage of the course content whenever SRSs were used (Beatty, et.al., 2004; Beatty, Leonard, Gerace & Beufresne, 2006; Burnstein & Lederman, 2001; d'Inverno, Davis & White, 2003; Burton, 2006; Cutts, 2006; Draper & Brown, 2004; Freeman, Bell, Comerton-Forder, Pickering & Blayney, 2007; Slain, Abate, Hidges, Stamatakis, & Wolak, 2004; Stuart, Brown, & Draper, 2004). Many instructors were not able to cover all the content they planned due to use of SRSs. Another challenge lecturers faced concerned the developing of questions. It was time consuming to create good SRS questions as reported by (Allen & Tanner, 2005; Beatty et.al., 2006; Boyle, 2006; El-Rady, 2006; Fagan, et.al., 2002; Freeman, et.al., 2007; Horowitz, 2006; Paschal, 2002 & Robertson, 2000). As can be seen from the aforesaid, it is imperative that lecturers plan the implementation of SRSs very carefully to ensure full coverage of content.

Students: Some students found it difficult to shift to the new way of learning because of its novelty (Allen & Tanner, 2005; Beatty, et.al., 2004; Fagan, et.al., 2002; Siau, et.al., 2006). Regarding new methods of learning, Kay (2009) observed that some students reacted adversely to the use of the SRSs because the overall approach to learning adversely changed. Since students were used to the traditional lectures, any change to the teaching methods led to stress, frustration, and resistance. More so, some students were distracted by the use of the SRSs. They found in-class discussions confusing or a waste of time as reported by (Draper & Brown, 2004; Nicol & Boyle, 2003; Reay, Li, Warnakulasooriya, & Baugh, 2005). In addition, too much effort was required by students when using the SRSs (Trees & Jackson, 2007). According to Caldwell (2007), using the SRSs for tests was not popular among students, and they did not like them either for monitoring attendance. Students want to remain anonymous (Abrahamson, 2006) when answering questions using SRSs and identifying them was not ideal. Some felt bad when they received negative feedback (Carnaghan & Webb, 2007). This then negatively affected their learning potentialities.

The SRSs based on clicking devices, downloaded software and receivers are expensive. This then has compelled educators in recent years to use web-based SRSs. With these systems around, one does not need to have expensive clicking devices, downloaded software, and/or receivers since online student response systems (OSRSs) are fast replacing classroom response systems (CRSs) or clickers (Mork, 2014). These virtual cloud-based systems give lecturers the freedom to use the technology in their classes without the need for institutional management to provide any special equipment. With regard to traditional clicker technology, Mork (2014) asserted that institutions usually make decisions on whether or not to adopt the technology. Importantly, OSRSs such as Socrative, Participoll and many others, are free. To access them, one only needs to have access to Internet enabled devices. Students do not need to have accounts in order to use them because they can enter the lecturer’s “classroom” code when he or she logs into the system (Mork, 2014). To this end, OSRSs are easy to implement because they allow students to use any browser and any mobile devices. Over and above this, Mork (2014) observed that their main superiority was their ability to motivate and engage students and enhance traditional teaching methods.

There is potential for OSRSs at Mzuzu University since many students have phones or personal laptops that have access to the Internet. Students could be asked to use WIFI hotspots on campus during lectures to respond to questions interactively using OSRS technology. Pinon (2015) described Socrative as a student response system that allows teachers to engage their learners with a series of educational exercises and games. It is a web-based platform that runs on any device with a web browser and Internet access (Mork, 2014). It is possible to save Quizzes for later use or sharing with other Socrative users. The advantage of Socrative is that it is accessible from any web-enabled device. Should lecturers want students to answer the quizzes at home, there is a feature that enables lecturers to leave quizzes for students to log in using access codes and complete the quizzes at home. Socrative has a feature that enables real-time questioning in the classroom. Lecturers can ask true/false or multiple-choice questions in class allowing all students to answer in real-time. These questions are typically written before class as lecturers are preparing lecture notes (Caldwell, 2007). Between two and five questions are asked in a 50-minute class session (Burnstein & Lederman, 2001; and Elliot, 2003). Sanfilippo (2015) noted that in a traditional classroom, not every student gets an opportunity to answer a question, but with Socrative every student would get that chance. Moreover, every response could be recorded and tracked by the instructor. Socrative is indeed an excellent tool for assessing students in the classroom environment. This is the reason many universities are now using it for such purposes. For example, Tokyo Woman's Christian University (TWCU) and Meiji University adopted Socrative OSRS in 2013 based on a colleague's recommendations regarding the viability of this system. These early adopters encouraged others to use this technology (Mork, 2014). It was easy to implement this innovation because all students except a very small percentage had smartphones. The minority that did not have smartphones borrowed from their peers who had already finished their activities on Socrative. Students accessed the system using their personal cell phone network providers, or institutions' Wi-Fi. It is interesting to note that when classes were conducted in computer laboratories, almost all the students preferred using their smartphones to computers. Mork (2014) speculated that the students chose phones because Internet connectivity in the computer laboratories was slow, and also that they found mobile phones more comfortable to use. Mork (2014) also found that the ability to respond anonymously to questions through Socrative encouraged students to participate actively in class activities. Even shy students answered questions without hesitation. To maximise the effectiveness of questioning, Mayer et al. (2009) recommended that lecturers should use conceptual questions after, rather than before the relevant portion of a lecture. Another benefit noted was that students found using Socrative distinctively enjoyable as it made learning more fun and exciting. This could be attributed partly to the uniqueness of the system. In addition, Mork (2014) was able to deduce from students' views on participation and enjoyment that Socrative was more motivating than other traditional forms. He found that SRSs facilitated group interaction, student self-assessment, mutual awareness building among students and student to student assessment. Likewise, SRSs stimulated discussions among students on relevant topics.

2.5 Learning theories

Heinich, Molenda, Russell and Smaldino (2002) defined learning as the development of new knowledge, skills, or attitudes as an individual interacts with information and the environment. Several theorists have postulated learning theories of which behaviourist, cognitivist, constructivist and social-psychological perspectives have been dominant over the past half century. Theories attempt to describe real-world phenomena in abstract terms (Poore, 2013). In education, theories help to explain complex issues in social and cognitive life to enable people elucidate how and why things happen the way they do. There are three broadly accepted theories of learning in education, which are behaviourism, cognitivism and constructivism.

Behaviourists believe that learning occurs through changes in behaviour, and is a function of the operations of stimulus-response. Behaviourists do not study the mind because they believe that internal mental processes cannot be observed and objectively measured. McLeod (2017) stated that behaviourism is only concerned with stimulus response behaviours that are observable. According to McLeod (2017), basic assumptions of behaviourism are as follows:

All behaviour is learned from the environment – Behaviourists assume that we learn new behaviour through classical or operant conditioning. Therefore, when we are born, our mind is a blank slate (tabula rasa).

Psychology should be seen as a science – Behaviourists believe that theories need to be supported by empirical data. The data that are used in these theories should be obtained through carefully controlled observation and measurement of behaviour.

Behaviourism is primarily concerned with observable behaviour, as opposed to internal events like thinking and emotion – Behaviourists study behaviour only because it can be objectively and scientifically measured although they accept the existence of cognitions and emotions.

There is little difference between the learning that takes place in humans and that in other animals - Behaviourists carry out research on animals and humans because they believe that there is no fundamental distinction between human and animal behaviour.

Behaviour is the result of stimulus-response – Behaviourists believe that all behaviour can be reduced to a simple stimulus-response association.

Cognitive theorists argue that learning occurs within the individual mind as the learner processes and stores knowledge internally. McLeod (2017) stated that cognitive psychologists scientifically study the mind as an information processor. They try to build up cognitive models of the information processing that they feel goes on inside people’s minds. These models consist of perception, attention, language, memory, thinking, and consciousness. According to McLeod (2017), the basic assumptions of cognitive psychologists include the following:

Mediational processes occur between stimulus and response – Cognitive psychologists believe that it is important to study mental processes of an organism and how these influence behaviour. They argue that mediational processes of the organism are important to understand behaviour.

Psychology should be seen as a science – Cognitive psychologists prefer objective and controlled scientific methods for investigating behaviour, just like the behaviourists. They use the results of their investigations for interpreting mental processes.

Humans are information processors – Cognitive theorists argue that information processing in humans is similar to that in computers, and is based on transforming, storing and retrieving information from memory.

However, constructivists argue that *"learning occurs within the mind but is also a collaborative, interactive process in which individuals create knowledge and meaning through experience and incorporate it into their existing frameworks for understanding"* (Poore, 2013, p. 10). The constructivists approach to teaching and learning, which is the focus of this study, stresses the learner's active participation in knowledge construction and in the learning process. Constructivists believe that learners use their own prior knowledge and experience to build new understandings of the world. Heinich, Molenda, Rusell and Smaldino (2002) agreed with Poore (2013) by stating that constructivism *"considers the engagement of learners in meaningful experiences as the essence of learning"* (p. 360). Constructivists believe that learners create their own interpretations of information when they are involved in active problem solving. One way to facilitate active learning is to use social media. Social constructivism holds that social relations and social interactions are key components of learning (Poore, 2013). The digital nature of social media like wikis for example, forces the social construction of knowledge in learners. Social networking compels learners to share information. Two key features of discovery learning are problem solving and independence, which social media encourage. Discovery learning posits that it is the meaning that learners create for themselves that is important to the learning process. Use of social media helps learners to construct new knowledge and consolidate the old knowledge as they engage in learner-centred and inquiry-based educational activities. The interactive nature of social media encourages peer learning because students can work together to construct and share understanding (Poore, 2013). Social media are used in education because they allow instructors to devise social tasks for learners.

Heinich, Molenda, Rusell, and Smaldino (2002) believed that effective learning happens when teachers engage students in meaningful tasks while actively interacting with the content. This view is supported by Poore (2013) who stated that what the students do during a teaching and learning session has the most value for learning and social media can sustain active learning situations. Social media also support cooperative learning. In this type of learning, students in small heterogeneous groups are required to participate actively on tasks to achieve academic goals. Students eventually take more responsibility for their learning as they work together in groups or in collaboration with the teacher on learning projects (Heinich, Molenda, Rusell, & Smaldino, 2002). Cooperative learning is advantageous because it promotes active learning. Students also acquire social skills as they interact with each other thereby developing interpersonal, communication, leadership, compromise, and collaborative skills. Positive interdependence and accountability are developed as students interact to reach a common goal or understanding. When a group's success depends on the input of each individual, students learn to be accountable for their actions. One of the challenges of cooperative learning is the difficulty of forming groups of students that will work together well. It is therefore incumbent upon the teacher to know his/her students well in order for him or her to form groups that will function effectively. If a teacher allows the best student to “carry” the others along, he/she may create dependency and defeat the purpose of cooperative learning. Another challenge is that cooperative learning is time consuming because it requires more time to cover the same amount of content than do the other methods.

If used appropriately, social media can have many benefits in an educational setting because they provide excellent tools for socialising students into the online world and for teaching them about online communication practices. However, Heinich, Molenda, Rusell, & Smaldino (2002) have warned that instructors should design teaching and learning tasks that demand deep, considered engagement with a topic, to enable students focus on the learning activity. In order to intelligently integrate social media in education, Heinich, Molenda, Rusell, and Smaldino (2002) have advised instructors to design tasks that require higher-order cognitive activity. These tasks should involve creativity, synthesis and evaluation.

For learning to occur effectively, learners should be engaged in tasks that are authentic and relate well to contexts that have meaning to them. Other technologies that fit very well in the constructivism theory are the Student Response Systems (SRS) because they encourage active participation of students in the learning process.

In order to understand opportunities that educational institutions can take advantage of and challenges that may hinder technology adoption, the researcher analysed several theories and models which are presented in the following section.

2.6 Theories and Models of Technology Acceptance

Digital technology has changed the way people learn. The 21st Century has seen learners use the Internet, mobile technology and other technologies in their quest to learn. Yates (2001) observed that nowadays media literacy is becoming an essential part of the school curricula. This change in the learning style demands innovation in the teaching and learning processes. While this is the reality, however, the way people perceive the newness of an innovation governs the way they react to it. Some will of course adopt and use the innovation without much-ado while others may not. There are many competing theories and models on acceptance of technology according to (Sharma & Chandel, 2013). Although *theory* and *model* are related terms, there is a difference between the two. According to Oxford University (2012), the distinction between a theory and a model is that the former is *"a set of principles on which an activity is based"* (p. 758), while the latter is *"something used as an example"* (p. 464). Some of the theories and models of technology acceptance include:

1. Theory of Reasoned Action (TRA)
2. Social Cognitive Theory (SCT)
3. Technology Acceptance Model (TAM)
4. The Motivational Model
5. Diffusion of Innovations (DOI)
6. Theory of Planned Behaviour (TPB)
7. Decomposed Theory of Planned Behaviour (DTPB)
8. Combined TAM and TPB (C-TAM-TPB)
9. Technology Acceptance Model 2
10. The Unified Theory of Acceptance and Use of Technology (UTAUT)

Each theory or model has its own acceptance determining factors and benefits. The following section presents analyses of selected five theories and models, which are Theory of Reasoned Action, Theory of PC Utilisation, Technology Acceptance Model, Unified Theory of Acceptance and Use of Technology and Diffusion of Innovations theory. These theories and models have been selected because they have aspects that this study used.

2.6.1 Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) was developed by Ajzen and Fishbein in 1980 and it originated from social psychology. It is one of the most fundamental and prominent theories of human behaviour. The TRA has three general constructs: Behavioural Intention (BI), Attitude (A), and Subjective Norm (SN). These constructs are defined as follows:

- Behavioural Intention (BI) is a person's supposed likelihood to engage in a given behaviour;
- Attitude (A), is how someone views and evaluates something or someone (Oxford University Press, 2015);
- Subjective Norm (SN), is a person’s perceptions or assumptions about other people’s expectations of certain behaviours that one will or will not perform (Huda, Rini, Mardoni, & Putra, 2012).

The Theory suggests that *"a person's behaviour is determined by his/her intention to perform the behaviour and that this intention is, in turn, a function of his/her attitude towards the behaviour and his/her subjective norm"* (University of Twente, 2010). Simply put, the TRA can be summarised by the following equation: (BI = A + SN). An expanded TRA flow can then be expressed as follows:

Belief toward an outcome	Attitude	Intention	Behaviour
Evaluation of the outcome			
Beliefs of what others think	Subjective norm		
What experts think			
Motivation to comply with others			

Figure 2-1 Theory of Reasoned Action

Source: Ajzen, 1980

This theory is based on the assumption that people are rational decision-makers. On the same notion, Sharma and Chandel (2013) stressed that people always evaluate their beliefs when forming attitude towards their behaviour. The theory has been applied in many disciplines including IT and health as illustrated in the following three examples.

Mishra, Akman and Mishra (2014) investigated behaviour for the adoption of Green Information Technology (GIT) among IT professionals from major public and private sector establishments. The respondents were IT professionals who came to attend an annual one-day seminar that was organised by the Turkish Informatics Association on issues in the use of IT in organisations. The study established that intentions influence behaviour positively. The study also found that the IT professionals who had positive intentions towards GIT were practicing GIT at their workplace. Results also established that external factors such as personal beliefs and individual level of awareness had significant impact on attitude towards the adoption of GIT.

Another study by Jemmott and Jemott III (1991) showed positive correlation between attitude and use of technology. This study tested attitudes and normative influences on intentions to use condoms by sexually active black unmaried undergraduate women at an inner-city commuter university in New Jersey. Multiple regression analysis on responses that were mailed anonymously by the participants showed that those respondents who registered positive attitudes towards the use of condoms reported stronger intentions to use condoms than those who showed negative attitude.

Likewise, Doane, Pearson and Kelley (2014) applied the TRA to explain cyberbullying perpetration among 375 college students in Southeastern Virginia. Four types of cyberbullying that were studied were deception, malice, public humiliation, and unwanted contact. The results showed that lower empathy toward cyberbullying victims predicted more favourable attitudes toward cyberbullying perpetration. It was also found that more favourable attitudes toward cyberbullying predicted higher intentions to cyberbully others. The results also indicated that higher cyberbullying intentions predicted more frequent perpetration of cyberbullying behaviours.

From the examples above one can safely conclude that behaviour is a result of specific intentions. It may thus be argued that a person's adoption and use of an innovation is a function of his/her intention to do so. It would be logical then, to conclude that people who show positive attitude towards innovation in eduction would adopt and use the innovative ways of teaching and learning. Attitude was incorporated as a variable in the eclectic model of this study. Attitude, which has been defined by Fishbein and Ajzen (1975) as *"a person's general feeling of favourableness or unfavourableness toward some stimulus object"* (p. 216) was one of the constructs that was selected for this study. It was assumed that if individuals with positive attitude towards technology were included in the study, the concept of using technology for educational purposes would be adopted easily. This construct was adopted from TRA.

2.6.2 Model of PC Utilisation

Thompson, Higgins and Howell (1991) observed that organisations invest heavily in personal computers for their employees. However having access to technology does not necessarily mean that the technology will be used. They then adapted the TRA which was developed by Ajzen and Fishbein (1980), to investigate factors that influence use of personal computers. Their study tested the following hypotheses:

> *H1: There will be a positive relationship between social factors concerning PC use and the utilisation of PCs.*

Social Factors are defined as *"individual's internalisation of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations"* (Thompson, Higgins & Howell, 1991 p. 126).

> *H2: There will be a positive relationship between affect toward PC use and the utilisation of PCs.*

Affect towards PC use are *"feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act"* (Thompson, Higgins & Howell, 1991 p. 127).

> *H3: There will be a negative relationship between the perceived complexity of a PC and the utilisation of PCs.*

Perceived complexity is *"the degree to which an innovation is perceived as relatively difficult to understand and use"* (Thompson, Higgins & Howell,1991 p. 128).

> *H4: There will be a positive relationship between perceived job fit and the utilisation of PCs.*

Job-fit is *"the extent to which an individual believes that using [a technology] can enhance the performance of his or her job"* (Thompson, Higgins & Howell, 1991 p. 129).

H5: There will be a positive relationship between perceived long-term consequences of use and the utilisation of PCs.

Long-term consequences are defined as *"Outcomes that have a pay-off in the future"* (Thompson, Higgins & Howell,1991 p. 129).

H6: There will be a positive relationship between facilitating conditions for PC use and the utilisation of PCs.

Facilitating conditions - *"provision of support for users of PCs may be one type of facilitating condition that can influence system utilisation"* (Thompson, Higgins & Howell, 1991 p. 129).

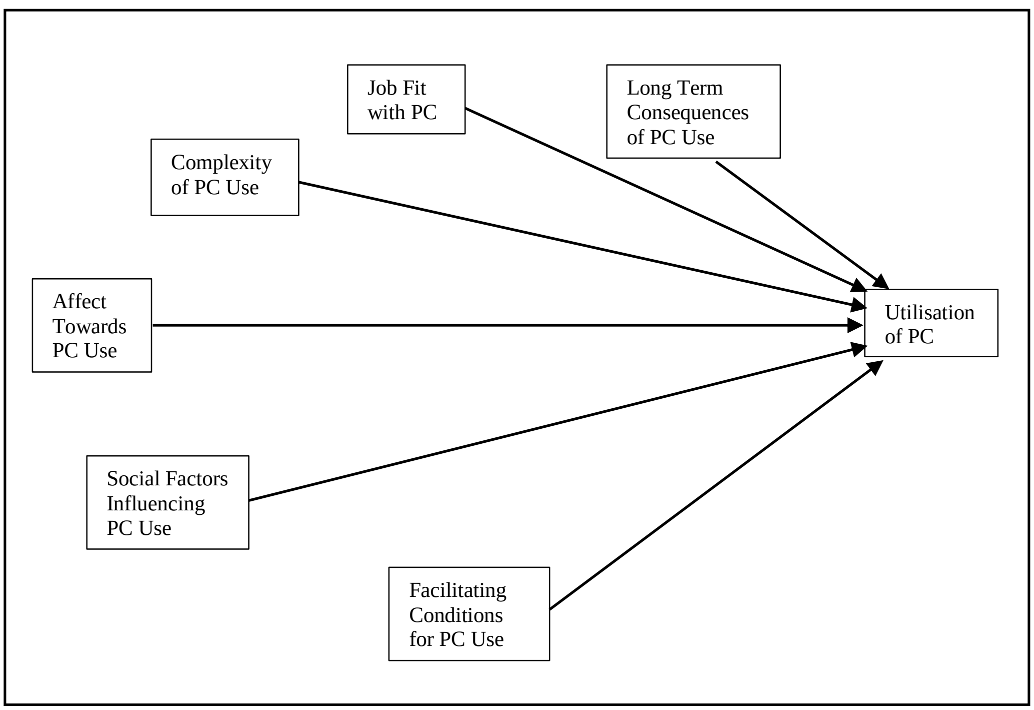


Figure 2-2 Factors Influencing the Utilisation of Personal Computers
Source: Thompson, Higgins and Howell (1991)

Support was found for Hypotheses H1, H3, H4 and H5. This means that social factors, complexity, job fit, and long-term consequences had significant effects on PC use but there was no evidence to suggest that affect and facilitating conditions had influence on PC use. The flow diagram of their theory showing the relationship among the six constructs and utilisation of PCs is shown in Figure 2-2.

Behaviour is determined by attitudes, social norms, habits and expected consequences of the behaviour (Al-Khadi & Wallace, 1999). In order to get a better perspective on the factors that influence the use of PCs, Al-Khadi and Wallace (1999) conducted a study to investigate the relationships between end-users' attitudes and PC utilisation among knowledge workers in Saudi Arabia. One of the objectives of the study was to ascertain attitudes of knowledge workers toward PC use in Saudi Arabia and determine if their attitudes were similar to their counterparts in Canada. In order to make this comparison they replicated a study by Thompson, Higgins and Howell (1991) who conducted a similar study in Canada.

In line with Thompson et al., they hypothised that:

H1: There is a positive relationship between social factors concerning the use of PCs and PC utilisation.

H2: There is a positive relationship between affect and PC utilisation.
H3: There is a negative relationship between perceived complexity and PC utilisation.

H4: There is a positive relationship between perceived long-term consequences of PC use and PC utilisation.

H5: There is a positive relationship between supporting facilitating conditions and PC utilisation.

H6: There is a positive relationship between PC training and PC utilisation.

H7: There is a positive relationship between the degree of access to the PC and PC utilisation.

H8: There is a positive relationship between the extent of PC experience and PC utilisation.

H9: There is a positive relationship between education level and PC utilisation.

H10: There is a negative relationship between age and PC utilisation.

The two research questions that Al-Khadi and Wallace (1999) were interested in were:

1. What are the essential differences between the perceptions of respondents in Saudi Arabia and of Canadian respondents?
2. Do different attitude constructs have differing effects on PC utilisation in Saudi Arabia and Canada?

Their findings showed that the significant contributing factors to PC utilisation for the Saudis were Perceived Social Factors, Affect, Job Performance Facilitation, and Facilitating Conditions like the Canadian respondents. However, they found that the Complexity and Long-Term consequences were not significant predictors of PC utilisation.

Apart from attitude, other variables that were considered in the design of this study included social factors, perceived complexity, perceived job fit and facilitating conditions. There is great likelihood for social factors to influence the spread of technology through interpersonal interactions that happen among individuals in social settings. In addition, individuals are more likely to use technologies they perceive less complex to understand and use, especially for those who are technophobic. The researcher feels that people will adopt and use something they trust will enhance their job performance. It is very difficult for some people to accept something they feel is irrelevant to what they do. The researcher believes that technology adoption may be enhanced by providing facilitating conditions. For example, management can offer users of technology support through provision of free access to e-learning technologies such as the Internet and computers.

A closely related construct to attitude that was isolated for the study was *affect*. It was generally felt that acceptance of technology would be easy for individuals who found use of technology pleasurable. This concept which was adopted from PC Utilisation theory, was incorporated into the current study.

2.6.3 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was proposed by Davis (1986). It assumed that an individual's acceptance of information systems is determined by *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEOU) (Lee, Kozah, & Larsen, 2003). Davis (1989) and Davis, Bagozzi, and Warshaw (1989) defined *Perceived Usefulness* as *"the degree to which a person believes that using a particular system would enhance his or her job performance."* They defined PEOU as *"the degree to which a person believes that using a particular system would be free of effort."* The TAM is similar to TRA and postulates that computer usage is determined by BI, but it differs from TRA in that BI is viewed as "*being jointly determined by the person's attitude toward using the system (A) and Perceived Usefulness (U), with relative weights estimated by regression: BI* = *A* + *U*" (Davis, Bagozzi, & Warshaw,1989). The TAM flow model is illustrated in the Figure 2-3.

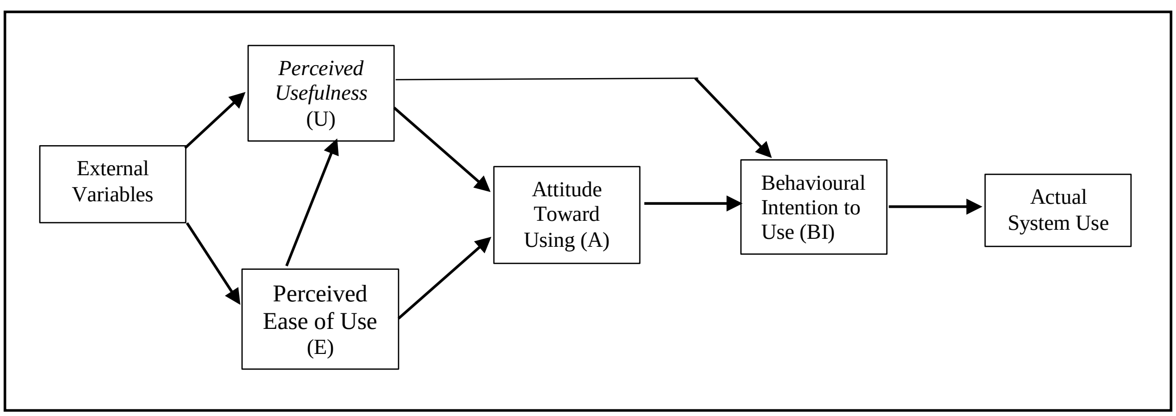


Figure 2-3 Technology Acceptance Model
From Davis, Bagozzi, and Warshaw (1989)

Similarly, Sharma and Chandel (2013) observed that PU has been used by many information system researchers. They also noted that TAM was developed to find out the factors which make people accept or reject IT. Technology Acceptance Model replaced the determinants of attitude of TRA by *Perceived Ease of Use* and *Perceived Usefulness*. Sharma and Chandel (2013) reported that Davis (1989) and Davis, Bagozzi, and Warshaw (1989) found that *Perceived Usefulness* is the strongest predictor of individual's intention to use information technology. TAM has been applied to different technologies like word processors, email, the World Wide Web and Hospital Management Systems and researchers in the information science field still use the theory in their studies (Lee, Kozah, & Larsen, 2003).

Having observed that there was a tremendous increase in the use of and demand for e-learning among university students, Sharma and Chandel (2013) felt the need to investigate factors that influence use and acceptance of e-learning in order to make it an effective tool in education. The focus of their study was on individual acceptance as opposed to organisational level. They formulated the folowing research questions for their study: (1) What are the main constructs that are affecting student's intention to use websites for learning? (2) What is the degree of strength of the relationship among these constructs? (3) What is the order of importance of these constructs? In their study, Sharma and Chandel (2013) added three more constructs to TAM: Perceived Web Quality (PWQ), Computer Self-Efficacy (CSE) and Attitude torwards e-learning (ATT). Their proposed model is illustrated in Figure 2-4.

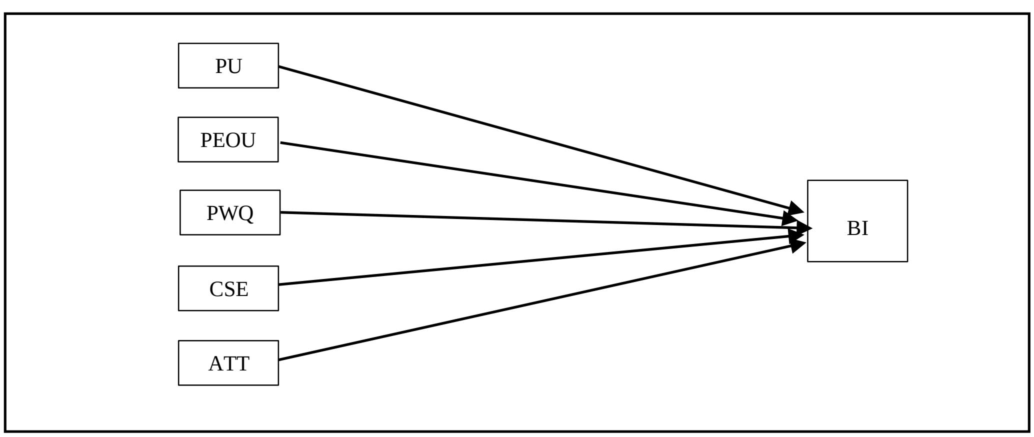


Figure 2-4 Technology Acceptance Model by Sharma and Chandel (2013)

Sharma and Chandel (2013) tested the following hypotheses in their research model:

H1: there is a positive relationship between Perceived Usefulness and behavioural intention.

H2: there is a positive relationship between Perceived Ease of Use and behavioural intention.

H3: there is a positive relationship between perceived website quality and behavioural intention.

H4: there is a positive relationship between computer self-efficacy and behavioural intention.

H5: there is a positive relationship between attitude towards e-learning and behavioural intention.

The researchers used parametric statistical techniques to test the proposed research hypotheses and found that all five constructs had positive relationship with Behavioural Intention. The possible constructs that can be used in this study from Sharma and Chandel (2013) findings are PU, CSE and ATT. This decision has been arrived at because this study requires use of computers hence computer self-efficacy is mandatory. Integration of technology in teaching and learning requires people with positive attitudes towards use of technology in education if they are to accept the innovation. Additionally, if an individual perceives that use of technology in his/her job is useful, then it is likely that he/she will adopt and use it.

In a similar study, Lederer, Maupin, Sena and Zhuang (2000) validated TAM with the World Wide Web as the users' application. The study confirmed that use of Websites depends on the usefulness and ease of use of that Website. Another study by Teo, Lim and Lai (1999) found that both usefulness and ease of use were predictors of usage but usefulness had a stronger effect.
Although the role of IT has increased significantly in education, however Hu, Clark and Ma (2003) noted that resistance to technology by public school teachers

worldwide was still far too high. They also observed that older public school teachers did not have technology know-how partly because they received their training when technology was less developed. This then, coupled with demanding workload and strict time constraints prevented the teachers from accepting the technology. This observation forced Hu, Clark and Ma (2003) to conduct a longitudinal study, in cooperation with the Hong Kong Professional Teachers' Union, to examine teachers' acceptance and decision-making at the beginning and the end of a four-week intensive PowerPoint training programme. In their study, they tested the following hypotheses:

H1. The degree to which a teacher considers PowerPoint to be useful has a positive effect on his or her intention to accept the technology.

H2. The degree to which a teacher considers PowerPoint to be easy to use has a positive effect on his or her intention to accept the technology.

H3. The degree to which a teacher considers PowerPoint to be easy to use has a positive effect on his or her perception of the technology's usefulness.

H4. A teacher's perceived subject norm concerning acceptance of PowerPoint has a positive effect on his or her intention to accept the technology.

H5. A teacher's perceived subject norm concerning acceptance of PowerPoint has a positive effect on his or her perception of the technology's usefulness.

H6. The degree to which PowerPoint is perceived to be relevant to a teacher's job has a positive effect on his or her perception of the technology's usefulness.

H7. A teacher's (perceived) computer self-efficacy has a positive effect on his or her intention to accept PowerPoint.

H8. A teacher's (perceived) computer self-efficacy has a positive effect on his or her perception of PowerPoint's Ease of Use.

H9. The degree to which PowerPoint is considered by a teacher to be compatible to the computer hardware and software of routine use at school or at home has a positive effect on his or her perception of PowerPoint's usefulness.

H10. The degree to which PowerPoint is considered by a teacher to be compatible to the computer hardware and software of routine use at school or at home has a positive effect on his or her perception of PowerPoint's Ease of Use.

According to their model, a teacher's decision to accept or reject a technology is directly affected by his or her perception of the following constructs: the usefulness of the technology, Ease of Use of the technology, computer self-efficacy and subjective norm. They proposed that the teacher is likely to consider a technology to be useful when it is easy to use. Hu, Clark, and Ma (2003) found that *Perceived Usefulness* is a critical determining factor for technology acceptance. They further noted that a teacher is likely to consider a technology useful if it is relevant to his or her job. These findings mean that we have to find technologies that users perceive relevant to their professions if the technolgies are to be accepted and used.

Subjective norm was seen to be a significant driver of acceptance at the beginning of the course but its importance declined as the participants became more and more experienced in using PowerPoint. This suggested that people who advocate use of technology should foster a positive community norm when they introduce a new technology because this will create initial technology acceptance. Afterwards, the technology adopters should be helped in acquiring more knowledge and skills in using the technology. Their model, which is based on TAM is illustrated below:

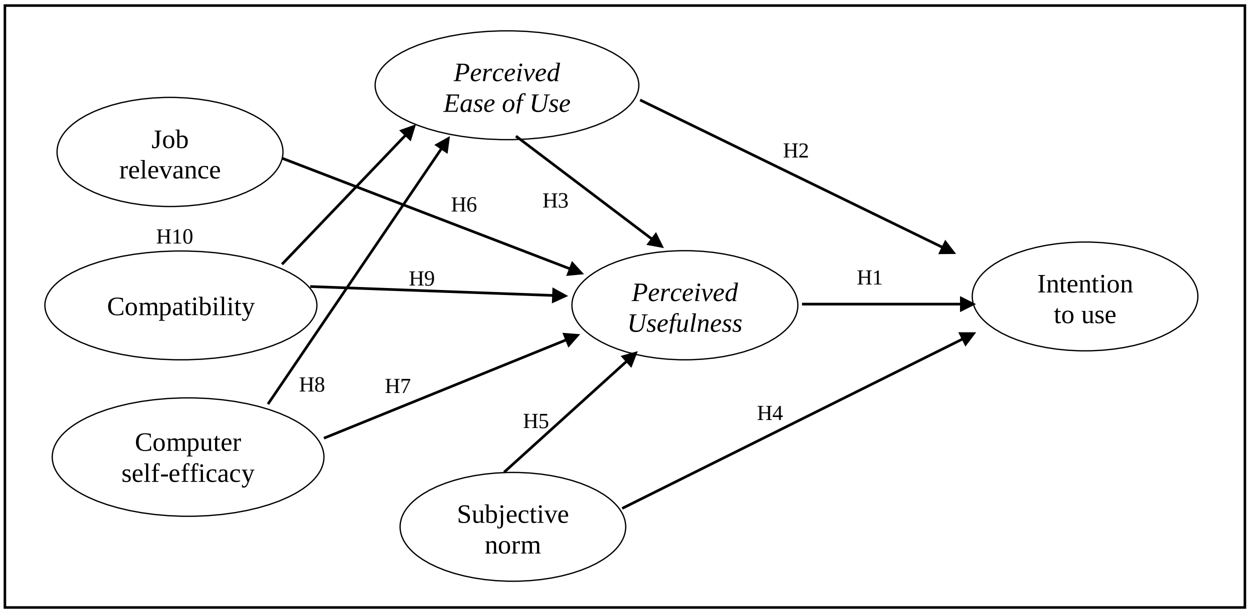


Figure 2- 5 Model proposed by Hu, Clark and Ma (2003)

The study also found that *Perceived Ease of Use* had limited direct influence on users' technology acceptance. The implication then was that users were unlikely to accept a technology merely because it is easy to use. *Perceived Ease of Use* will have a positive effect on user acceptance when the users see that the technology is useful. Consequently, continued training and user support are necessary to ensure that users find it easy to use the technology after they adopt it.

Analysis of computer self-efficacy, which referred to an individual's judgement of his or her ability to use a computer (Compeau & Higgins, 1995), showed that it had an effect on technology acceptance. In general, Hu, Clark, and Ma (2003) found that most of their hypotheses were supported. They however warned that the study had several limitations hence generalisation of the findings should be done with caution. One of the limitations was that results were obtained from a single study. Another limitation was on the sample used which was not random and did consist of only teachers attending a training that was designed for technology competency certification.

The variables PU and PEOU from TAM are applicable to this study. *Perceived Usefulness* is similar to the variable job fit from the Model of PC Utilisation while PEOU has similar characteristics to the variable Complexity. These variables were incorporated in the design of this study as well as attitude. The researcher of this study felt that if *Perceived Usefulness* were used in selecting participants for this study, integration of technology in education would be achieved. So, this construct was used when selecting participants for Phase Two.

2.6.4 Diffusion of Innovations (DOI)

The DOI theory tries to explain how innovations are adopted in a population. It is thus defined as the *"process by which an innovation is communicated through certain channels over time among the members of a social system"* (Rogers, 2003, p. 5). The DOI theory has been used since the 1960s to study a variety of innovations, ranging from agricultural tools to organisational innovation (Tornatzky & Klein, 1982).

There are five perceived attributes of innovations as postulated by Rogers (2003), namely: *relative advantage, compatibility, complexity, trialability and observability*. *Relative advantage* is the degree to which an innovation is seen as better than the idea it replaces. An individual is more likely to adopt an innovation if he or she thinks that it is advantageous. *"The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be"* (p. 15). Confirming this assertion, Ostlund (1974) argued that individuals with positive perceptions about an innovation have high probability of adopting the innovation. The potential adopters of a new idea must be introduced to the merits of the innovation.

The second attribute according to Rogers (2003) is *compatibility*. This is the degree to which an innovation is seen as being consistent with the existing values, past experiences, and needs of potential adopters of a new idea. Norms and values of a social system are very crucial at determining whether an idea is adopted or not. An innovation that is incompatible with the value system of a society will not be adopted. Rogers (2003) affirmed that, *"the adoption of a new incompatible* *innovation often requires the prior adoption of a new value system, which is relatively slow process*" (p.15).

The third perceived attribute of diffusion of a new idea is *complexity*. This is the degree to which potential adopters perceive the difficulty to understand and use the innovation. This attribute will determine the rate of diffusion of a new idea in a society. The easier a new idea is to be understood the more rapidly it will be adopted because it requires the adopters to spend little time to develop new skills and understand it.

Rogers (2003) described the process of experimenting with an innovation on a limited basis as *trialability*. New ideas that can be tried on a pilot basis diffuse quickly. *Trialability* of an innovation is important to reduce uncertainty on the part of an individual who is considering it for adoption because as it is easier to learn by doing.

Another important attribute of diffusion of innovations is *observability*, which Rogers (2003) termed "*peer-to-peer networks*" (p.16). People are likely to adopt an innovative idea more easily if they can clearly see the results of the innovation. This happens because such visibility stimulates the peers to discuss the new ideas.

Innovations that will be adopted more easily are the ones that people perceive to have greater relative advantage, compatibility, trialability, observability and are less complex to use and understand. These five characteristics of an innovation are very important to explain the rate of adoption. However, Rogers (2003) stressed that the first two qualities, *relative advantage* and *compatibility*, are particularly important to explain the rate at which an innovation is adopted. In line with Rogers (2003) findings, other research findings have consistently shown that technical compatibility, technical complexity and relative advantage are important precursors to the adoption of innovations (Bradford & Florin, 2003; Crum, Premkumar, & Ramamurthy, 1996).

Another important concept of diffusion worth mentioning is *re-invention*, which Rogers (2003) defined as *"the degree to which an innovation is changed or modified by a user in the process of adoption and implementation"* (p.17). Some innovations undergo considerable *re-invention* while others are difficult to be re-invented. Adopting an innovation is an active process where adopters customise the innovation to suit their needs. Research has found that an innovation that can be re-invented by its adopters diffuses more easily and is more likely to be sustained. Variables that determine the rate of diffusion of an innovation are shown in Figure 2-6.

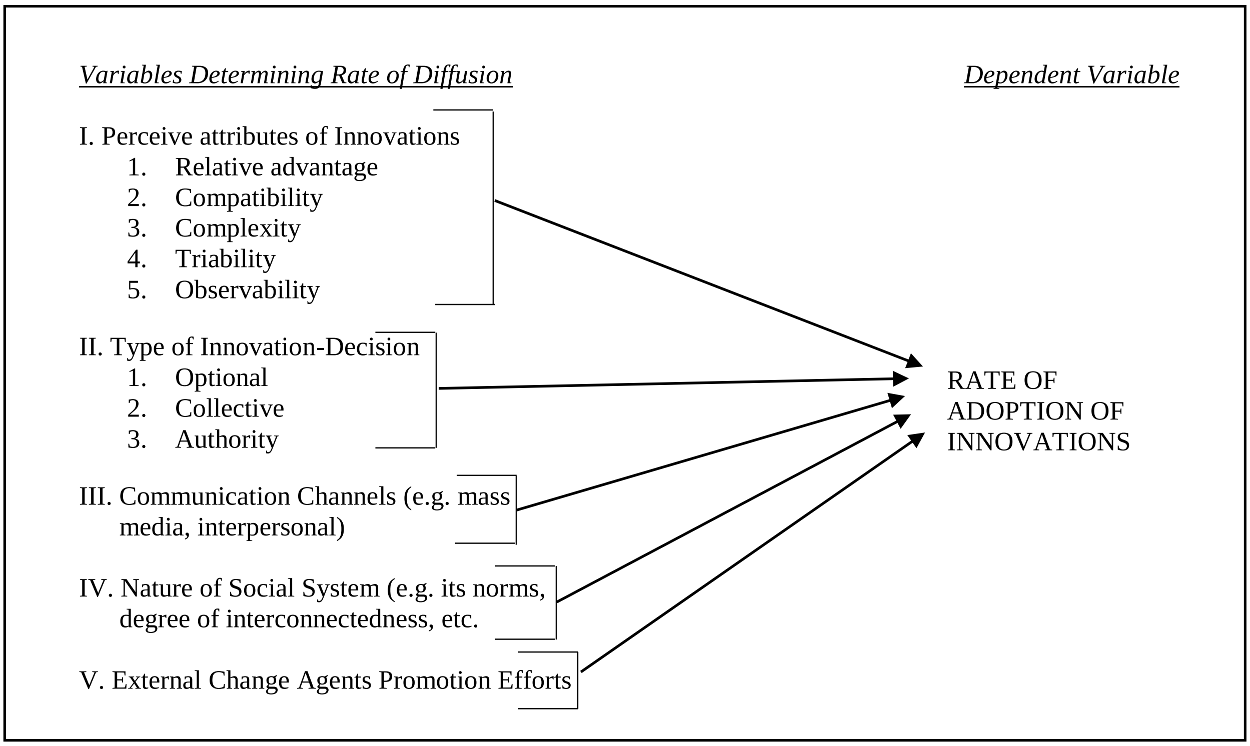


Figure 2-6 A paradigm of variables determining the rate of adoption of innovations
Source: Rogers (1983)

The rate of adoption is defined as *"the relative speed with which an innovation is adopted by members of a social system. It is generally measured as the number of individuals who adopt a new idea in a specified period, such as a year"* (Rogers, 1983, p. 221). Moore and Benbasat (1991) who were working in an IT context expanded Rogers' five perceived attributes of innovation to eight. They proposed that the following eight attributes impact the adoption of IT: *voluntariness, relative* *advantage, compatibility, image, Ease of Use, result demonstrability, visibility* and *triability.*

The variables that the researcher believed were relevant to the proposed study from the DOI theory included *relative advantage, compatibility, complexity, triability, observability, optional type of innovation decision, interpersonal communication channel* and *external change agents' promotion efforts.* Consideration to include these variables in the study were made during the design stage of the study.

2.6.5 The Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT was formulated by Venkatesh, Morris, Davis, and Davis (2003) based on conceptual and empirical similarities across eight technology acceptance models. In their study, they:

1) reviewed user acceptance literature and discussed eight prominent models,
2) empirically compared the eight models and their extensions,
3) formulated a unified model that integrated elements across the eight models, and
4) empirically validated the UTAUT model.

The analysis of the models of technology acceptance made them theorise that the following constructs would have significant roles as direct determinants of user acceptance and usage behaviour: *performance expectancy*, defined as *"the degree to which an individual believes that using the system will help him or her to attain gains in job performance"* (p. 447); *effort expectancy,* defined as *"the degree of ease associated with the use of the system"* (p. 450); *social influence*, defined as *"the degree to which an individual perceives that important others believe he or she should use the new system"* (p. 451) and *facilitating conditions*, defined as *"the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system"* (p. 453). Constructs that were theorised *not* to be direct determinants of intention were *attitude toward using technology*, *self-efficacy* and *anxiety.* Their research model is illustrated in Figure 2-7.

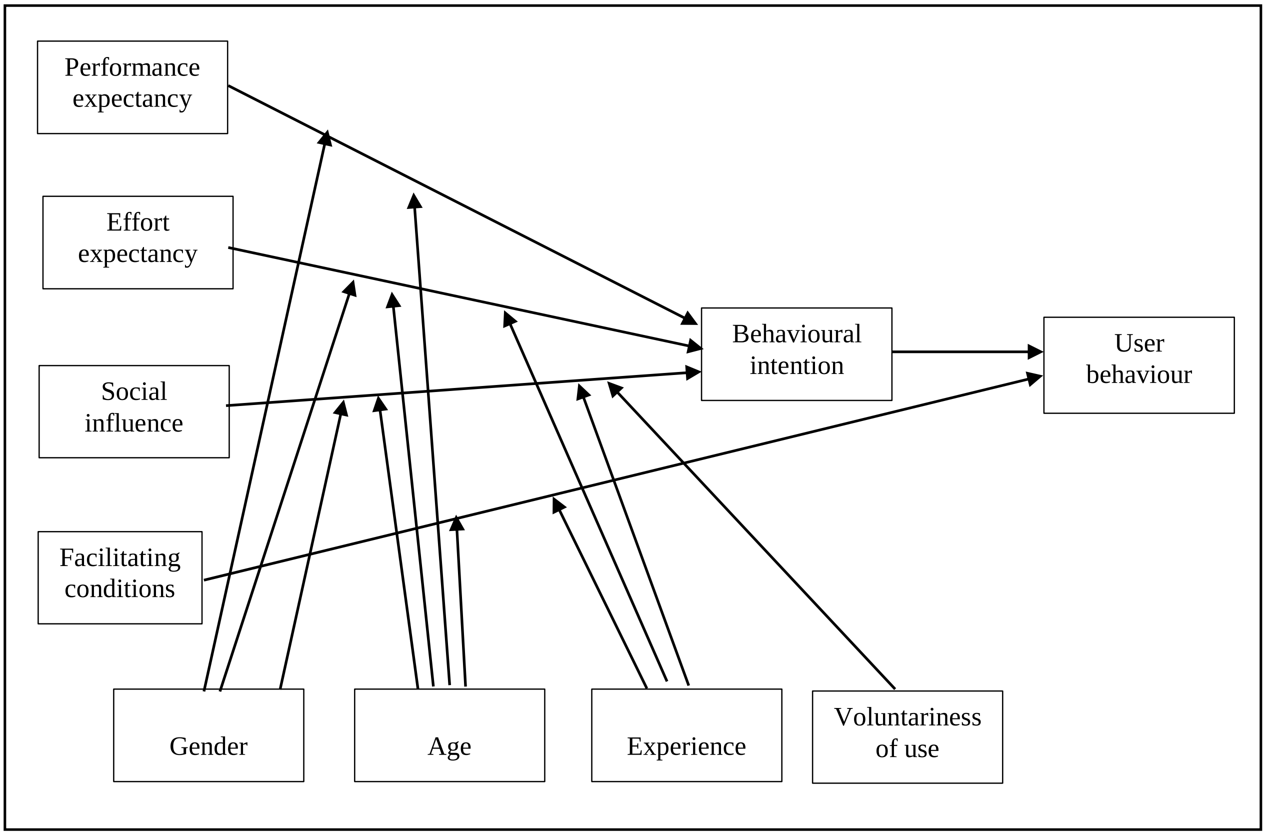


Figure 2-7 Model proposed by Venkatesh, Morris, Davis and Davis (2003)

The following are hypotheses proposed by Venkatesh, Morris, Davis and Davis (2003) and findings of their study:

> *H1: The influence of performance expectancy on behavioural intention will be moderated by **gender** and **age**, such that the effect will be stronger for men and particularly for younger men.*

The study revealed that the effect was stronger for men and particularly younger workers. Performance expectancy appeared to be a determinant of intention in most situations. However, the strength of the relationship varied with gender and age. The effect was more significant for men and younger workers.

*H2: The influence of effort expectancy on behavioural intention will be moderated by **gender**, **age**, and **experience**, such that the effect will be stronger for women, particularly younger women, and particularly at early stages of experience.*

The findings of the study revealed that the effect of effort expectancy on intention was also moderated by gender and age. The effect was more significant for women and older workers, and those effects decreased with experience.

> *H3: The influence of social influence on behavioural intention will be moderated by **gender**, **age**, **voluntariness**, and **experience**, such that the effect will be stronger for women, particularly older women, particularly in mandatory settings in the early stages of experience.*

The effect of social influence on intention is dependent on all four moderators (gender, age, experience and voluntariness of use). Researchers found it to be non-significant when the data were analysed without the inclusion of these moderators. The effect was stronger for women, older workers, under conditions of mandatory use, and when workers had limited experience.

> *H4a: Facilitating conditions will **not** have a significant influence on behavioural intention.*

It was found that the effect of facilitating conditions on behavioural intentions was non-significant due to the effect being captured by effort expectancy.

> *H4b: The influence of facilitating conditions on usage will be moderated by **age** and **experience**, such that the effect will be stronger for older workers, particularly with increasing experience.*

The findings showed that the effect of facilitating conditions on usage was only significant when examined in combination with the moderating effects of age and experience. The effect was stronger for older workers with increasing experience.

> *H5a: Computer self-efficacy will **not** have a significant influence on behavioural intention.*

Researchers found that the effect of self-efficacy on behavioural intention was non-significant due to it being captured by effort expectancy.

> *H5b: Computer anxiety will **not** have a significant influence on behavioural intention.*

The findings revealed that the effect of computer anxiety on behavioural intention was non-significant due to it being captured by effort expectancy.

> *H5c: Attitude toward using technology will **not** have a significant influence on behavioural intention.*

The researchers found that the effect of attitude on behavioural intention was non-significant due to it being captured by process expectancy and effort expectancy.

> *H6: Behavioural intention will have a significant positive influence on usage.*

The constructs from the UTAUT theory that were considered for inclusion in the design of the proposed study included performance expectancy, effort expectancy, social influence, facilitating conditions and attitude towards using technology. The researcher believes that an individual is likely to adopt and use technology if he or she believes that using the system will help him or her to advance in job performance. Also, the individual is likely to use a technology that is easy to use.

The findings showed that behavioural intention had direct effect on usage. The basic concept that summarises the technology acceptance theories into three basic steps is illustrated in Figure 2-8.

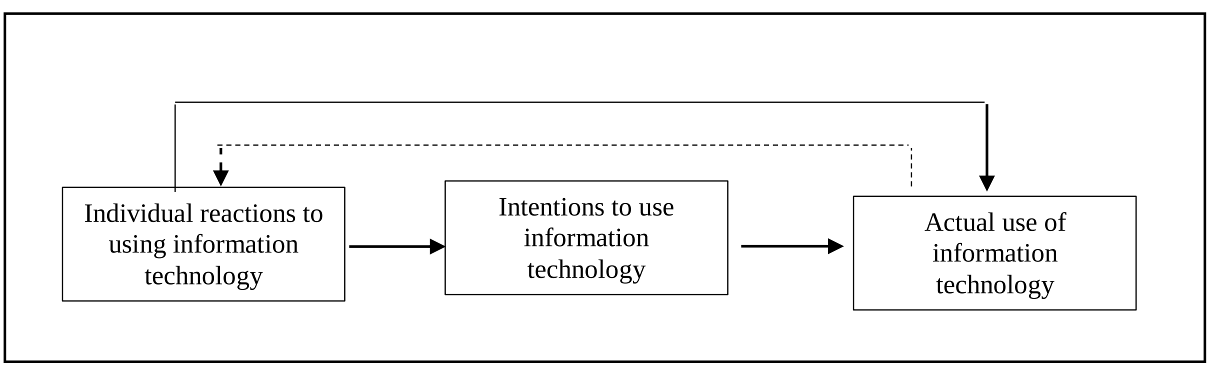


Figure 2-8 Basic concept underlying technology acceptance models

Another construct that was considered in the design of the proposed study was social influence. As stated in the Model of PC Utilisation and the DOI Theory, an individual is likely to be influenced to use a new system through interpersonal interactions. The researcher believes that facilitating conditions are important in spreading use of technology in a social system although it was found that the effect of facilitating conditions on behavioural intentions was non-significant in the UTAUT theory. Another construct that was theorised *not* to be a direct determinant of intention was *attitude toward using technology*. Although this was so, the researcher believes that attitude is an important construct for diffusion of technology and it was considered in the design of the study.

The following is a summary of the variables from the theories and models that the researcher found relevant and would be adopted or adapted for the proposed study.

Theory of Reasoned Action (TRA)

- *Attitude*

Technology Acceptance Model

- *Perceived Usefulness*,
- *Perceived Ease of Use*

Model of PC Utilisation

- *Attitude,*
- *Social factors,*
- *Perceived complexity,*
- *Perceived job fit,*
- *Facilitating conditions*

Diffusion of Innovations

- *Relative advantage*
- *Compatibility*
- *Complexity*
- *Triability*
- *Observability*

- *Optional type of innovation decision*
- *Interpersonal communication channel*
- *External change agents' promotion efforts*

The Unified Theory of Acceptance and Use of Technology

- *Performance expectancy*
- *Effort expectancy*
- *Social influence*
- *Facilitating conditions*
- *Attitude towards using technology*

2.7 Theoretical Framework

There are many competing technology theories out there and researchers have a great challenge when choosing theories for their research. Many researchers are thus compelled to choose constructs across theories while ignoring contributions from alternative theories (Venkatesh, Morris, Davis, & Davis, 2003). This observation was true for the current study. The constructs that have been used have been picked from various theories as described later in this section. The attributes that were deemed relevant to the current study have been isolated from the five theories described above to constitute the methodology. However, basing on the prevailing culture at Mzuzu University, the researcher felt that the DOI theory had more relevant attributes to the current study than other theories. Elements like triability, observability, interpersonal communication channel and external change agents' promotion efforts, which the researcher thought would affect the acceptance and use of innovation, were only available in the DOI theory. From experience, the researcher feels that very few people would accept a new technology without doing a trial run. It is only when they know that a system works after making trials, that they will adopt it. Peer influence at many institutions in Malawi is very effective at making people accept something new and use it, especially if they have observed from a colleague that it works. In Malawian public education institutions in general, there is a culture of depending on donations, especially computers. Majority of computers and accessories in public schools are either donations or acquired through external agencies. In addition, there are many studies on adoption and use of innovations in many fields. Many constructs from Roger's theory of diffusion of innovations seem to fit in the current study. Many scholars (Al-gahtani, 2003; Boz & Akbay, 2005; Martins & Steil, 2004; Pagani, 2006) have done research on the adoption of innovations mainly in relation to the five elements of innovations as factors in innovation adoption and use. A study done by Al-Gahtani (2003) in Saudi Arabia found that perceptions of relative advantage, compatibility, observability, and trialability were positively related to computer adoption and use, while complexity was negatively correlated with adoption of computer and its usage. This study was conducted to investigate the relationship between the five perceived attributes of computer technology innovation, and computer adoption and use. These findings supported Rogers' DOI theory that innovation attributes are important in determining adoption and use of innovation. The factors and the empirical evidence by other researchers presented above, influenced the researcher of this study to choose the DOI theory. A brief overview of some empirical studies related to innovation adoption will be expounded. Afterwards, a more comprehensive discussion on the diffusion of innovations will follow.

Alkhateeb, Khanfar, and Loudon (2009) asserted that *"diffusion of innovation (DOI) theory provides a solid foundation for developing conceptual models that assess the impact on new information technology on users, over time"* (p. 121). The strength the DOI Theory is that it focuses on adoption of the technology while other theories simply focus more on the concept of accepting the technology. The following constructs were adopted from DOI Theory which was the main guide for this study. The DOI Theory was chosen because the researcher saw it as a perfect fit for most of the constructs and intended outcomes of the study. For instance, users need to see the relative advantage of a proposed new technology if it is to be adopted. Figure 2-9 presents a model that was followed in this study. The model is an adaptation of the DOI Theory by Rogers (2003).

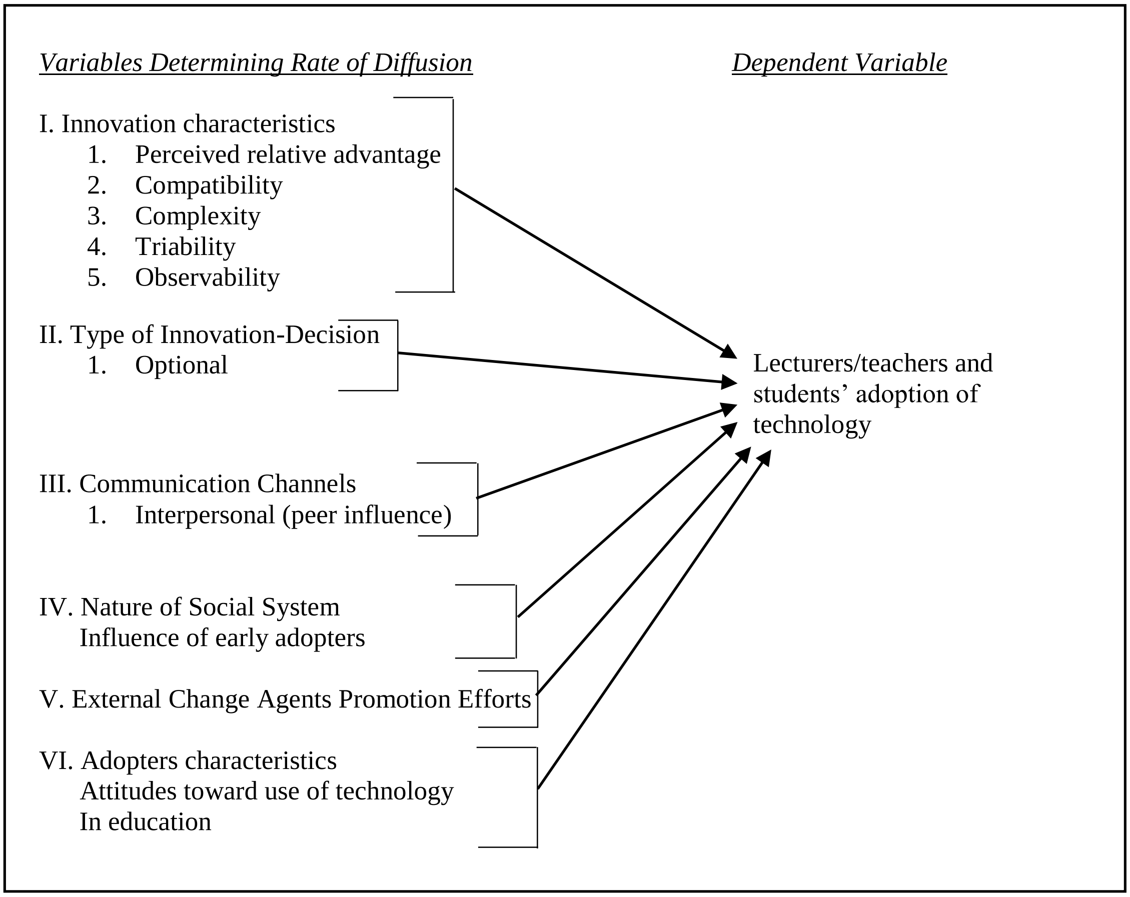


Figure 2-9 Proposed model of the current study
Source: Adapted from Rogers (1983)

It has to be perceived *"as being better than its precursor"* (Moore & Benbasat, 1991, p. 195) if the innovation is to be accepted. In addition, the new technology needs to have compatibility, which Moore and Benbasat (1991) defined as *"the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters"* (p. 195). If the would-be adopters are to accept the innovation, the results of using the innovation must be tangible. In other words, the results of using the new technology must be observable. Interpersonal communication, a variable adopted from DOI Theory, was used to inform participants about the proposed innovation to be used in this study.

Another variable from the DOI Theory that was used to stimulate adoption of the proposed innovation was the promotion efforts from external change agents. So far, the following orgaisations have donated computers and other teaching and learning equipment to MZUNI: the African Development Bank, FAIR (Fair Allocation of Infotech

Resources)-Denmark Project, Computer Aid (UK), Airtel (Malawi) and Malawi Communications Regulatory Authority (MACRA). These donations have increased access to technologies for teaching and learning. This increased access to technology is envisaged to promote adoption and use of technology.

2.7.1 Diffusion of Innovations Theory

According to Boston University School of Public Health (2013), the DOI Theory is one of the oldest social science theories. It was developed by E.M. Rogers in 1962. The theory explains why some innovations are adopted while others are not. In this theory, it is argued that it is difficult to get a new idea accepted even when it has obvious advantages. This is evidenced by many lecturers' reluctance in universities such as MZUNI to adopt digital technologies. One explanation to this phenomenon could be that new ideas take time to be accepted and diffuse into society's crust. The newness of the idea in the message content creates a degree of uncertainty. A technology is thus supposed to reduce the uncertainty in the cause-effect relationships involved in achieving a desired outcome. Technological innovations do not necessarily diffuse themselves just because they are superior. More than just the relative advantages of an innovation are required for people to adopt it, even when its benefits are very clear. Diffusion can be described as a special type of communication in which an innovation is transferred from one person to another in a social system (Rogers, 2003). The desired goal of diffusion is that people should adopt the new idea, behaviour or product. When adoption occurs, it is expected that people will do things differently from what they used to do before.

2.7.2 Why diffusion fails

Adoption of an innovation is a process where some people are more willing to adopt the innovation than others (Boston University School of Public Health, 2013). Diffusion brings about change. There are many reasons innovations fail to diffuse in a society. A diffusion campaign is likely to fail if an innovation is perceived to be culturally inappropriate by a community of would-be users. An innovation must be compatible with the values, beliefs, and past experiences of individuals in the social system for it to be adopted successfully. Indigenous knowledge systems and interpersonal networks are important factors in adoption or rejection of an innovation. More so, diffusion of innovation is more of a social process than a technical matter (Rogers, 2003). Lievrouw and Livingstone (2006) stated that an innovation is introduced in a social group, which can be a community, an organisation or an industry, by a change agent that has an interest of promoting it. Rogers (2003) noted that there was need for change agents to be *client-oriented* rather than *innovation-oriented* if diffusion was to take place. This means that the message about any innovation should suit clients' felt needs if they are to be persuaded to adopt it. There are four elements of diffusion that Rogers (2003) identified, namely: *innovation*, *communication channels*, *time* and *social system*. These elements are discussed in some detail in the next section.

2.7.3 Elements of diffusion

2.7.3.1 Innovation

Rogers (2003) defined innovation as *"an idea, practice, or object that is perceived as new by an individual or other unit of adoption"* (p. 12). An innovation is not necessarily a new idea or practice as it can be exploratory of exploitative (Chibambo, 2016). Something may have been invented long time ago, but if people see it as new, then it is an innovation to them. Intended adopters of a technological innovation do not usually perceive the benefits of the proposed innovation, especially when they initially learn about it. They are not sure that it offers a superior alternative to the previous practice that it might replace. Rogers (2003) observed that the process of deciding to adopt an innovation is essentially an information-seeking and information-processing activity in which an individual or a group is encouraged to think about the advantages and disadvantages of the innovation. In support of this idea, Yates (2001) stated that potential adopters of an innovation must first learn about the technology before they can decide whether to adopt it or not.

2.7.3.2 Communication channels

Communication is a process by which people create and share information with one another in order to reach a mutual understanding. For Rogers (2003), diffusion is a particular type of communication in which the message being shared is concerned with a new idea. This process involves (1) an innovation, (2) an individual or unit of adoption that has knowledge of the innovation, (3) another individual or unit that does not have knowledge of the innovation, and (4) a communication channel connecting the two units.

Two types of channels that can be used to share information concerning new ideas are mass media and interpersonal channels. Mass media are the most efficient means of informing potential adopters of an innovation. Channels such as radio, television and newspapers are suitable for creating awareness of the existence of innovations. However, interpersonal communication such as face-to-face exchange of information between two or more individuals are more effective in persuading an individual or a group to accept a new idea. This is especially true if the individuals involved in the interpersonal communication are similar in socioeconomic status, education or other important characteristics. This study used interpersonal communication to sell the idea of integrating technology in education to individuals who have shown interest in using technology in this area. Diffusion can be thought of as being a social process that involves interpersonal communication. Rogers (2003) suggested that *"the heart of the diffusion process consists of the modelling and imitation by potential adopters of their network partners who have previously adopted"* (p. 19). In addition to the aforementioned, interactive Internet communication has become more important for diffusion of certain innovations in the present digital era.

In human communication, transfer of ideas takes place more easily between individuals who are homophilous. Rogers (2003) has defined homophily as the degree to which two or more individuals who interact are similar in certain attributes, such as beliefs, education and socioeconomic status. Given freedom to choose who to interact with, individuals tend to select someone similar to them. This study thus took advantage of this concept by approaching lecturers who were homophilous to him to introduce the innovative idea of using technology in education. The opposite of homophily is heterophily, which is defined as *"the degree to which two or more individuals who interact are different in certain attributes"* (Rogers, 2003, p. 19). Physical and social nearness that result when individuals live or work near each other makes homophilous communication more likely to happen than heterophilous communication. Rogers (2003) noted that *"one of the most distinctive problems in the diffusion of innovations is that the participants are usually quite heterophilous"* (p. 19). An ideal situation for diffusion of innovations to happen is that the individuals should be homophilous in all other variables like education and economic status but heterophilous regarding the innovation itself. A change agent must be more technologically competent than his or her client otherwise there will be no diffusion if both have the same technological competencies. A case in point here was that this study had leading individuals who were savvy in the field of instructional design and technology. This, it was hoped, would encourage diffusion of the proposed innovation.

2.7.3.3 Time

The third element in diffusion research is time. The time element is included in three areas: (1) the innovation-decision process, (2) the innovativeness of an individual or other unit of adoption compared to other adopters of an innovation and (3) an innovation's rate of adoption in a system (Rogers, 2003).

Innovation-decision process: According to Rogers (2003), an individual or a unit passes through a five-step *innovation-decision process* before an innovation is adopted. The would-be adopter must first have knowledge of an innovation before he or she can form an attitude towards it. After that, the individual decides to adopt or reject the innovation. If the idea is accepted, the adopter implements and uses the new idea. Finally, a decision is confirmed. Thus, the innovation-decision making process has the following five main steps: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation.

During the *knowledge* stage, a potential adopter learns about the innovation and understands how and why it works. Then the persuasion stage follows where the adopter forms an *attitude* towards the innovation. This attitude can be favourable or unfavourable. After attitude formation, the individual goes through the *decision* stage where he or she engages with the innovation resulting in a choice between acceptance or rejection of the innovation. At this stage, an individual would like to know what the innovation is all about. The individual would like to know the innovation's advantages and disadvantage. He or she would like to know whether the innovation will be useful or not. Rogers (2003) observed that *"interpersonal communication networks with near peers are particularly likely to convey such evaluative information about an innovation"* (p. 21). At this point, an individual who would like to adopt an innovation wants to get specific information hence mass media channels may not be really essential. Although decisions about integration of technology are frequently at a higher level such as government or university management, Straub (2009) was convinced that *"it is the individuals' adoption patterns that illustrate a successful implementation"* (p. 625). The *implementation* stage occurs when the adopter uses the innovation. The final step, *confirmation*, takes place when an adopter seeks reinforcement of the decision taken. It is likely that the individual will sustain the decision if the reinforcement is affirmative. There is a great likelihood that the adopter may reverse the decision if he or she receives conflicting reports concerning the innovation.

Rogers (2003) defined the innovation-decision process as the length of time required to pass through the innovation-decision process. This process involves time because the five steps usually occur in a time-ordered sequence from knowledge, persuasion, decision, implementation, to confirmation.

Innovativeness and adopter categories: This is a second way in which the time dimension is involved in the diffusion of innovations. Rogers (2003) defined *innovativeness* as the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system. Individuals in a social system adopt innovation in *"an over-time sequence"* (Rogers, 2003, p. 267). Hence, they can be classified into adopter categories based on the time they begin using a new idea. The classification of a social system on the basis of innovativeness includes: (1) innovators, (2) early adopters, (3) early majority, (4) later majority, and (5) laggards. Boston University School of Public Health, (2013) stressed the importance of understanding characteristics of the target population when promoting an innovation because research has revealed that people who adopt an innovation early have different characteristics from those who adopt it later.

The adoption of a new idea normally follows a normal, bell-shaped curve when plotted over time on a frequency basis. An S-shaped curve results if the cumulative number of adopters is plotted (Rogers, 2003). The S-shape adopter curve rises slowly at first, when there are only a few adopters. Then it rises sharply to a maximum until half of the individuals in the system have adopted. Then it increases at a gradually slower rate until the remaining individuals adopt the technology.

Innovators

People who seek information actively about new ideas are called innovators. They want to be the first to try the innovation. They have interest in new ideas and are willing to take risks. Generally, they are financially sound and have the ability to understand and apply complex technical knowledge. Their degree of mass media exposure is high and they have a wide interpersonal network. This study has identified two such individuals at MZUNI and one at one secondary school in Mzuzu City. These three innovators will be enlisted into this study. Rogers (2003) asserted that *"innovators must be able to cope with a high degree of uncertainty about an innovation at the time he or she adopts it"* (p. 282).

Early adopters

Early adopters are what Rogers (2003) called localities. *"This is an adopter category that has the highest degree of opinion leadership in most systems"* (p. 283). This is the group that potential adopters look up to for advice and information about the innovation. Lievrouw (2006) stressed that the success of diffusion of a new idea in a social setting often depends on the social status of early adopters. Many people who want to adopt an innovation, check with these early adopters before adopting the new idea. Early adopters act as catalysts of diffusion of innovations. They *"help trigger the critical mass when they adopt an innovation"* (Rogers, 2003, p. 283). They already know the need for change therefore, they do not need any additional information to convince them to change. Strategies required for this category include how-to use manuals and information sheets on implementation (Boston University School of Public Health, 2013).

Early majority

This category adopts new ideas just before the average member of a system. Unlike early adopters, this group rarely holds a position of opinion leadership in a society but interact frequently with peers. It acts as a link between very early and relatively late adopters of new ideas. The early majority need to see evidence that the innovation works before they adopt it. They need success stories and evidence of the innovation's effectiveness (Boston University School of Public Health, 2013). This group makes up about one-third of all members of the social system. According to Rogers (2003), the *"innovation-decision for this group is relatively longer than that of innovators and early adopters"* (p. 283). This is the case because members of this category discuss the innovation for some time before adopting it completely.

Late majority

The late majority adopt innovations after the average member of a system. This category makes up one-third of a system. They are sceptical and cautious. They adopt new ideas after most others in their system have done so. They are uncertain about the new ideas because they lack resources. They adopt new ideas only when they are certain that it is safe to do so. Strategies that work with this group include information on how other people have tried the innovation and have been successful.

Laggards

Laggards have traditional values and are the last to adopt new ideas in a social system. They are very conservative and are very difficult to bring on board. They tend to be suspicious of new ideas and of change agents. They are very cautious in adopting new ideas because of their *"precarious economic position"* (Rogers, 2003, p. 285). They make decisions based on what happened in the past. Their innovation-decision process is quite lengthy. Strategies that appeal to this group as suggested by Boston University School of Public Health (2013) include statistics, fear appeal, and pressure from people in the other groups.

Rate of adoption: This is the third dimension of diffusion of innovations. Rogers (2003) defined rate of adoption as *"the relative speed with which an innovation is adopted by members of a social system"* (p. 23). The distribution of adopters of an innovation can be shown graphically by plotting a graph of the cumulative frequency of adopters of an innovation against time. The resulting graph is an S-shaped distribution. Initially, only a few people (innovators) adopt the new idea. Then the graph rises sharply as more and more people adopt the innovation each succeeding time. Afterwards the gradient of the graph reduces as fewer and fewer people remain who have not adopted the innovation. Eventually, the diffusion process finishes as the graph reaches its asymptote. The rates of adoption of different innovations vary. Some innovations have higher rates of adoption while others have lower rates. Different rates of adoption for the same innovation are also observed in different social systems. According to Lievrouw (2006), two important concepts in diffusion include the *adoption threshold* and *critical mass*. The former is defined as the number of adopters necessary to induce one or more individuals to adopt a new idea whereas the latter is the point at which enough people have adopted an innovation for it to succeed.

2.7.3.4 Social system

According to Rogers (2003), a social system is a set of interconnected units that aim to jointly solve a problem in order to accomplish a common goal. All members in the unit work together to solve a common problem in order to reach a mutual goal. A school or a university is an example of such a system.

Chapter summary

Technology makes practical use of scientific human knowledge to turn resources into products that the society needs. The society uses technology to solve problems. There are many technologies that are used in the teaching and learning. Lately, many educational institutions worldwide are using social media mostly to support the *live* instructor in the classroom. Literature has shown that some social media that are used in education include blogs, wikis, podcasts, Facebook, Twitter, YouTube and Google.

Empirical research has provided evidence that the use of SRSs encourages students to participate actively in class. Such systems include, among others, *clickers* (sometimes called *zappers*), Socrative, Participoll, Edmodo, Nearpod, InfuseLearning, and Google Forms. Although the technology provides an opportunity for instructors to think about the questions they ask their students during lectures, literature has shown that some lecturers face difficulties to provide personalised attention to every student especially in large classes. Literature has shown that the mobile phones have provided an opportunity for students who missed classes to access courseware outside the class.

Five theories and models on adoption and use of technology were analysed. These included theory of Reasoned Action (TRA), Model of PC Utilisation, Technology Acceptance Model (TAM), Diffusion of Innovations (DOI) and the Unified Theory of Acceptance and Use of Technology (UTAUT). Some attributes from each theory or model were selected, based on their relevance to this study, for inclusion in the design and methodology of the study.

The next chapter introduces the study methodology. It gives a detailed account of the philosophy, research paradigms, methods employed, the techniques for data collection and analysis, and gives a description of the researcher’s standpoint. The chapter describes how research sites and participants were selected.

Chapter 3: Study Methodology and methods

3.1 Introduction

The previous chapter outlined five theories on technology acceptance as stipulated by various scholars. Competing theories on acceptance of technology were discussed. Other issues that were discussed included theories of learning, social media and SRSs. This chapter describes the methodology which has been adopted in this study. It presents a detailed account of the philosophy underpinning the study, gives a description of the research paradigms, explains methods employed, the techniques used to collect and analyse data, and presents a description of the researcher's standpoint. The chapter also explains how research sites and participants were selected. The Economic and Social Research Council (ESRC) (2016) defined social science as the study of society and how people behave and influence each other. The ESRC added that social science looks at the world beyond people's immediate experience. It helps to explain how societies work. This study falls in the category of the social sciences because it explains social phenomena using available evidence as observed by Lewins (1992). The heart of this study was to collect and examine available evidence in order to explain how institutions with limited resources could integrate technology in the teaching and learning processes using locally available resources.

3.2 Methodology

The word methodology in research has been defined as the overall approaches to the research process as a whole (Neville, 2007). According to Collis Hussey (2003), in Neville (2007), the main issues that are considered in the definition are: reasons for collecting the data; type of data that must be collected; where the data are collected; how the data are collected, and how they are analysed. In addition, Bellamy (2012) defined methodology as theories of how far a research design allows researchers to make inferences to conclusions that offer answers to the research questions. Similarly, Crotty (1998) concurred with Neville (2007) when he defined methodology as the strategy for the choice and use of specific methods and relating the choice of methods to desired outcomes. When researchers conduct research, they do it in relation to theoretical perspectives. By theoretical perspectives, Crotty (1998) meant the philosophical point of view informing the methodology. During research, people engage with the nature of the world and how they get to know it (Byrne, 2011). Methodology enables researchers to understand how they can make inferences about the adequacy of theories from the findings of empirical research. One important aspect of methodology is that it helps researchers to design research projects in such a way that they can make defendable conclusions about what might be the causative agents of what they observe. A good understanding of methodology helps researchers avoid collecting and analysing data only to realise that they cannot draw defensible conclusions. A faulty research design can lead to this end. Methodology, if properly understood, enables researchers to make well informed arguments from the analyses of data and then draw defendable conclusions. According to Bellamy (2012), many social scientists disagree on the subject of methodology because each is based on a particular philosophical stance. This is why practical social science researchers need to know the underpinning philosophy. Practical social science researchers are involved in different kinds of philosophical debates as they transact their business. Knowledge of philosophy therefore, enables them to know whether some mistakes they make as they conduct research are philosophical or have to do with the application of a particular method. In addition to that, understanding of philosophical debates is essential because it helps us understand the kinds of claims we make for our conclusions, especially when we want to confirm or undermine a model or theory. This is because, as Ballamy (2012) concluded, different philosophical positions give different statuses to the claims researchers make about inference.

3.3 Research Paradigm

Braun and Clarke (2013) defined a paradigm as a conceptual framework where scientific as well as other theories are designed. A researcher's ontological and epistemological orientation govern his or her research approach. These could be quantitative or qualitative. Two dominant ontological and epistemological ideologies are positivism and interpretivism.

Positivism: Positivism has its roots in the physical sciences and is called a systematic, scientific or positivist approach. Another paradigm is known as the qualitative, ethnographic, ecological or naturalistic approach (Kumar R. , 2005). The belief of positivists is that only ‘scientific’ knowledge is the ‘true’ knowledge of the world. They contend that there is a single ‘objective reality’ to any research phenomenon, irrespective of the researcher’s perspective (Hudson & Ozanne, 1988). Positivists generally use a quantitative approach while interpretivists use a qualitative approach. Positivism, whose founder was Auguste Comte (The Stanford Encyclopedia of Philosophy, 2014), is one kind of empiricism where the basic idea is that knowledge comes directly from experience. Positivists believe that knowledge comes from what we observe. Here, observation means what we can detect with our senses or with instruments that we use to enhance the senses. Kumar (2005) believed that researchers should be objective and control bias when they conduct research regardless of the paradigm they work within. Their approach to research is controlled and structured. They do this by identifying a clear research topic, constructing appropriate hypotheses and adopting a suitable research methodology (Churchill, 1996; Carson, Gilmore, Perry & Gronhaug, 2001).

Interpretivism: An ‘alternative’ approach that is often used in social sciences is interpretivism. This may be a form of qualitative methodology. According to Study.com (2016), this ideology relies upon both the trained researcher and the human subject. These are the instruments that are used to measure some phenomena. Interpretivism involves both observation and interviews. Interpretivists mainly aim at understanding situations rather than measuring behaviours because they believe that reality can only be understood through analysis of the actors’ meanings and actions. Unlike positivists, interpretivists avoid research frameworks that are rigid. Instead, they adopt more personal and flexible research structures (Carson, Gilmore, Perry & Gronhaug, 2001). They believe in the notion that the researcher and the participants are interdependent and mutually interactive (Hudson & Ozanne, 1988).

Pickard (2013) observed that all research begins at the philosophical level. Guba and Lincolin (1989) believed that research methodologies are shaped by ontological assumptions regarding the nature of reality, which respond to the question 'what is there that can be known?' or 'what is the nature of reality?' In practical terms, ontology is the way human beings perceive things around them. A same situation may be perceived differently by two people depending on the importance each one of them attaches to the observed phenomenon. This branch of metaphysics has been defined by Bellamy (2012) as a sub-discipline of philosophy which is concerned with what exists, and what status we are assigning, especially to unobservable and abstract things.

Byrne (2011) argued that theoretical perspectives must include an ontology, that is, a worked out understanding of what the world is all about. Ramazanoglu and Holland (2002) stressed the point that methodology relies on ontology and epistemology. They defined the former as theories about the nature of reality and the latter as theories about the nature of knowledge. According to (Blaikie, 2007), ontological assumptions constitute ways of answering the following question:

> *"What is the nature of social reality? These assumptions are concerned with what exists, what it looks like, what units make it up, and how these units interact with each other" (p. 3).*

Two fundamental ingredients of methodology according to Ballamy (2012) are *inference* and *warrant*. They defined *inference* as the process of making claims on what cannot be directly observed based of what we know about things that we have observed. The choice of research instruments depends on a theory of how those instruments work. On the other hand, they interpreted the term *warrant* as the degree of confidence that researchers have in the capability of inference they make to deliver correct facts about things they cannot observe directly.

As alluded to earlier on, epistemology also shapes the stance and orientation a researcher makes when choosing a research methodology. Epistemology is a sub-discipline of philosophy concerned with the truth regarding the status of knowledge that can be achieved either by observation or by inference (Bellamy, 2012). It focuses on how human beings acquire knowledge as well as how they discern truth from falsehood. Modern epistemology generally involves a debate between rationalism and empiricism, or the question of whether knowledge can be acquired *priori* or *posteriori*. Empiricism is the practice of relying on observation and experiment when acquiring knowledge usually obtained through experience. Conversely, rationalism argues that knowledge is acquired through the use of reason. In this regard, the Stanford Encyclopedia of Philosophy (2013) argues that the disagreement between rationalism and empiricism is about the extent to which people are dependent upon sense experience to gain knowledge. Rationalists posit that there are many ways in which concepts and knowledge are gained independently of sense experience. Empiricists assert that sense experience is the definitive source of all our concepts and knowledge.

Epistemology is important because it is central to how we think and carry out research. Cline (2016) claimed that we would not have coherent way of thinking without means of understanding how we obtain knowledge, as well as how we rely upon our senses and how we develop concepts in our minds. It can thus be argued that a thorough understanding of epistemology is essential for sound thinking and reasoning.

3.4 Research Design

Research design is the *"complete plan for collecting data for answering the research question"* (Fraenkel & Wallen, 2009, p. G-7). This also includes the specific data analysis techniques or methods that the researcher intends to use. Additionally, Bellamy (2012) defined research design as *"the plan of how data will be created, collected, constructed, coded, analysed and interpreted to enable the researcher to draw warranted inferences"* (p. 20). Three research approaches according to Creswell (2003) are quantitative, qualitative and mixed. This study was descriptive in nature, and adopted a mixed methods design. As Fraenkel and Wallen (2009) and MacMillan (2004) observed, educational research is increasingly a mixture of quantitative and qualitative approaches. Both approaches are employed in one study when collecting and analysing data, and when writing a report (Creswell, 2003). Briefly, the main characteristics of qualitative, quantitative and mixed-methods research are as follows.

Qualitative research

Qualitative research is primarily exploratory and enables researchers to gain an understanding of reasons, opinions, and motivations (Snap Surveys, 2016). It tries to study human actions from the perspective of the people themselves by attempting to describe and understand their behaviour without explaining it (Babbie & Mouton, 2001). It provides insights into the problem and tends to be inductive and theory generating (Braun & Clarke, 2013) for potential quantitative research. Qualitative Research is also used to uncover trends in thought and opinions, and get deeper understanding of the problem being investigated. Braun and Clarke (2013) observed that qualitative research takes longer to complete because it is interpretative and there is no formula for it. Data collection methods for qualitative research usually involve direct interaction with individuals on a-one-on-one basis or in groups. The main methods for collecting qualitative data are individual interviews, focus groups, observations, and action research. Information derived from qualitative research is richer and has a deeper insight into the phenomenon under study (University of Surrey, n.d.).

Quantitative research

Quantitative research, on the other hand, is concerned with the degree to which a phenomenon has certain properties, similarities and differences, and the possible causal relations between these (Labuschagne, 2003). In this approach, the researcher mainly uses post positivist assertions (Creswell, 2003). It is further stated on the Snap Survey (2016) website that quantitative research is used to generate data that can be converted into statistics for the purpose of quantifying the problem. The phenomena to be quantified could be attitudes, opinions, behaviours, and other definable variables. The findings from a given sample might be generalised to a population. It is also pointed out on the same website that quantitative research uses measurable data to formulate facts and uncover patterns in research. When compared to the qualitative approach, quantitative data collection methods are much more structured than qualitative data collection methods. To concur with this assertion, Creswell (2003) stated that quantitative research makes use of research methods such as experiments and surveys. It collects data on instruments that produce statistical data.

Mixed-methods research

Researchers who use mixed-methods approach tend to base their claims on pragmatic grounds (Creswell, 2003). In this approach data are collected either simultaneously or sequentially in order to understand the research problems better. Data collection includes the gathering of numerical and textual information. Thus, both quantitative and qualitative information is collected using this approach. This study has used a mixed methods approach because the nature of its research questions required the use of different data gathering strategies. Quantitative data that were collected were mainly for descriptive analysis purposes. The qualitative aspect focussed on getting a holistic picture of how teachers in the selected secondary schools and MZUNI use technology in their classes. To gain insights into how the teaching was conducted, lessons were observed on a regular basis (Fraenkel & Wallen, 2009) in one computer class at MZUNI and Physical Science classes in two selected Secondary schools during data collection of the interventional phase of the study.

3.5 Action Research

This research project falls within the action research domain because the primary reason for conducting it was to assist in improving and refining the teaching and learning situation in institutions where resources were limited. Action research focuses on a specific local problem and results in an action plan to solve the problem (Fraenkel & Wallen, 2009). According to Great Schools Partnership (2014), action research is designed to diagnose problems or weaknesses and help educators develop practical solutions to address them quickly and efficiently. There are two main types of action research: practical action research and participatory action research. According to Fraenkel and Wallen (2009), practical research is conducted to address a specific problem within a classroom, a school or community. Its main aim is to improve practice in the short term. It can also be used to inform larger issues. In addition to the purpose outlined above, participatory action research has two more purposes. The first one is to empower individuals and the second is to bring about social change at some level. This study was practical in nature because its main focus was to gather information that would help to improve the way teaching was conducted in large classes in the study area where the research was conducted. The researcher's main interest was to identify better ways of encouraging students to participate actively in class with the help of technology. Generalisation to other settings was of minimal importance in this study. One may question the importance of conducting research in just one local situation if the results cannot be generalised. An immediate answer to this question is what Fraenkel and Wallen (2009) stated when they said that the results of action research *"have immediate meaning for that situation: it may stimulate others to replicate your study: and it may generate some ideas for further studies."* (p. 588). This study was carried out under the basic assumption that those involved were committed to improving their teaching performance, which was the case with many lecturers who participated in this study as will be illustrated in the study findings chapter.

3.6 Researcher Standpoint and Motivation

In this section, personal experiences and inclinations that may have implications in the way reality is perceived and things interpreted are presented. The researcher was born and raised in Malawi. His interest towards sciences started during secondary school days. Because of this interest, Mathematics, Physics and Chemistry were prioritised at A-level studies at the Kamuzu Academy. He passed the Cambridge A-level examinations in 1986 and secured employment at Kamuzu Central Hospital, one of the referral hospitals in Malawi, as a pre-professional employee awaiting training. In 1987, he secured a scholarship to undergo training in Diagnostic Radiography at the Middlesex and University College Hospitals Schools of Radiography in London under the sponsorship of the British Council. Here he graduated with a diploma in December 1990 and started work at Lilongwe School of Health Sciences (now called Malawi College of Health Sciences) in 1991 as a tutor in Radiography. Because of his bias towards sciences, he chose to teach Radiographic Equipment, Radiographic

Photography and Imaging Processes and Principles of Radiological Physics. In 1997, he attended a one-year training course in Tanzania and graduated with a diploma in Health Personnel Education. Two years later, the researcher went to MZUNI where he did an upgrading bachelor's degree programme in health science education. In 2001, he joined MZUNI as Assistant Librarian (Technical Services) and four months later got a scholarship to pursue a master's degree in Instructional Design and Technology (IDT) at Virginia Polytechnic Institute and State University (Virginia Tech) in the USA. From 2003, he worked as lecturer in ICT after finishing the master's degree. He later joined the Centre for Open and Distance Learning (CODL) in 2011. It was at CODL that the interest in e-Learning was born and grew.

The motivation for doing this PhD in e-Learning started in 2010 when the researcher went to the University of Glasgow as an Honorary Research Fellow under the auspices of the Scotland-Malawi Partnership. Professor Victor Lally was his advisor during the six-month internship. The Inter-Life Project (Interdisciplinary Learning, Education, Technologies and Society, 2014) which was led by Professor Victor Lally gave the researcher impetus to pursue his interest in e-Learning further. The concepts that impressed him most in this project were the interdisciplinary nature of the project and promotion of computational thinking and use of open source software. Seeing that most lecturers at MZUNI in Malawi were still using traditional methods of teaching despite e-Learning becoming increasingly prominent in secondary and tertiary education the world over, the researcher thought that his expertise in IDT would come in handy to repurpose print-based materials for electronic delivery. To do this, there was need for a study to be undertaken to find out how technology could solve the problem of large classes, high cost of Internet services and deficiencies of resources in teaching and learning. Specifically, the interest during the research fellowship in Scotland was mainly in e-Learning authoring tools, Web-based instructional material design and multimedia Compact Disk - Read Only Memory (CD-ROM) based teaching and learning instructional design.

Before, enrolling for the PhD programme, he read about various e-Learning solutions such as Claroline, Joomla, Moodle, Hot Potatoes, E-learning XHTML Editor (eXe) and Participoll. He started the data collection exercise for this study with sufficient knowledge of principles of instructional design and an inclination towards e-learning which might have affected the way he perceived and analysed issues. It is important to note that, deliberate efforts were made to go into the field with an open mind in order to discover and learn from people who participated in this study.

3.7 Methods

The purpose of this section is to provide details of the methods which were used in collecting data. An account of how data were analysed is also presented. According to Bellamy (2012), methods are techniques for the creation, collection, coding, organisation and analysis of data. Data creation methods were further defined as techniques that are used to produce raw materials for research that can be used to perform further investigations. Examples of these methods include ethnographic or participant observation, focus group discussions, individual interviews and questionnaire surveys. Once the techniques for producing raw materials are in place, data have to be gathered. Data collection methods are procedures for capturing important information for answering the research question from the data that have been created. This process may involve analysing text for particular themes, codes or content (Bellamy, 2012). After this process, data have to be coded to determine whether the information indicated by such data meets the standards or thresholds required for them to be classified under a certain category. Data organisation then follows. This step is important because it makes it possible for research to be analysed properly. The final step is data analysis. Data analysis methods are *"procedures for manipulating data so that the research question can be answered, usually by identifying important patterns"* (Bellamy, 2012, p. 10). In this study, data were collected from three different sources: class observations, focus group discussions, in-depth individual interview sessions and questionnaire administration.

Phase One: Phase One was a baseline study of the status of technology at MZUNI and the four selected secondary schools in Mzuzu City. The four secondary schools consisted of two conventional and two community day secondary schools. For confidentiality of the findings, the two conventional secondary schools have been named CSS-1 (Conventional Secondary School 1) and CSS-2 (Conventional Secondary

School 2), while the two community day secondary schools have been called CDSS-1 (Community Day Secondary School 1) and CDSS-2 (Community Day Secondary School 2). The first concern of the researcher was the status of the available resources. Therefore, there was need to establish human and non-human resources that were available for the teaching and learning processes. Knowledge, attitudes and skills of faculty members, teachers and students regarding use of technologies was also sought. In this phase, institutions were checked for readiness and use of e-learning. For those who were already using technology, formative evaluation as a way of improving them was required. The study also wanted to establish the availability of policies on e-learning that guide e-learning processes. The study also sought to identify opportunities and challenges associated with technology integration. It was felt that the information that would be collected in Phase One would be vital for designing Phase Two of this study. Phase one used self-administered questionnaires, focus group discussions and in-depth individual interview sessions as tools for gathering data. Questionnaires were distributed personally to informants at MZUNI unlike at the secondary schools where teachers collected the questionnaires and distributed them to their students. Students in Forms 3 and 4 studying Physical Science and their teachers were included in this phase. At MZUNI, students and faculty members from the faculties of Education; Health Sciences, and Information Sciences and Communications were targeted.

Phase Two: This section presents the methodology of Phase Two of the study. This study was interventional in nature because it tried to implement some solutions which were observed during Phase One. A longitudinal qualitative research approach was used. Longitudinal research is a study in which information is collected at different points in time in order to study changes over time (Fraenkel & Wallen 2009). The longitudinal design that was employed was a trend study. Different samples from the population were surveyed at different points in time. As an instructional designer, the researcher assumed both the researcher and instructional designer roles. The prime role as an instructional designer was to find new technologies that would aid learners' cognition (Mayer, et al., 2009).

3.7.1 Preparation for data collection

Preparatory work for Phase Two of the study started with the installation of Physical Science interactive exercises on servers at CSS-1 and CSS-2 in Mzuzu City. These exercises were not installed at CDSS-1 and CDSS-2 because of lack of computers. These schools were not part of the Fair-Denmark Project. Schools that were involved in the Fair-Denmark Project received computers with preloaded instructional materials. Permission to use networked computers which were donated by Fair-Denmark Project was sought from the Coordinator of the project who was based at MZUNI, and head teachers of the two secondary schools. In response to findings of Phase One, interactive Physical Science exercises were designed by the researcher with the help of Physical Science teachers from the two schools. The purpose of these exercises was to allow students practice what they had learnt and get immediate feedback on their performance from a computer. The Physical Science exercises were installed on the schools' servers to enable students to practice during their free time and do revisions.

At CDSS-2, the situation was different. This school did not have computers which could be used by students for this study. The three computers that were available at the school were allocated to members of staff only. Thus, the researcher's personal laptop and multimedia projector to enable students access the interactive Physical Science exercises were used although the classrooms did not have any electricity. To this end, the head-teacher provided a 10-metre electrical extension to tap electricity from his office. The same was the case for CDSS-1 although things did not work out here. Tapping electricity was impossible due to unavailability of a long enough extension cable. Therefore, no practice interactive Physical Science exercises were conducted at CDSS-1.

After designing the interactive Physical Science exercises, the researcher then designed an electronic voting system (EVS) using php and MySql, and organised recording, editing and distribution of Bachelor of Arts Education and Bachelor of Science e-Modules for ODL delivery mode. The EVS was considered an answer to the problem of implementing the instructional method of questioning (Mayer, et al.,

2009) in large classes where schools could not afford to implement the alternative 'clicker' technology. One faculty member from the ICT Department at MZUNI and five teachers from the four secondary schools were contacted and asked to take part in this study. The researcher then went ahead designing the EVS websites in Physical Science and C programming. The EVS was based on the Participoll and Socrative SRSs principles.

3.7.1.1 Production of e-Modules

Production of e-Modules was organised by the Centre for Open and Distance Learning (CODL) at MZUNI. The idea of producing the e-Modules was to supplement the existing print modules in order to provide more information to distant learners when they study on their own during self-study period each semester. Lecturers in the Faculty of Education were asked individually to participate in the e-Module production process. Twenty-nine participants agreed to take part in this exercise. Twenty-seven were lecturers from Faculty of Education and two were Coordinators from CODL. The first e-Module production exercise lasted five working days. The e-Modules were produced using Camtasia screen capture software. Lecturers captured their PowerPoint lessons using Camtasia Studio. They were taken to a holiday resort for a week where they recorded the lessons in their rooms because the University did not have a purpose-built audio-visual studio. The captured lessons consisted of the PowerPoint Slides and lecturers' voice as they were making the presentations.

3.7.1.2 Phenomena that were studied

Instructional technology has brought about a shift in the teacher's role. The teacher's chief task is no longer the disseminator of information, but the provider of a wide variety of learning experiences (Walter & Schuller, 1979). Learning processes nowadays use various media to carry information between a lecturer and students. When media like video, television, diagrams, printed materials, computers and mobile phones carry information with an instructional purpose, they are considered to be instructional media (Heinich, Molenda, Rusell, & Smaldino, 2002). Moreover, many institutions of higher learning in developed and developing countries are now using computer-based interactive media to deliver instruction. According to Heinich, Molenda, Rusell, and Smaldino (2002), interactive media are powerful and practical methods for individualising and personalising instruction. Use of interactive media is thus far advantageous in that multiple media like text, audio, graphics, still pictures, animation and video can all be combined in one easy-to-use system. Furthermore, interactive media require that learners actively engage in activities. These materials help maintain students' attention, and do allow learners to actively participate in the learning processes. Likewise, Heinich, Molenda, Rusell, and Smaldino (2002) claimed that interactive video may be used to provide simulation experiences in such areas as medicine, machine operations, and interpersonal skills. It is however stated that media alone do not cause learning to take place but instructional methods do (Mayer, et.al., 2009). Given this assumption, lecturers should strive to find methods that encourage student-lecturer interaction for all learners especially in large classes where communication tends to be between the lecturer and a few eager and vocal students (Pelton, Pelton, & Sanseverino, 2008). In cases like these, many students tend to sit back and do become mere passangers while taking notes and leaving others to actively participate in the discussions. According to Pelton, Pelton and Sanseverion (2008), this silent majority forfeits opportunities to learn and share their ideas with others.

Although interactive media have many advantages, Heinich, Molenda, Rusell and Smaldino (2002) argued that they have their own limitations, which include high cost, production expenses and rigidity. It is expensive to produce interactive multimedia although the prices of ready-made discs and machines are decreasing. It is also expensive to produce context-based CD-ROM and Digital Versatile Discs (DVDs), making it mandatory for most users to rely on commercially prepared discs, which may not meet local needs. Another limitation is that the discs cannot be changed once they have been made; therefore, material may become outdated. In summary, Heinich, Molenda, Rusell, and Smaldino (2002) argued that interactive media are valuable learning systems for tasks that must be shown rather than simply told. Factually, interactive media are the appropriate choice for learners who need to interact with the instruction. Some higher learning institutions are thus using open source course management and CMSs to offer instruction.

Realising the ‘paradigm shift’ in the teachers’ roles from mere content providers to facilitators, this study sought to redesign some instructional materials from print to electronic formats and distribute them to learners using various electronic media. This was done with the assumption that learners would actively participate in the learning experiences. During the design stage of the study, subject specialists were consulted, using Roger’s (2003) interpersonal communication strategy, to explain the intentions of the study. Later teachers and lecturers agreed to transform their print instructional materials to e-formats. In June 2013, one lecturer in the Department of ICT began working with this researcher to repackage C-Programming lecture notes into an interactive website using e-learning XHTML editor (eXe) and Hot Potatoes programmes. Also, some content that was in electronic text format was converted to audio (mp3) format using a Text-to-Speech programme to enable students listen to instruction in addition to reading. The lecturer allowed the researcher to sit in some of his C-Programming classes to record class proceedings in order to convert the class sessions to video (mp4) and audio (mp3). The videos were edited using Camtasia and U-lead video editing programmes while audio files were edited using Audacity. The lecturer was also taught how to record, edit and distribute his lessons using Camtasia screen capture software. The edited video and audio files were then distributed to students using flash disks.

Screen capture technology was deemed to be ideal for teaching C-Programming because it was thought that students would grasp programming techniques easily if they saw the programmes being written, compiled and run alongside the lecturer’s explanations. Camtasia Studio was the screen capture programme that was used for this purpose. Camtasia Studio is published by Tech-Smith Corporation. This screen capture software is designed to capture activities on a computer screen and render videos into Audio Video Interleave (AVI) format. This is a multimedia container format introduced by Microsoft in 1992 as part of its Video for Windows technology. An AVI is both sound and motion picture file that conforms to the Microsoft Windows Resource Interchange File Format (RIFF) specification. This tool is invaluable for teaching computer literacy skills among others. One may wonder why someone would want to capture a screenshot or indeed, record a video of one’s screen. The reason for doing so is that it can help a person communicate with more clarity and impact than one can do with written words alone as TechSmith Corporation (2015) suggested. In a classroom situation, teachers capture what is on their screen to record procedures of how things are done or answer questions. They also use this technique to give students audio-visual feedback as the best alternative to one-on-one conversation when it is not possible to meet face-to-face. Screen capture technology becomes handy when students want to access lessons at anytime and anywhere. If a lecturer missed classes for some reason, recorded videos can help a colleague who has been asked to act as a substitute teacher play the videos to learners.

3.7.1.3 C Programming

In January 2015, the lecturer who was teaching C-Programming and the researcher continued with the design process of the programming course materials and tried it out with a new cohort of thirty-three students who were taking C-programming course. Noting that many students in his class were not participating actively in class discussions, the lecturer thought that technology would solve this problem. In a quest to integrate technology in the teaching of C-Programming and improve students' participation in class, the researcher suggested to introduce SRS in addition to video recordings. An SRS website using PHP and MySQL in form of multiple-choice questions was designed. To do this, WAMP (Windows, Apache, MySQL, PHP) server was installed on the researcher's laptop that was running Windows. A WAMP server is a free all-in-one mini-server that can run on almost any Windows Operating Systems. WAMP includes built-in copies of recent versions of the following software: Apache, MySQL and PHP (Yank, 2009). Apache is a Hypertext Transfer Protocol (HTTP) server developed and maintained by an open community of developers under the auspices of the Apache Software Foundation. MySQL is an open source relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases. Hypertext Pre-processor (PHP) is a general-purpose server-side scripting language (Yank, 2009) that was originally designed for web development to produce dynamic web pages. It can be embedded into Hypertext Mark-up Language (HTML) to create a wide variety of mini-applications. The website was then linked to the database to enable the capturing of students' responses in order to monitor their performance. The students' interface of the multiple-choice questions website gave them four options to choose from. During implementation of the questioning method of instruction, students were asked to respond to multiple choice questions after which they were shown how many chose each alternative using the bar graph which was projected on the screen. The class was then allowed to discuss the rationale for the correct answers (Mayer, et al., 2009).

3.8 Site selection

Participants of the study were drawn from MZUNI and four selected secondary schools within Mzuzu City. These constituted two conventional secondary schools and two community day secondary schools. The researcher targeted secondary schools that offered Physical Science in Forms 3 and 4. Another factor that was considered when selecting schools was proximity to MZUNI. Secondary schools that were close to the University were chosen to keep operational costs low because the study involved frequent trips to and from the university. Conventional secondary schools were better resourced than community day secondary schools. Two of each type of secondary schools were included for better understanding of what it would take to integrate technology in a typical secondary school system in Malawi. This study did not include private secondary schools due to financial resources limitation.

3.9 Sample and sampling procedures

Cluster sampling (Fraenkel & Wallen, 2009) was used to select participants in the four selected secondary schools. The clusters that were used were Forms 3 and 4 Physical Science classes. A deliberate effort was made to include almost equal numbers of males and females in the samples by using quota sampling. Purposive sampling was used at MZUNI only. Purposive sampling was chosen because the informants chosen were known to the researcher as (Fraenkel & Wallen, 2009) suggested that such informants would provide the much-needed information. This sampling technique was used to increase the range of data and maximise the possibilities of uncovering multiple realities (Lincoln & Guba, 1985). A sample of one hundred and seventy-five students, thirteen secondary school teachers and twenty-one lecturers was selected.

3.10 Data collection procedures

This section presents the timeline of data collection procedures.

Data collection Timeline:

Ethical Approval

Ethical approval from the University of Glasgow College of Social Sciences Ethics Committee – 1/12/2014

Phase 1:

December 2014.

- Consent from Ministry of Education Science and Technology, MZUNI and respondents;
- Pretest of the methodology;
- Questionnaire administration to secondary school students;
- Focus Group Discussion (FDG) with ODL students;
- Coding and preliminary analysis of questionnaires from secondary school students

January 2015:

- Questionnaire administration to MZUNI respondents;
- Questionnaire administration to secondary schools for teachers

March – September 2015: Analysis of Phase 1 Findings

October – November 2015:

- Design of Phase 2 Data collection tools;
- Pretest of the methodology.

Phase 2

December 2015:

- Data collection in ICT class – *Cohort 2;*
- Data collection in Physical science classes

January – December 2016:

- Data collection on Moodle, Turnitin, WhatsApp and e-Modules;
- Data sorting, coding, analysis and interpretation

January 2017 – December 2019 – Thesis Write-up and consultations with supervisor

January 2019 – Thesis submission

Ethical approval was sought from the University of Glasgow College of Social Sciences Ethics Committee before beginning any data collection process. Consent was also sought from the Ministry of Education, Science and Technology (Malawi), MZUNI and the respondents. Consent from participants was sought and they signed consent forms. The researcher did not face many problems when getting consent from participants because the Plain Language Statement they were given answered most of the questions they had about the study. They were informed of their rights to participate or reject. Those who were interviewed were informed that the interview would be recorded using a digital recording device and that such recordings would not be used for any purposes other than for this study. Findings of Phase One and Phase Two are presented in chapters four and five respectively.

A pilot study of the methodology was carried out to find out reaction of respondents to the methodology. The researcher wanted to find out the availability of the study population, acceptability of the data collection methods used in the study and the time it would take to administer questionnaires. The researcher wanted to determine whether the tools would collect the information he needed and whether those tools were reliable. No major issues were encountered with questionnaire administration. So, no changes were made on the questionnaires.

e-Modules were piloted in Phase 1 of the study. For this phase, e-Modules in Linguistics, English Literature, Geography, History, Biology, Mathematics and Physics were produced. The e-Modules and the corresponding print modules were given to sixteen Level 3 ODL students for piloting purposes. They used them during the twenty-week self-study period. Data were collected from the students after their self-study period. Their comments were used to revise the e-Modules in preparation for Phase Two.

Pilot study of the EVS was done in October – November 2015 at MZUNI, CSS-1 and CDSS-2. Respondents who took part in the pilot study were not included in Phase Two of the study. The pilot study established that not all students at MZUNI had smartphones or laptops. It was also established that students at CSS-1 and CDSS-2 were not allowed to bring phones to school. This meant that the EVS could not be conducted in its true sense but had to be modified, which was done as described in Section 3.10.2.

3.10.1 Phase One

During Phase One, questionnaires for students were delivered to head-teachers in the four secondary schools. They distributed the questionnaires to students. For students at MZUNI, the questionnaires were given to the Deputy Director of CODL, Heads of Department of Security Studies, and ICT to distribute to students. Questionnaires for lecturers were distributed to Heads of Department of Security Studies, ICT, Library and Information Sciences (LIS), Languages and Literature, Chemistry, Mathematics and Nursing and Midwifery. Some questionnaires were given to the Dean of Education, Deputy Dean of Education, and the Dean of Students. Likewise, the questionnaires for teachers were delivered to head-teachers in the sampled secondary schools to give to Physical Science teachers in January 2015. Questionnaires were collected a week after distribution, and coding and analysis followed soon afterwards.

Apart from distributing the questionnaires, a focus group discussion was conducted with a class of ODL students who were in third year of study to formatively evaluate their WhatsApp group. This provided an opportunity to bring together participants to discuss, share, and compare their experiences. The focus group discussion involved all fifteen students who were in this class. A predetermined semi-structured interview schedule was prepared. Broad questions concerning the group's WhatsApp were asked to elicit responses and generate discussion among the respondents. The aim of these questions was generate fruitful discussion. The researcher asked probing questions to introduce respondents to the topic and to make them feel comfortable to share their opinions freely with the group. Follow-up questions were used where necessary to elicit opinions from more respondents.

3.10.2 Phase Two

This section briefly describes the data collection methods for Phase Two of the study which included observation, interviews and questionnaires.

C Programming Class Observation

The implementation of an SRS that was designed with the help of the lecturer in C Programming is described. A total of six class sessions were observed. The first session of C Programming covered introductory elements. Fundamental principles of C Programming language were discussed and a typical C Program was presented. Towards the end of the session, the lecturer gave multiple choice questions to the students to answer. The students were supposed to study the questions carefully before attempting them. They were asked to respond to each question by voting electronically. The questions were asked towards the end of the lesson to evaluate students' understanding and maximise the effectiveness of the questions as (Mayer, et.al., 2009) proposed. Conceptual questions were asked, as opposed to questions seeking factual information. The challenge that the researcher had was that there was only one laptop against thirty-three students. This issue compelled the researcher to connect the laptop which hosted the interactive website and the questions to a projector that enabled the class see questions on a large screen. During answering sessions, the laptop was disconnected from the projector to prevent students from seeing the responses of their peers. Students were asked to come in front where the laptop was and 'cast' their vote on the laptop. The voting interface is as shown on in Figure 3-1

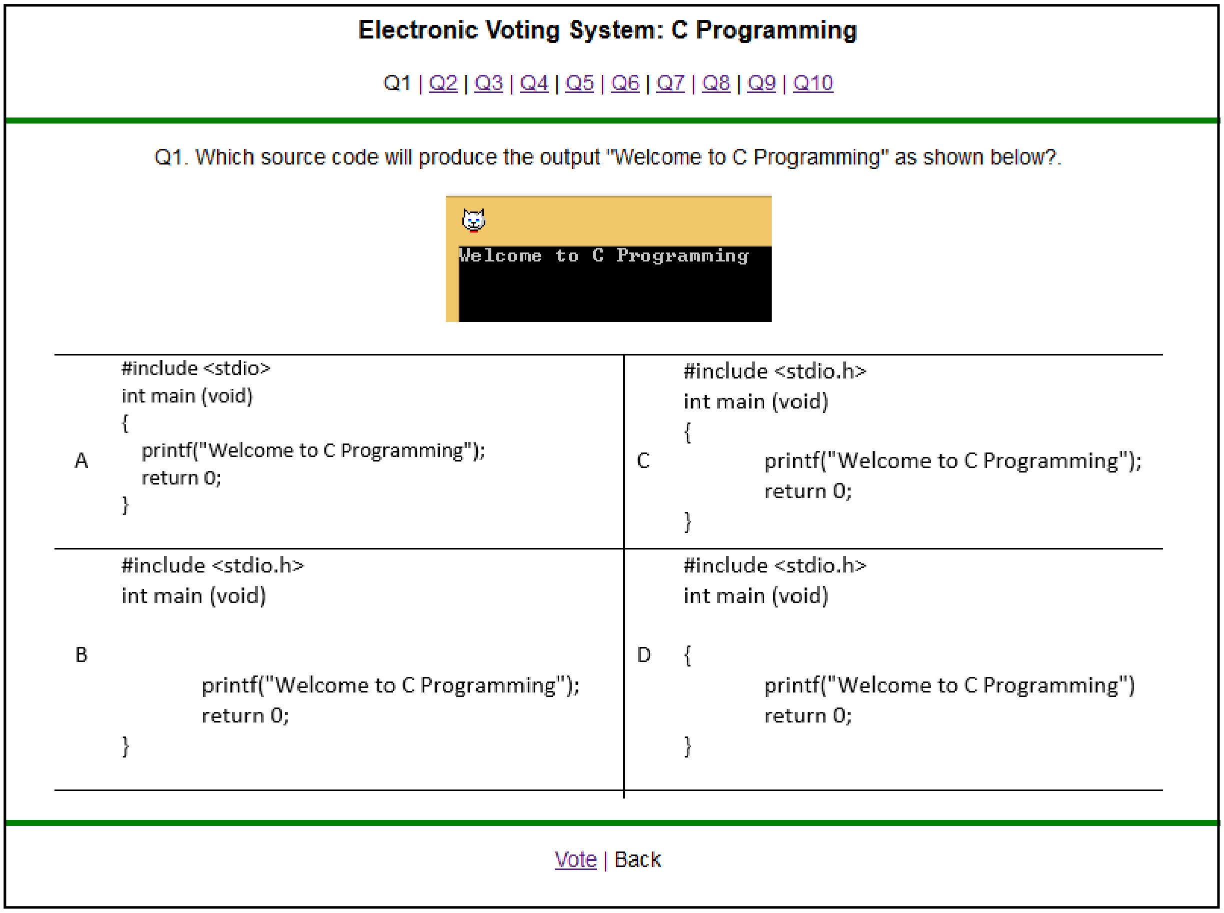


Figure 3-1 EVS student interface 1

When the ‘Vote’ link was clicked, students were presented with another interface to cast the vote as shown in Figure 3-2 below.

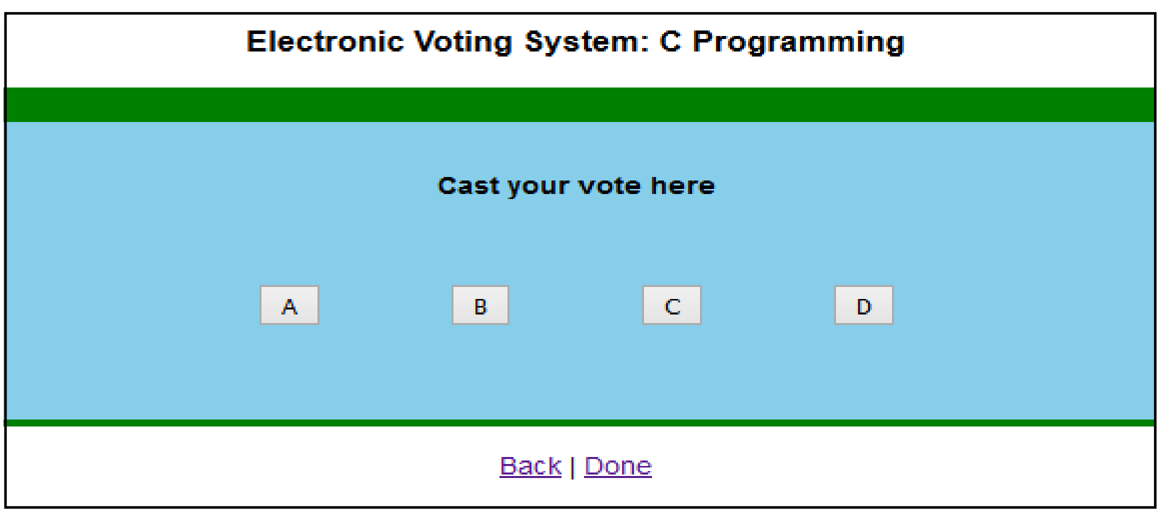


Figure 3-2 EVS student interface 2

After casting a vote for any option, the system gave feedback to the voter confirming what the student had voted for as shown in Figure 3-3.

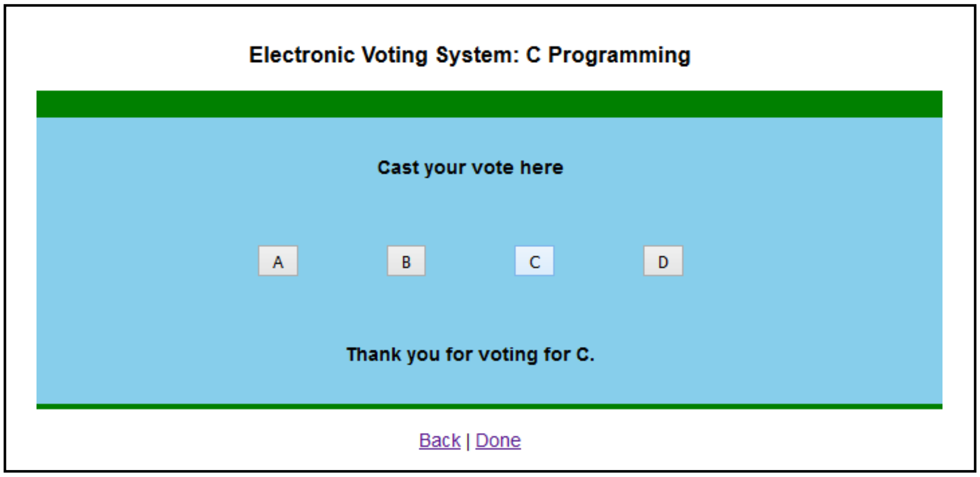


Figure 3-3 EVS student interface 3

In this example, a student voted for option C. The voter was then asked to click on the link labelled 'Done' (Figure 3-3) to remove the feedback in readiness for the next voter. This process was repeated for each student until all students had voted. Voting took about ten minutes for all the thirty-three students. This is comparable time to the time Mayer, et.al., (2009) used in his clicker-enabled class. When students had finished voting, the lecturer checked the students' responses by logging into the website using an interface different from the one students used. Figure 3-4 shows the interface for the lecturer.

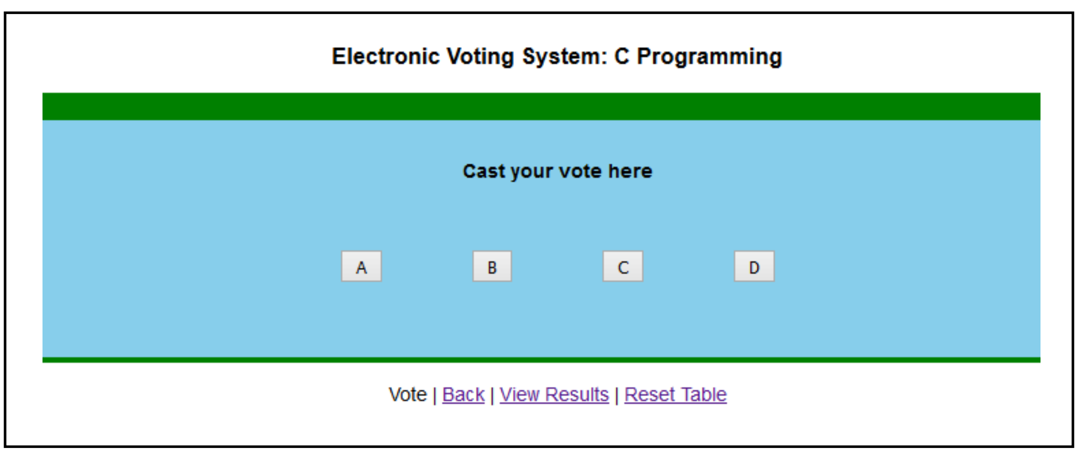


Figure 3-4 EVS lecturer's interface 1

The lecturer had administrative rights to view results and to reset the database. To check the students' responses, the lecturer clicked on the 'View Results' link. The system displayed the voting results as shown in Figure 3-5 below.

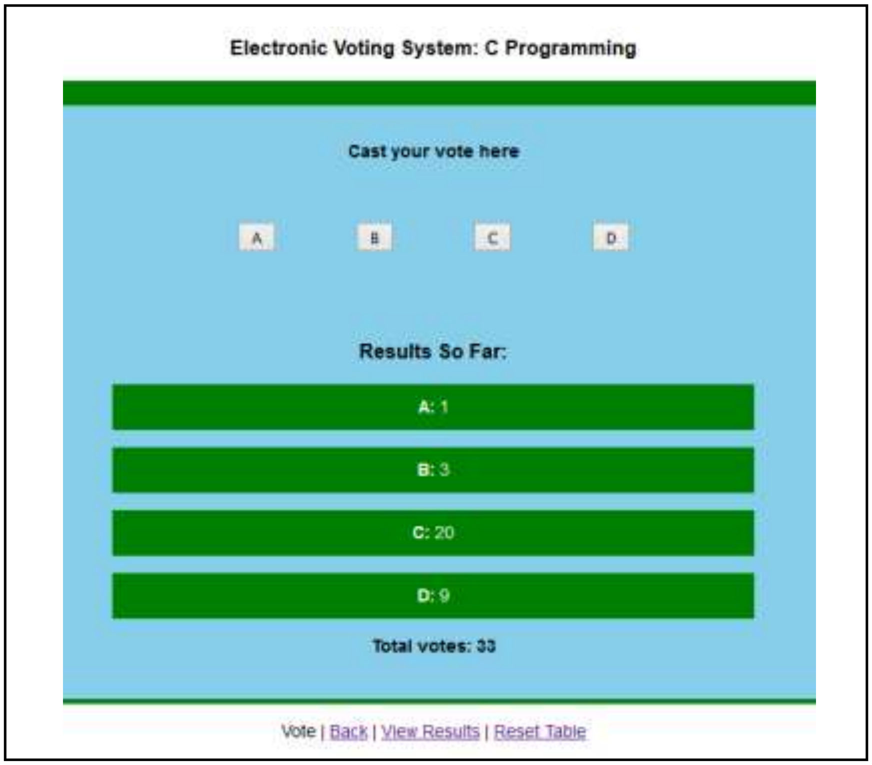


Figure 3-5 Results of voting

This feedback was shown to students on the projector but they were not told what the correct answer was. Afterwards the class was asked to discuss the results in pairs. After discussions the students voted again secretly. The purpose of letting students discuss in Buzz Groups was to encourage peer learning. When students had voted for the second time, the voting results were shown again to the class. The class then discussed the results to agree on the correct answer to the question. After the lecturer recorded the results of the voting process at the end of the class session, he reset the database using the interface shown in Figure 3-6.

During the second class session the EVS was conducted at the beginning of the lesson. The students were asked to answer the same questions they were asked in an earlier class.

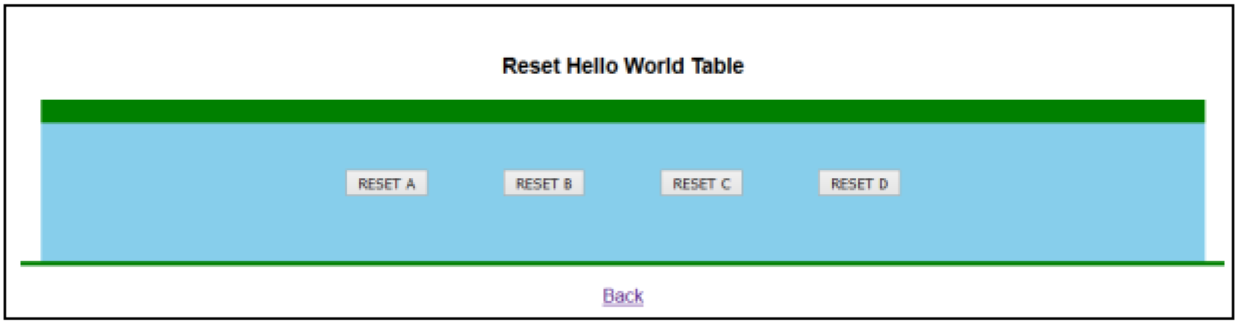


Figure 3-6 EVS lecturer's interface 2

The rationale for doing so was to find out if the students had revised the work or not. The multiple-choice options were rearranged to reduce guessing. This time, the lesson started twenty minutes earlier to allow time for voting and feedback before the lecturer presented the next lesson. The voting procedure was similar to one done in the previous class.

The third class session was cancelled because the lecturer was assigned to perform other duties therefore, he could not make it to class. Although the class was cancelled, the researcher managed to conduct an EVS session with the students before they were dismissed. The students were asked to answer three questions based on the first lecture they attended. The purpose of doing so was to find out if the students had revised the work. This time they were asked to provide answers to three multiple choice questions on pieces of paper in order to save time. Students' responses were entered onto a server by the researcher. Later, feedback on how they performed was provided before they broke off.

In the fourth class session, the EVS session was conducted towards the end of the lesson. The students were asked to answer four questions on *mathematical functions* and *IF statements*. The purpose of this exercise was to find out if the students had understood what they had just covered in class. Again, the students were asked to write the answers to the four questions on pieces of paper in order to save time. Students' responses were recorded on the database while the lecturer was presenting his lesson. Feedback was given soon after their votes were entered in the system.

In the fifth class session, the lecturer and the researcher decided to use Socrative Student Response System. Unfortunately, there was no access to the Internet as there was electricity blackout when the class started. The University's generator was not working either. The plan was to use the computers that were connected to the university's local area network in one of the computer laboratories but this was not possible because of electricity problem. As a backup, an offline EVS that was installed on the researcher's laptop was used instead.

The sixth class session was set for revision. Students were given thirty multiple-choice questions covering everything they had learnt in the previous five lessons. They were asked to answer the questions in pairs. The aim of pairing them was to encourage discussion and peer-learning. At the end of the session, the students were given more multiple choice quizzes, mp3 audio and mp4 video recordings to study at home in preparation for end of semester examinations.

Data collection during the C-Programming sessions was supplemented with data from questionnaires administered to students and a face-to-face interview session with the lecturer responsible for C Programming. Data on how the students interacted with the e-learning resources given to them to study at home were collected when they came for the end of semester examinations. Questionnaires were distributed to all thirty-three students, nonetheless only fifteen students responded. This represented a 45% response rate. This low response rate must be attributed to poor timing by the researcher since the data were being collected while students were writing examinations. It is reasonable to conclude that most students were anxious about their examinations and did not have enough time to answer the questionnaires. When students had finished writing the C Programming end of semester examinations, the lecturer was then interviewed on the processes involved in designing e-learning instructional materials for C-Programming.

Physical Science class observations at CDSS-2

The researcher made arrangements with the head-teacher of CDSS-2 to conduct weekly EVS revision sessions with twenty Form 3 students on Thursdays from 2:00

O'clock in the afternoon after the students had finished classes. Classes finished this early because the school was running a shift system. It was not possible to conduct these sessions while students were attending normal classes as that would have disturbed their routine work. A total of four sessions were conducted. The researcher played the role of the participant observer. He used students' notes and text-books that were borrowed from the school's library to enable him set multiple choice questions for the activities. For the first three sessions, the researcher's multimedia projector and laptop installed with home-made EVS, similar to the one used in the C-Programming course at MZUNI, were used. The first session was an introductory session on the concept of EVS in education. This session was designed to orient students on how to use the EVS and computer since many students were not familiar with such technologies. The researcher used questions on the topic *Graphs of Motion* for this introductory session. Multiple choice questions were beamed on the wall and volunteers were asked to come in front and choose options they felt were correct. Afterwards, students were asked to discuss the answers. A total of ten questions were covered within an hour using this mode. The school provided a ten-metre extension cable which was used for tapping power from the head-teacher's office to the classroom which was provided for this exercise since it did not have electricity.

In the second session, students were asked nine questions from one of the textbooks for MSCE Physical Science by Mwanza, at.al, (2012). The questions were projected on the wall and students were asked to write answers to each question anonymously on pieces of paper. Later, the answers were collected and entered into the database. The scores were analysed and were presented as bar graphs. The results were later projected on the wall for discussion. At the end of the session, feedback regarding students' performance was given to the class teacher. Based on this feedback, the teacher decided that another quiz on the same topic be conducted the following week since students performed unsatisfactorily.

When the researcher went for the third session, there was no electricity hence the multimedia projector could not be used. Given frequent blackouts in Malawi, the researcher had already prepared printed questions as a backup. The class answered the quiz using printouts which were then submitted for the analysis. Students' answers were manually coded in an Excel spreadsheet on the researcher's laptop. The questions for this session were similar to the ones in the first session even though this time notes that students took in class were used to formulate the quiz. Likewise, feedback on students' performance was given to the class teacher.

The students were asked to come to MZUNI after class for the fourth session. The researcher decided to conduct the fourth EVS session at MZUNI because he wanted the students to use University computers. The students used eight standalone computers which were installed with EVS website. Although only sixteen students came, still the session took place. The participants were asked to work in pairs to answer the multiple-choice questions on desktop computers using an interactive website which gave them immediate feedback. The students were asked to answer questions based on *electricity* and *carboxylic acids* topics.

Physical Science class observations at SS-1

Class observations were conducted at SS-1. Working with the Physical science teacher for Forms 3 and 4, the researcher wanted to find out if the Form 4 students could remember concepts they covered while in Form 3. He then formed a quiz covering two topics namely: *Graphs of Motions and Speed* and *Velocity and Acceleration* that were covered in Form 3. He did not use EVS for these exercises though. Instead, the students answered the questions on pieces of paper. Results were analysed graphically using Microsoft Excel that was installed on the researcher's laptop. In this first exercise, fifty-six Form 4 students participated. They wrote the exercise without prior preparation because it was expected that they could do the task easily since they had already covered the topics in the previous year. They were also asked to write another multiple choice quiz a day later. This time though, only thirty-six students participated. The exercise was on *Graphs of Motion*.

One EVS session was conducted at CSS-1 with Form 3 Physical Science class on *Chemical Bonding topic*. Towards the end of the session, students were asked to answer one multiple choice question using EVS. A laptop was connected to a multimedia projector which projected the question on a screen. The students were given two minutes to study the question before answering. The laptop was then disconnected from the projector and students were invited to vote on the researcher's laptop using the EVS. Only one question was evaluated because of time limitations. The voting process took about ten minutes to service the thirty students. After all the students had voted the researcher analysed the votes using Ms Excel and produced a bar chart for class feedback while the teacher was concluding his lesson. The teacher then clarified students' problems and misconceptions based on the results of the quiz. At the end of the class, the teacher also wanted feedback from the students regarding the lessons. To do this, the researcher projected the following evaluation question:

How well did you understand today's lesson?
A = Did not understand the lesson at all
B = Understood the lesson partially
C = Understood the lesson well
D = Understood the lesson very well
E = Understood the lesson totally

The students wrote their answers on pieces of paper, which they handed in as they were knocking off. Students' responses were analysed at some point and feedback was given to the teacher.

In addition to class observations, ten interview sessions were conducted with lecturers who had worked on various e-Learning projects at MZUNI. Specialist areas included C Programming; Interactive Websites; Physics; Chemistry; Semantics; Language and Gender; Bilingualism; Turnitin and Moodle. Questionnaires were distributed to students who were pursuing studies in C-Programming and Education courses using the ODL delivery mode. Questionnaires were also administered to ODL students to solicit their opinions and perceptions regarding the mp4 e-Modules given to them as study materials.

3.11 Data analysis

Analysis of quantitative data was done using descriptive statistics. The major advantage of descriptive statistics is that it allows researchers to describe the information contained in many scores with a few indices as Fraenkel and Wallen (2009) purported. The analysis of quantitative data was done using frequency distribution tables, and charts. In Phase One, tables were used for descriptive statistics for the following: distribution of respondents according to age, gender, place of work and experience of teachers and lecturers, and level of study of students. Some tables depicted Level of electronic technology skills of respondents, resources that were available locally for repurposing instructional materials and the media that respondents found sustainable to use in the teaching and learning process. Graphs were used to summarise responses on formative evaluation of locally available teaching and learning resources, the results of EVS and diffusion of e-module production. Analysis of qualitative data was mainly in the form of narrative text on respondents' opinions and data from interview sessions.

Sufficient information about research procedures in this study has been provided in Sections 3.7 to 3.11 to enable a re-study to be made. Apart from this, it is feasible to replicate this study because most programs required to do a re-study, for example, PHP, MySQL, eXe, Hot Potatoes, Participoll and Socrative are free and open source. Only PowerPoint and Camtasia are proprietary but open source equivalents are available. Free source code for EVS can be found on the Internet which can be modified to suit local settings. In the following chapter, details of the study findings for Phase One are presented.

Chapter 4: Study finding of Phase One

4.1 Introduction

This chapter presents the findings of Phase One which gathered baseline data on technology integration in teaching and learning. Respondents have been assigned unique identifier codes for purposes of anonymity. The codes are numbered sequentially preceded by letters '*S*', for students and '*T*', for secondary school teachers and lecturers. In the previous chapter, the researcher described the methodology and methods which were adopted in this research. He provided a detailed account of the philosophy behind this research. A description of the research paradigms and methods employed, and the techniques used to collect and analyse data were given. He then concluded the chapter by posting his stance as a social science researcher. The purposes for carrying out a baseline (*pre-intervention)* study on technology integration in the teaching and learning process were to:

- find out the availability of resources for implementing technology integration in teaching and learning;
- formatively evaluate existing e-Learning instructional materials with the aim of improving on them;
- assess opportunities for integrating technologies in education and the challenges that would negatively affect the success of using technology in schools and universities;

This section presents data that were collected through questionnaires which were distributed by the researcher to informants in person, focus group discussions and the in-depth interview sessions. Quantitative data have been presented using tables and graphs. Qualitative data were categorised into thematic areas and have been presented using textual narrative method. This study was conducted based on Rogers' (2003) DOI theory because technology integration is a new concept in Malawi. The data presented herein were collected in Phase One in order to establish the status of technology at MZUNI and in the four selected secondary schools in Mzuzu City. Qualitatively, perceptions of informants were likewise, sought on C-Programming, Moodle and WhatsApp, as they were already being used as e-learning tools. Phase

Two of the study used the findings from Phase One, and therefore, was more focused on technologies that were available locally.

4.2 Characteristics of the respondents

Phase One of the study used self-administered questionnaires as the main tool for gathering data. The first part of the questionnaire sought demographic data of respondents in terms of gender, age and level of study of the student respondents, and the level of experience in using technology for teaching and learning by secondary school teachers and university lecturers. Teachers were asked to indicate schools they belonged to while students were asked to indicate their level of study and programmes. The total number of respondents (students, teachers and lecturers) for Phase One was 202.

4.2.1 Gender

Table 4-1 shows gender distribution of student respondents.

Table 4-1 Distribution of students according to gender in Phase One

Institution	Frequency		Total
	Male	Female	
Secondary schools	47 (27%)	58 (33%)	105 (60%)
MZUNI	62 (35%)	8 (5%)	70 (40%)
Total	109 (62%)	66 (38%)	175 (100%)

Overall, there were more male student respondents (62%) in this study than females (38%).The distribution of respondents in secondary schools was deliberately biased towards females because the researcher wanted to include views from this minority group. Therefore, more female respondents were included in the sampled schools than males. It was felt necessary to capture data from both males and females. On the ground, there were more male students in secondary schools than females at the time of doing this study. According to Education Policy and Data Center (2014), the percentage of secondary school age girls who were out of school (32%) was higher than boys who were out of school (23%). In addition, gross enrollment for upper secondary school (Forms 3 and 4), which this study targeted, was higher for boys (19%) than for girls (14%). This fact was illustrated further in the BRIDGE (n.d.) Website where it was stated that the number of boys is higher than that of girls by approximately three to one in Malawi's mixed secondary schools. For MZUNI, the picture was different. Majority of student respondents were male. This is common in Malawi’s tertiary education institution since the number of females who reach university is always very low. More females than males drop out of school at primary and secondary school levels. This is in line with what was established by the BRIDGE (n.d.) website that there were progressively more boys than girls in enrolment from the end of primary to tertiary education. Another factor that can shade light on this anomaly was that the programme which contributed most students to this study, admitted very few female students. Table 4-2 shows distribution of secondary school teachers and university lecturers.

Table 4-2 Distribution of teachers and lecturers by gender and place of work

School/Faculty	Frequency		Total
	Male	Female	
CDSS-1	1 (3%)	0 (0%)	1 (3%)
CDSS-2	3 (8%)	1 (3%)	4 (11%)
CSS-1	4 (11%)	0 (0%)	4 (11%)
CSS-2	3 (8%)	1 (3%)	4 (11%)
Faculty of Information Science and Communications	7 (19%)	1 (3%)	8 (22%)
Faculty of Education	7 (19%)	3 (8%)	10 (28%)
Faculty of Health Sciences	2 (6%)	3 (8%)	5 (14%)
Total	27(75%)	9(25%)	36 (100%)

For teachers and lecturers, more males (75%) were included in the study than females (25%) as shown in Table 4-2. The low retention rate of females at primary and secondary school levels, and the low numbers of females admitted into universities has a knock-on effect on the numbers of females recruited into teaching jobs at secondary and tertiary levels respectively.

More respondents (75%) in this category were male with majority (64%) coming from MZUNI. Informants in the selected secondary schools were few because only Physical Science teachers were targeted. This was the case because there are very few science teachers in Malawi secondary schools.

4.2.2 Age

The second section of the questionnaire asked respondents to indicate their age bracket. Distribution of student respondents by age is shown in Table 4-3. Eighty-nine out of one hundred and six secondary school students responded to this item, giving a response rate of 84%. All university student participants responded. Sixteen students did not respond to the questionnaire.

Table 4-3 Distribution of student respondents according to age

Age bracket	Frequency		Total
	Secondary Schools	MZUNI	
Below 20	77 (48%)	0 (0%)	77 (48%)
20-29	10 (6%)	13 (8%)	23 (14%)
30-39	2 (1%)	46 (29%)	48 (30%)
40-49	0 (0%)	11 (7%)	11 (7%)
Total	89 (56%)	70 (44%)	159 (100%)

From this figure, seventy-seven secondary school students, making up 48% of the sample, were below 20 years of age while majority (85%) of university students were between 20 - 39 years of age. University students in the sample comprised those straight from secondary schools and others who joined the university as mature students having been in various jobs for some. This is especially true for students who were enrolled in the Open and Distance Learning (ODL) and the Security Studies programmes.

University lecturers and school teachers were also asked to indicate their ages. Majority (97%) were between 20 – 49 years of age. Since the retirement age in Malawi is 60 years, many lecturers and teachers have at least ten years to serve before retiring.

4.2.3 Level of study of the student participants

Majority of the student respondents (60%) were from the four sampled secondary schools in Mzuzu City. These students took Physical Science in Forms 3 and 4. Students from MZUNI were drawn from the Security Studies, Bachelor of Arts Education (ODL delivery mode), Bachelor of Science Education (ODL delivery mode), and ICT. Table 4-4 below shows the distribution of the student participants by level of study.

Table 4-4 Distribution of students according to level of study

Level of study	Frequency
Form 3	51 (29 %)
Form 4	54 (31%)
University Level 1	6 (3%)
University Level 2	22 (13%)
University Level 3	27 (15%)
University Level 4	15 (9%)
Total	175 (100%)

4.3 Availability of resources

This research considered the fact that in Malawi, resources for technology integration in education were scarce, especially in CDSSs. According to the The World Bank (2010) CDSSs do not have adequate resources as compared to conventional secondary schools. These schools are generally underfunded, and teachers are underqualified.

The learning environment is poorer, and they lack appropriate teaching and learning materials and equipment.

The researcher thought that it was important to find out the available human and non-human resources in Phase One so as to lay a base for designing and repurposing instructional materials for Phase Two of the project. The following sections present the findings on level of experience of participants in using technology, respondents' access to technology and available skills and attitudes of teachers and lecturers for designing e-learning instructional materials.

4.3.1 Level of experience among lecturers, teachers and students in using technology for teaching and learning

Respondents were asked to indicate their level of experience in using technology in educational environments. This information was sought to determine entry characteristics of respondents in terms of technology use in order to enable the researcher make proper plans for technology integration in teaching and learning in Phase Two of the study. Ten participants (two lecturers and eight students), who represent 5% of the informants, did not respond to this item. Many respondents (59%) were average users while 15% were non-users and only 7% of the respondents were expert users. If we add all users together (novice to expert), the results show that majority of respondents (85%) were users of technology with only 15% of non-users. It is encouraging to note that majority of the respondents use technology because one would expect that technology would diffuse rapidly through such a group. One implication, however, of this finding is that non-users and novice users would require short courses in use of technology to enable them use it effectively. Expert users could be asked to be resource persons to train novice users and non-users. To ensure that the proposed innovation in teaching and learning is relevant to the would-be users, the instructional designers need to be conversant with the existing technologies.

Table 4-5 Level of technology experience of teachers, lecturers and students

Level of technology expertise of respondents	Students	Lecturers and teachers	Total
Non-user	25	6	31 (15%)
Novice	33	4	37 (18%)
Average	101	18	119 (59%)
Expert	9	6	15 (7%)
Total	168	34	202 100%)

Table 4-5 shows a summary of the responses on participants' level of experience in the use of technology in education.

4.3.2 Availability of instructional resources

The researcher wanted to put the TALULAR concept to the test. Before starting redesigning the instructional materials, it was necessary to establish what resources were available that could be used. This section examines the resources for the teachers and lecturers in order to determine what could be used when redesigning instructional materials. A list of items was prepared for respondents to tick. Teaching and learning resources that teachers and lecturers already had are shown in Table 4-6.

Resources for repurposing instructional materials that were available for nearly 50% of the teachers and lecturers were computers, printed notes, books and print modules. These materials would need time to be converted to electronic format. The fact that majority of the respondents (94%) had access to computers was encouraging as the computers would be used to convert print resources for e-learning. This meant that the vital equipment (the computer) for converting instructional materials

Table 4-6 Availability of resources for repurposing instructional materials

Resources	Frequency					Total
	CDSS-2	CSS-1	CDSS-1	CSS-2	MZUNI	
Computer	3	3	1	4	23	34 (94%)
Lecture materials in print format	1	2	0	1	21	25 (69%)
Time to convert your lecture materials to electronic format	0	2	0	1	17	20 (56%)
pdf convertor	0	1	1	1	15	18 (50%)
Scanner	0	1	1	1	8	11 (31%)
People with website design skills	0	2	0	0	8	10 (28%)
Digital camera	0	0	0	0	8	8 (22%)
Video camera	0	0	0	0	6	6 (17%)
Website editing software	0	0	0	1	4	5 (14%)
Personnel with audio editing skills	0	2	1	0	2	5 (14%)
Personnel with video editing skills	0	2	1	0	2	5 (14%)
Voice recorder	0	0	0	0	4	4 (11%)
Microphone	0	1	0	2	1	4 (11%)
Video editing software	0	1	0	0	2	3 (11%)
Voice recorder	0	1	0	0	2	3 (11%)

from print to electronic format was available. Thus, there were resources, though limited, to kick-start the process if the participants were willing to use them for this purpose. If they were willing, participants with video and audio editing skills could teach the others who did not have the requisite skills.

Audio editing software, Text-to-Speech and Speech-to-Text software as well as video and digital cameras which were unavailable or in short supply could be purchased for the pilot study. It is important to note that only 56% of the participants had time they could use to change lecture notes and other teaching materials to electronic format. In such a case, production of electronic teaching and learning materials could be done by hired experts. This meant that there might be need to hire someone to do the job or give them incentives to motivate them.

Lecturers and teachers were also asked to indicate the skills they had to enable them to design e-learning materials. It was found that most of the lecturers (about 83%) had the following skills: converting documents into pdf format and finding instructional materials on the Internet. These are basic skills every lecturer should have. Lecturers should be able to find information on the Internet and repackage for their students. But many lecturers at MZUNI did not have knowledge and skills for distributing instructional materials onto the Web. Nowadays, lecturers are expected to know how to upload instructional materials onto the Web to enable learners access them anytime.

Table 4-7 Level of skills of lecturers required for e-learning

Skill	**Levels of Skills**				
	None	**Low**	**Average**	**Above average**	**High**
Converting documents into PDF format	2	0	1	7	14
Finding instructional materials on the Internet	0	1	2	7	13
Editing speech using voice editing software	20	1	1	1	0
Using Text to Speech software	20	2	1	0	0
Using Speech Recognition software	20	2	0	1	0
Editing videos using video editing software	18	2	2	0	0
Using Learning Management Systems like Moodle	16	2	1	1	3
Designing blogs	14	5	0	1	3
Recording lecture using a voice recorder	13	2	2	3	3
Editing photographs using graphic editing software	13	2	4	1	1
Designing web pages	12	4	2	3	2
Recording video using a video camera	11	3	4	3	2
Uploading instructional materials on the Web	8	2	6	4	2
Scanning documents	4	3	5	4	7
Taking photographs using a digital camera	1	1	3	9	9

Table 4-7 presents the responses from lecturers regarding their level of skills in e-learning. Looking at column labelled 'None', it is evident that many lecturers lack important skills required to design e-learning instructional materials. Critical skills most lecturers lacked to enable them convert print instructional materials to electronic format were:

- Editing speech using voice editing software
- Using Text to Speech software
- Using Speech Recognition software
- Editing videos using video editing software
- Designing web pages and blogs
- Using Learning Management Systems like Moodle

The skills listed above are crucial for designing rich and interactive instructional materials. It is understandable that lecturers at MZUNI did not have skills listed in the first four bullets above because they might not have had access to the required software. However, it was expected that they would have known how to use Moodle since the learning management system had been installed at the university a few years ago and it had been publicised. Acceptance to use Moodle by MZUNI lecturers has thus been very slow. Accordingly, there is need to organise refresher courses for lecturers in the areas mentioned above to enable them repurpose print instructional materials for electronic delivery. After the trainings, aggressive marketing of the technologies is required to make sure that they know and embrace the technologies. Above all, the University should develop a policy on the use of technology in teaching and learning.

For secondary school teachers, the results were similar. They lacked skills to enable them convert print-based instructional materials into electronic format. Skills that most teachers had for converting print instructional materials to electronic were finding instructional materials on the Internet, scanning documents, and taking photographs using a digital camera.

Table 4-8 presents responses from secondary school teachers regarding their level of skills in various e-learning activities.

Table 4-8 Level of skills of secondary school teachers required for e-learning

Skill	Levels of Skills				
	None	Low	Average	Above average	High
Finding instructional materials on the Internet	1	0	2	1	7
Scanning documents	1	3	2	0	4
Taking photographs using a digital camera	0	2	3	2	4
Using Speech Recognition software	9	1	0	0	0
Using Learning Management Systems like Moodle	9	0	0	1	0
Using Text to Speech software	8	0	1	1	0
Designing blogs	8	2	0	0	0
Designing web pages	8	0	2	0	0
Editing speech using voice editing software	7	1	1	1	0
Recording lecture using a voice recorder	7	1	1	0	1
Editing photographs using graphic editing software	6	2	1	0	1
Editing videos using video editing software	5	1	1	2	0
Uploading instructional materials on the Web	5	2	2	0	1
Converting documents into PDF format	2	0	4	1	2
Recording video using a video camera	1	2	3	0	3

These basic skills would be required to start the process of converting print instructional materials into e-learning materials. However, there was need to train them so that they might acquire skills listed below which most of them lacked.

- Using Speech Recognition software
- Using Learning Management Systems like Moodle
- Using Text to Speech software

- Designing Blogs
- Designing web pages
- Uploading instructional materials on the Web
- Editing speech using voice editing software
- Recording lecture using a voice recorder

4.4 Sustainable electronic media

After subject matter experts produce e-learning materials, they distribute them to learners. Modes of distribution include the Internet, Facebook, memory sticks and many more. Modes of distribution chosen should be acceptable and sustainable for both the producers (lecturers and teachers) and recipients (learners). The following sections present findings on modes of distribution of e-learning materials participants found feasible and sustainable.

4.4.1 Sustainable media for distributing e-learning materials – Responses from teachers and lecturers

Lecturers and teachers were asked to indicate the media they found practical for distributing electronic instructional materials. The top five electronic media they mentioned which have been ranked in the order of popularity were: The Internet, Facebook, memory sticks, personal computers and ordinary cell phones. Very few respondents mentioned tablets, iPads, iPods and Moodle platform. Ironically, one would have expected lecturers from MZUNI to mention Moodle since the e-learning platform had been installed a long time ago at their institution. A possible explanation for this situation could be that lecturers may not have been interested in using Moodle mainly because it was not mandatory for them to use the facility for teaching.

In order for institutions to distribute instructional materials using the Internet and Facebook sustainably there was need to tackle the issue of access first. As a matter of fact, Internet access is costly in Malawi. Students and staff who have access pay dearly. Secondly, lecturers, teachers and students need to be convinced that apart from using Facebook and WhatsApp for social communication, these can also be used for academic purposes. Once these challenges have been surmounted, it would be easy to start distributing academic content to students via the Internet, WhatsApp and Facebook and other social media.

Table 4-9 below presents the results of the electronic media lecturers and teachers found sustainable.

Table 4-9 Sustainable electronic media for lecturers and teachers

Media	**MZUNI Lecturers**	**Secondary School teachers**	**Total**
Internet	23 (64%)	13 (36%)	36 (100%)
Facebook	21 (58%)	13 (36%)	34 (94%)
Memory sticks	21 (58%)	10 (28%)	31 (86%)
Personal Computers	21(58%)	8 (23%)	29 (81%)
Ordinary cellphone	19 (53%)	10 (28%)	29 (81%)
Smartphone	17 (47%)	9 (25%)	26 (72%)
Institution’s computers	16 (44%)	10 (28%)	26 (72%)
DVD player	13 (36%)	11 (31%)	24 (67%)
Blank CDs	11 (31%)	9 (25%)	20 (56%)
YouTube	15 (42%)	4 (11%)	19 (53%)
Blank DVDs	10 (28%)	9 (25%)	19 (53%)
Twitter	11 (31%)	5 (14%	16 (45%)
Multimedia projector	13 (36%)	3 (8%)	16 (44%)
Mp3 player	11 (31%)	5 (14%)	16 (44%)
Tablet	8 (22%)	0 (0%)	8 (22%)
e-learning platform	6 (17%)	1 (3%)	7 (20%)
iPad	2 (6%)	0 (0%)	2 (6%)

Memory sticks have a better chance of success as a sustainable medium for distributing e-learning materials to university students since lecturers and students have them as shown in (Tables 4-9 and 4-10). There is however, need to guard against transmission of computer viruses among users. One way of doing this is by asking students to bring formatted flash disks to be used when sharing data and to scan every memory stick with potent antivirus.

4.4.2 Sustainable media for distributing e-learning materials – Responses from MZUNI students

Table 4-10 shows media that university students in these programmes found suitable and sustainable.

Table 4-10 Sustainable electronic media for university students

Media	P1	P2	P3	Total
Internet	5	14	45	64 (91%)
Facebook	5	11	36	52 (74%)
ordinary cell phone	4	12	35	51 (73%)
Memory sticks	3	10	35	48 (69%)
DVD player	3	11	31	45 (64%)
Moodle	0	1	40	41 (59%)
Stand-alone computer	5	6	28	39 (56%)
Blank CDs	3	7	26	36 (51%)
Blank DVDs	2	6	23	31 (44%)
Smartphone	5	5	18	28 (40%)
Computer on LAN	4	3	18	25 (36%)
Multimedia projector	2	2	19	23 (33%)
Twitter	3	2	17	22 (31%)
YouTube	4	4	13	21 (30%)
Tablet	2	2	9	13 (19%)
iPod	2	0	4	6 (9%)

Information on the media MZUNI students had access to was sought from students from the following the programmes: Bachelor of Information and Communication Technology, Bachelor of Arts/Bachelor Science Education (ODL Mode) and Bachelor of Security Studies students. These study programmes had been assigned codes P1, P2 and P3, randomly for purposes of presenting the results anonymously. The letter 'P' stands for programme.

The top electronic media that the university students identified as sustainable when accessing resources were the Internet, Facebook, ordinary cell-phones, memory sticks and DVD players. These media have the potential to be utilised for electronic delivery of instruction. Use of DVDs for distributing electronic instructional materials should be explored because many students (64%) have access to DVD players. Media that university students had little access to were iPads, iPods, external hard-drives, radios, memory cards and WhatsApp. When data were being collected, WhatsApp was not popular but later, many students installed it on their phones. Although it was being used for social communication by students, some lecturers started using it to send instructional materials to students.

4.4.3 Sustainable media for distributing e-learning materials – Responses from secondary school students

Secondary school student respondents were also asked to indicate the electronic media they would find sustainable to use when accessing e-learning materials. Electronic media that at least half of secondary school students could use sustainably to access e-learning instructional materials in order of priority are DVD players, the Internet, Facebook and cellphones. This means that these media have the potential of being used to support e-learning in secondary schools. Students had very little access to e-learning platforms, radio and WhatsApp, though. Since there were no DVD players in the selected secondary schools, it was assumed that students were accessing e-learning instructional materials in their homes. If this was the case, this means that secondary school teachers should be taught how to produce instructional materials in audio and video formats. Blank CDs and DVDs needed to be bought in order for videos to be distributed. Table 4-11 presents a summary of the responses.

Table 4-11 Suitable electronic media for secondary school students

Media	CDSS-1	CDSS-2	CSS-1	Total
DVD player	17	19	34	70 (67%)
Internet	20	9	35	64 (61%)
Facebook	18	16	30	64 (61%)
Ordinary cell phone	15	20	27	62 (59%)
mp3 player	19	0	32	51 (49%)
iPod	8	15	19	42 (40%)
Institution's computers	5	4	29	38 (36%)
Blank CDs	5	9	14	28 (27%)
Smartphone	8	8	12	28 (27%)
Blank DVDs	6	9	9	24 (23%)
Memory sticks	7	3	7	17 (16%)
Tablet	5	4	6	15 (14%)
Personal computer	5	5	5	15 (14%)
iPad	2	4	5	11 (10%)
YouTube	3	3	4	10 (10%)
Twitter	4	6	0	10 (10%)
e-learning platform e.g. Moodle	2	1	2	5 (5%)
Radio	1	2	0	3 (3%)
WhatsApp	0	2	0	2 (2%)

Use of the Internet and Facebook would require sourcing money because the selected secondary schools did not have Internet connectivity. So, use of Internet-based instruction did not seem to be a sustainable option because Internet services in Malawi are quite expensive. The situation may change when the national optic-fibre connectivity project extends to secondary schools.

In general, the findings showed that the common media that lecturers, teachers and students found most suitable were DVD players, the Internet, Facebook and cellphones. This means that these media have the potential to facilitate the exchange of academic information among lecturers, teachers and learners. MZUNI students

(64%), secondary school students (70%) and teachers and lecturers (67%) had access to DVD players. This means that DVDs, CDs and VCDs could potentially help distribute e-learning materials among the students. These findings also mean that teachers and lecturers could utilise the Internet, Facebook and DVD players to distribute educational resources to their students if funding is provided, especially in secondary schools.

4.5 Opportunities and challenges

There are many opportunities nowadays for accessing instructional materials. Educators can use open source software, free webhosting, free LMSs like Moodle, and Social media like Facebook, Twitter and WhatsApp to distribute instructional materials. Challenges that may be faced when accessing e-learning content include lack of expertise in using Linux or Ubuntu, shortage of computers, tablets or smartphones and high Internet connectivity charges. One way to counter lack of expertise in using pieces of software for developing e-learning materials include organising training workshops on e-learning resources. The researcher sought the opinions of lecturers, teachers and students on this idea. The following section presents the findings.

4.5.1 Participants' opinions on attending workshop on e-learning

Student informants were asked to indicate whether they were willing to attend a workshop on how to use e-learning resources. The responses the students gave on e-learning training workshop have been summarised in Table 4-12 and reasons for their answers have been presented below the table.

Table 4- 12 Responses of students on e-learning workshop

Response	Secondary Schools			MZUNI			Total
	CDSS-1	CDSS-2	CSS-1	P1	P2	P3	
Willing	24	24	49	5	15	50	167 (95%)
Not willing	1	6	1	0	0	0	8 (5%)
Total	25	30	50	5	15	50	175 (100%)

Majority (167 out of 175 (95%)) were willing to attend the workshop on e-Learning. However, eight respondents, all from the four secondary schools, were not willing to attend. The reason for those who turned down the workshop attendance have been presented in section 4.5.1.2.

4.5.1.1 Reasons given by secondary school students for willing to attend workshop

Three themes emerged from analysis of reasons given by secondary school students who were willing to attend the e-learning training workshop. The thematic areas were:

- Knowledge and skills acquisition
- Access to information
- Communication

Knowledge and skills acquisition

Many secondary school students indicated that they were willing to attend the workshop because they wanted to acquire knowledge and skills on how to use e-learning instructional technologies. Apart from knowledge and skills acquisition, students wanted to know how to access instructional materials on the Internet. Some were more specific in identifying their needs. They were willing to attend the workshops to learn how to use the Internet, podcasts, Facebook and YouTube since they did not have any idea on how these technologies worked. They felt that the knowledge gained would help them now and in future. Students generally knew that the Internet had vast amounts of information on all subject areas and hence the need to know how to use it properly. It was strongly felt that the knowledge they would gain from the use of the technologies in general and the Internet in particular would help them develop their country. They were totally convinced that the workshops would enable them to gain knowledge they could not find at their schools. Some students expressed the desire to become experts in the use of technologies. Students believed that the use of technology would help them know more about the outside world. They also stated that workshops would help improve their personal as well as their academic life. One student who already had knowledge on using the Internet and Facebook just wanted to improve his skills. Another student felt that knowledge on these technologies was scarce and hence a must-have. Some students expressed the desire to teach other people who were not able to find educational information through technologies. Apart from using the knowledge and skills immediately, two students said that what the workshop would teach them would be used when they go for vocational training after secondary school education.

Access to information

Some students expressed the desire to attend the workshop because they knew that there was a lot of information on the Internet which could help them in their studies. Students emphasised the fact that nowadays one can get information faster when connected to the Internet, Facebook, YouTube and podcasts and other web-based resources instead of relying on the traditional sources only. Technologies increase access to information in this information era. Because some news is spread through the Internet, students were eager to learn how to access these technologies in order to enhance their education. But the big question was whether the students were in a position to distinguish credible sources of information from fake ones. While accessing information on the electronic media is good, students may not always use the Internet, Facebook or YouTube for academic purposes alone since some may use it to access other information contrary to education and hazardous to their moral development. Therefore, the lecturers and teachers should urge students to guard against misuse of the media.

Communication

Communication was one of the issues some students were interested in. They wanted to attend the workshop to learn how to use modern technologies to help them communicate and chat with friends on Facebook within the country and outside. Apart from simply chatting, they also indicated that they would want to share information about technology with their counterparts in other countries.

4.5.1.2 Reasons given by secondary school students against attending workshop

Reasons that were given by eight secondary school students against the workshop were that workshops were disturbing and some students did not have cellphones.

These reasons are described in more details below.

Workshops are disturbing

Students who indicated that they would not attend the workshop on e-Learning said that workshops might disturb them from their studies. Instead of studying, they would be busy attending workshops. They believed that workshops would negatively affect their school performance. They would rather spend more time working on education related issues. These students needed more interrogation because they did not spend all their time on books. They observed that there would be time for them in future to attend workshops after they had done away with school. These sentiments are not entirely true because workshops in Malawi are usually conducted for the working class and normally, people go to resorts on Lake Malawi for some days. Nowadays students do attend workshops just as adults. Some respondents indicated that workshops were outside the secondary school curriculum hence not relevant at that level. This reasoning is also lacking substance. School curricula includes extracurricular activities such as counselling, sports and entertainment: discos and clubs. It was further mentioned that students in secondary schools do not use workshops as instructional methods. One student pointed out that workshops were irrelevant to him because as he was only in Form 3, workshops would negatively affect his studies. A reason to explain the sentiments of these students could be that they did not link workshops to training. Maybe the researcher should have used the word *training* instead of *workshop*.

Lack of cellphones

One student was reluctant to attend the workshop because she did not have a cellphone to use to access information. She also indicated that it was difficult to acquire one as she had not yet started working to enable her buy one for herself. It is true that access to technology such as computers and tablets is not easy in Malawi but nowadays many students are acquiring mobile phones more easily. Access to technology in secondary schools is made even more difficult because students are not allowed to bring phones to school. Expecting secondary school students to access technologies for learning is an uphill task.

4.5.1.3 Reasons given by university students for willing to attend e-Learning workshop

All university students were willing to attend the workshop. The following five themes emerged from analysis of the data:

- Knowledge and skills acquisition
- Technology advancement
- Access to information
- Simplification of learning
- Communication

Knowledge and skills acquisition

University students indicated that they had the desire to gain knowledge on how best to use the Internet for educational purposes. They felt that the knowledge they would acquire would help them to effectively access information on the Internet, podcasts, Facebook and YouTube. The Internet was regarded as the main source of information since the university library did not have adequate resources. Some students who had not used the Internet, Facebook and YouTube before, welcomed the workshop because they felt that it would give them an opportunity to learn how to use these technologies and broaden their knowledge since such workshops enhance knowledge. A student who had not used the Internet before had this to say:

> *"Being a novice in these areas, the workshop will benefit me a lot. I will be able to access whatever I want because I will have the technological know-how now"* (S001, 2015).

Respondents who already knew how to access on-line instructional materials wanted extra knowledge to enrich their experience with the Internet. Technology is changing very fast and the need to learn new technologies that are relevant to education is mandatory to everyone. The issue of globalisation was also mentioned. Respondents felt that electronic instructional materials could easily be shared in this global village and the workshop on how to access electronic materials would be very useful. Some respondents were of the view that technology provided fast and accurate services hence the need to acquire tech-know-how skills in their lives. For example, one respondent was very positive about the workshop and he said:

> *"It will help us improve our learning skills and understand how to access instructional materials from the Internet"* (S002, 2015).

Technology advancement

Another theme that was mentioned frequently was technology advancement. Respondents wanted to learn whatever was latest in the IT field to remain abreast with technology. The 21st Century is an information era and respondents saw the need to be on this information super highway so as to improve their study skills through e-learning. One respondent emphasised the importance of keeping up with technology when he observed that:

> *"It is important in the modern world to acquaint oneself with modern technology in accessing instructional materials which are becoming more and more usable than traditional ways of instruction"* (S003, 2015).

Another respondent stressed the need to keep up with modern technology and linked it to learning as follows:

> *"I would like to move with advanced technology in my learning. Therefore, I would be interested to learn how to use the Internet, podcasts, Facebook and YouTube"* (S004, 2015).

Access to information

Information technology is developing fast, and most educational information is disseminated through electronic media. Some respondents believed that the knowledge they would gain from the training workshop would increase their access to electronic educational resources through the Internet, Podcasts and YouTube. It was also mentioned that some learning materials are only found on the Internet. With the acute shortage of books in our libraries, the Internet is a viable option to accessing information. Although Internet has become an important information source as stated by Findahl (2014), finding reliable information on it is not easy since it has vast amount of information some of which is fake and unreliable. It requires proper knowledge management skills. Some respondents hoped that they would get such knowledge from the training workshop.

Simplification of learning

Another important theme that emerged from the data was that technology made learning simple. On the same, one respondent said that:

> *"The Internet makes learning easier as materials for learning are made readily available"* (S005, 2015).

Students who missed classes for some reason can catch up easily on what they missed as illustrated in the following response by one respondent:

> *"Learning using technology is fun. It is also flexible due to the fact that you do not need to go to class. You can learn even when you are at home"* (S006, 2015).

Missing classes does not go well with some teachers who want every learner to attend their classes. In fact, some teachers keep attendance registers to ensure that every learner attends their classes although keeping class attendance register is only possible for small classes.

Communication

Some students felt that workshops would enable potential users to fully get acquainted with communication using modern technology. As we are living in a global village, learning and communication are continuous processes hence the need to discover modern and simpler ways of sourcing and sharing academic information. Some students stated that modern technology had simplified the way people communicate. Instead of using snail mail for communication, people nowadays use emails, Facebook, Twitter and WhatsApp more and more making communication much easier and faster than ever before.

4.5.2 Responses of lecturers and teachers on a proposed workshop on e-learning resources

Lecturers and teachers were asked to indicate whether they were willing to attend a workshop on using electronic instructional resources. All of them were willing to do so. The following themes were identified from the reasons they gave:

- Knowledge and skills acquisition
- Access to information
- Teaching methods
- Technology advancement

Knowledge and skills acquisition

Respondents were willing to attend the workshop in order to learn how to convert print instructional materials into electronic formats. At the moment, most respondents only know how to use Microsoft products like Word, Excel and PowerPoint. Some lecturers and teachers use PowerPoint through trial-and-error initiatives. They have had no formal training on how to use technology in teaching and learning. Some expressed the need to use the knowledge they would gain from the workshops in their teaching to improve their instructional delivery. They were eager to learn new skills in converting print instructional materials to electronic formats like web pages so that they could use them in their lessons. They stated that application of technology was mandatory nowadays for everyone. They also stated that the knowledge gained from the workshops would equip them with relevant knowledge and skills in electronic technology they would use in their classes since most of the activities nowadays use technology. It was generally believed that the use of relevant technology in education was essential for improved instructional delivery. One teacher expressed his eagerness to attend the workshop as follows:

> *"I have ever used PowerPoint presentations in instructional delivery. I do not know how to convert instructional materials in print format to other electronic formats. I am willing to learn."* (T001, 2015).

Many lecturers and teachers were willing to integrate technology in their teaching and learning activities as the following statement by one respondent illustrates:

> *"Application of the skills gained from such a training can improve quality of lesson presentation, storage of instructional materials and give a better chance to the learners to revise the work more effectively"* (T002, 2015).

Access to information

Lecturers and teachers alike stressed the point that the workshop would assist them acquire skills that would in turn enable them create electronic materials for their students. One respondent emphasised the importance of technology when he said:

> *"Electronic materials improve access to information in this computer age because they can be accessed at any time through smartphones and computers using the Internet"* (T003, 2015).

Apart from access, multimedia make interactivity possible. This point was illustrated by another participant who said:

> *"Having acquired the skills, it would assist me to convert my print teaching materials to electronic format that I would then give my students for their use, making lessons more interactive and interesting"* (T004, 2015).

When instructional materials have been uploaded on the Internet, many people throughout the world would access them as stated by one respondent. He alluded to the fact that electronic instructional materials would improve access for learners.

Teaching methods

Another important theme that emerged from the findings was that technology had the potential of changing the way instructional delivery was done. Firstly, technology would simplify searching, storage, retrieval and distribution of instructional materials as opposed to how it was being done using traditional ways of teaching and learning. Time would be saved if technology were used. Lecturers and teachers were ready to migrate from traditional ways of delivering lessons to a technological way of offering instruction as stated by one lecturer:

> *"It is a step towards e-learning. If the learning material is available online, it gives me as a lecturer more time to conduct research"* (T005, 2015)

The availability of teaching and learning materials in electronic form is the answer to the problems of large classes and shortage of books in libraries as stated by one respondent:

> *"It helps in delivering lectures especially when dealing with big classes where only limited textbooks are available"* (T006, 2015)

Respondents were optimistic that the knowledge and skills they would gain from the workshop would enable them to present their lessons easier. Examples that were cited included the ease of updating instructional materials that were in electronic format. Lessons in print format compel teachers to rewrite everything all over should there be need to revise the materials. It would be very easy to revise instructional materials if they were in electronic format. They believed that the whole purpose of technology was to help people do things better, easier and faster.

Technology advancement

On technology advancement, some lecturers and teachers felt that they should move with time as technology advances. They felt that they needed to embrace technology and be in line with the global village trends if they were to be relevant.

The themes that were common to lecturers, secondary school teachers and students were *knowledge and skills acquisition* and *access to information.*

4.5.3 Converting print lecture notes to electronic format

This section examined the readiness of lecturers and teachers to convert their print teaching resources into electronic format. The participants were asked whether they were willing to convert their print lesson notes to electronic format. All lecturers were willing to do so. However, two out of the thirteen secondary school teachers were not willing to do that.

The reasons that were given by those who were willing to convert their print instructional materials are presented below. The following were the themes that were isolated from the data.

- Access to information by students
- Teaching methods
- Memory and learning enhancement

Access to information by students

Lecturers and teachers asserted that electronic content was much easier to access than print. Respondents believed that e-learning would increase access to education even for those students who were not able to physically attend class. In addition, they stated that technology would enhance learning for the students. On increasing access, one lecturer commented that the materials on the Web could be accessed for twenty-four hours every day unlike print materials. In addition, many lecturers felt that learning materials in many formats would facilitate learning.

Lecturers and teachers alike believed that electronic technology would facilitate learning since almost all students, especially university students, had mobile phones, laptops and other devices that could enable them access electronic lecture notes either online or offline without problems thereby cutting costs on printing the materials. Technologies such as the Internet would improve access to information.

Teaching methods

Some lecturers and teachers were eager to convert their print lessons notes into electronic format because they felt that this would simplify their teaching especially if their lecture materials were converted into audio or video formats. Teaching using electronic formats would save time and make teaching more interesting to learners at the same time. Some lecturers also stated that technology would improve their lesson presentation skills. They were convinced that students would follow lessons better if the content were presented electronically. Some lecturers found teaching with PowerPoint enjoyable and simple. Furthermore, they found electronic instructional materials easier to store, retrieve and share than print-based resources. Sometimes it becomes necessary to revise instructional materials. On this point, they reported that electronic materials were preferred because they could easily be modified and improved. Some respondents observed that it was easy to edit or refine electronic educational materials than print information. One lecturer pointed out that it was important for him to learn how to convert his print lessons into audio or video formats since he already converts his materials to PowerPoint hence he would find it easy to learn other technologies. From the researcher's experience, Screen casting technology would be ideal for this job.

Memory and learning enhancement

It was observed by some lecturers and teachers that instructional materials in electronic format were perfect for memory enhancement because learners use more senses, especially if they are active participants in the learning processes. Multimedia instructional materials contain a mixture of text, sound, video and interactivity. They recounted that the teaching and learning materials in electronic format were more portable and the combination of text, graphics, audio and video makes learning interesting for students. They also stated that technology helps learners to seek knowledge on their own thereby enabling them become self-directed and active learners.

Two teachers were however reluctant to change their print teaching resources into electronic formats. One did not give any reason for such a stand.

The other teacher however said:

> *"At the meantime, no; but when I get the knowledge that will be very simple"* (T007, 2015).

This teacher wanted to be taught first how to digitise his print instructional materials before committing himself to converting them into electronic formats. This point of view makes sense and it would be important to include subject matter experts when redesigning the instructional materials.

4.5.4 Recording sessions

Lecturers and teachers were asked to indicate whether they were willing to have their class sessions recorded and distribute the recordings to students. Many (86%) were willing and only five (14%) rejected the idea.

4.5.4.1 Responses of lecturers and teachers who were willing to record class sessions

Reasons given by the respondents who were willing to have their class sessions recorded were classified into three thematic areas as follows:

- Access to instructional materials
- Revision of classwork at students' convenient time
- Simplification of teaching and learning

Access to instructional materials

Access to instructional materials was one issue that was mentioned by lecturers and teachers who said that recording class lessons would help learners have easy access to what was previously covered in class. Respondents felt that this innovation would be an easier way to ensure that all students had access to lecturer presentations. It would also ensure that students who missed out on classes for whatever reason had access to class proceedings. Sometimes lecturers and teachers miss classes because of some commitments. When this happens, students would use the recorded lessons in the absence of teachers. The lessons would be distributed using CDs, DVDs or they could be uploaded on servers to be accessed online. One advantage of recording class lessons is that students are able to access the lessons at their own time. This technology can enable students to replay any part of the lesson that they did not understand. In turn, this activity will enhance their understanding of the lessons. Books are not only scarce but they are often too expensive for students and educational institutions to buy. Recording class lessons will meet the challenge of scarcity of textbooks.

Revision of classwork at students' convenient time

Some lecturers and teachers were willing to record their classes because they believed that recorded work would assist learners to revise the work covered in class at the students' own convenient time. This would also give enough time to students to study the notes within class time or remotely as long as they had access to local area network or the Internet. Students can revisit what they learnt in class should they wish to do so. Students would have an opportunity to replay lessons in order to understand better what they did not understand in class. This idea was emphasised by one lecturer who said:

> *"Students will have a chance to listen to the lessons at their own appropriate time. Sometimes students grasp or fail to grasp what is covered in class depending on the mood of the day or due to other factors. Recorded instructional materials will give them another chance"* (T008, 2015).

Modern technology gives learners opportunities to learn using various media. For example, they can download recorded lecture sessions to a smartphone, tablet or laptop to be accessed whenever they wish. Recorded class sessions can be distributed to students in various formats such as mp3 audio or mp4 videos which they can listen to or watch, as the case may be, if they missed a point during the live lecture presentation. This would improve their retention of what was covered in class and in turn boost their understanding of the lesson.

Simplification of teaching and learning

On the aspect of teaching and learning, lecturers and teachers were of the view that technology makes the teaching and learning process easy. It was pointed out that electronic class notes can be easily modified or updated. Lecture notes that are in electronic formats are more portable for students. It was also noted that lecturers and teachers, other than the authors of the recorded instructional materials, could use the recordings in their classes. This sharing of information will enable revision of the work developed by others thereby promoting the spirit of peer learning and acceptance.

4.5.4.2 Responses of lecturers and teachers who did not want to record their classes

Two lecturers who were against recording their class sessions for distribution to students wanted to be assured that issues of copyright would be sorted out before they could allow their instructional materials to be converted into audio or video formats. The fear was that their intellectual property would be abused by people who were good at copying, manipulating and using other people's work without permission. This is a valid observation because unlawful copying of people's work is rampant in Malawi and elsewhere around the globe. Safeguards need to be put in place if intellectual property rights are to be protected. One way would be to upload the recorded materials on platforms that allow only registered users to access the materials without downloading them.

Another issue that was raised was that the recorded materials would encourage laziness among students. They would become less attentive in class and some would even miss classes because they would find class proceedings uploaded online after class. Another legitimate concern was equity. Not all learners would have access to the recorded class sessions because some of them did not have access to computers, DVD players or mobile phones. This observation is true because the findings of this study showed that secondary school students who had access to DVD players and mobile phones were only 67% and 62% respectively. To make matters worse, the mobile phones that most students had could not play videos. Another interesting fact on mobile phones is that secondary school students were not allowed to bring cell-phones to school because teachers believed that phones distract students from learning. It would, therefore, be very difficult to use mobile phones for distributing recorded class sessions to secondary school learners in this a case. This means that other ways of distribution should be found. After finding out that lecturers and teachers were willing to record their classes, the researcher wanted to know if students were willing to use recorded instructional materials. The following two sections present students' opinions on this matter.

4.5.5 Use of recorded class sessions – Responses from secondary school students

Secondary school students were asked to indicate if they would use recorded class sessions. Four students, which represent about 4%, did not respond to this item. Majority (77%) were willing to use recorded materials. It is interesting to note that a significant percentage (23%) indicated that they would not use the recorded materials. The reasons given by the two groups are presented in the sections that follow.

4.5.5.1 Responses of students who were willing to use recorded class sessions

The reasons given by secondary school students who had shown interest in using recorded instructional materials have been summarised under two thematic areas:

- Knowledge acquisition
- Memory enhancement and convenience

Knowledge acquisition

Some students indicated that they were willing to use recorded class sessions because they wanted to acquire knowledge about technology so as to become experts in using CDs, DVDs, cell-phones and the Internet. They also believed that from the recorded sessions they would get more information in addition to what they got in class.

Memory enhancement and convenience

Many students welcomed the idea of using recorded class materials because they believed that it was easy to remember what they learnt in class so as to pass examinations easily. They explained that recorded materials were advantageous because they acted as reminders of what was covered in class. They said that they understood lessons better when they went over the materials repeatedly. When they replay recorded information their memory would be enhanced as reported below:

> *"Sometimes notes we write at school cannot be read properly. Recorded information will be like watching a movie and cannot be forgotten in our brains"* (S007, 2015).

Recorded instructional materials will help those students who missed classes due illness or other reasons. In addition, respondents were convinced that recorded class sessions would enable them to study at their own time. The following quotes reflect a variety of opinions from the student respondents:

> *"It will help students study more and make own notes"* (S008, 2015).
> *"You can be watching the materials at your own time"* (S009, 2015).
> *"Students can rewind videos to understand better"* (S010, 2015).
> *"We will have access to the information wherever we are"* (S011, 2015).
> *"It can help us revise easily"* (S012, 2015).
> *"It makes learning easier and faster"* (S013, 2015).
> *"Because one can read at any time one wants"* (S014, 2015).
> *"Helps one hear the instruction clearly without anything that can disturb you" (S015, 2015).*

Participants presented other advantages of using recorded class material which included, among others, access and enhancement of the teaching and learning process, and ease of distribution of information. Views of some participants are recorded below:

> *"Knowledge gained in class can be easily distributed to others using technology"* (S016, 2015).
> *"I want to have access to computers" (S017, 2015).*

> *"It will be cheaper for students as they will stop buying books. Students can rewind videos to understand better"* (S018, 2015).
>
> *"Since it is fast, it helps learners capture many things at a time* (S019, 2015).
>
> *"Technology will make a country develop"* (S020, 2015).

A problem with using recorded instructional materials is that it would encourage rote learning especially in examinations where students are required to reproduce exactly what they learnt in class.

4.5.5.2 Reasons given by students who were against using recorded class sessions

A significant number of students (23%) were against the idea of using recorded class sessions. Several reasons were given by these students. Firstly, they observed that these materials would distract them from learning. They would not concentrate on what the teacher would be teaching because they would be thinking that even if they missed some information or facts in class, they would replay the whole session afterwards. On use of phones and the Internet, one participant had this to say:

> *"Recorded materials will disturb learners because they will be busy with phones and Internet during class"* (S021, 2015).

Knowing the current '*dot.com*' generation, one needs to be cautious before introducing technology in class. Enough research is required before introducing innovation into the classroom. Cellphones may turn out to be more of a distractor than a tool for learning. Some students felt that recorded media would promote laziness in students. Instead of learning actively in class, students would passively attend a class and they would stop taking notes because they would be relying on recorded lessons.

Lack of access to technology was another issue of concern. Participants said that not everybody would have access to the recorded materials because some students cannot manage to buy the equipment required to view the recorded material. One participant mentioned lack of knowledge to use technology as the sole reason he was against the idea of using recorded class sessions. Some participants insisted that a teacher should be physically present in the class for them to learn. This idea was expressed by two respondents as follows:

> *“Some students cannot understand by just watching recorded class session but they need a teacher in front of them”* (S022, 2015).
>
> *“Some students understand clearly when somebody is teaching face-to-face”* (S023, 2015)

Another concern that was mentioned against using recorded class sessions was lack of interactivity between teachers and learners unless the electronic instructional materials were in an interactive web page format. Some of the participants' responses on the issue of interactivity are as follows:

> *“Students will find it difficult to understand the lesson because they will not be able to ask questions”* (S024, 2015).
>
> *“I won't be able to ask questions on where I haven't understood”* (S025, 2015).
>
> *“If there is anything we haven't understood, we cannot ask questions* (S026, 2015).

A suitable way needs to be devised to enable students ask questions whenever they need clarification as they watch recorded class sessions. For example, it might be possible set aside toll-free numbers for students to use whenever they have questions although that arrangement would come at a cost. A less expensive method for students to communicate with teachers after class would be to use social media such as Facebook or WhatsApp. The problem with this provision though is that students who did not have access to social media would be stranded. It would appear that students would have to meet teachers concerned in order to ask questions and get feedback physically or virtually through video conferencing.

4.5.6 Use of recorded class sessions – Responses from university students

Students at MZUNI were also asked to indicate if they would use recorded class sessions. Only one out of sixty-nine did not respond to this item. Majority (88%) were willing to use the recorded materials. Twelve percent indicated that they would not use the recorded materials.

4.5.6.1 Responses of university students willing to use recorded class sessions

University students gave a variety of reasons for accepting to use recorded instructional materials. Their responses were grouped into the following main themes:

- Reviewing class sessions
- Convenience
- Recorded classes are like face-to-face lessons
- Access to information
- Time saving and Technology advancement

Reviewing class sessions

Participants indicated that using recorded class sessions was a good way of reviewing some of the things they had missed in class. Recorded instructional materials would also act as a reference point to be revisited in the event that a student did not understand a concept in class. Similar sentiments were expressed by secondary school students. Presented below is a selected sample of what the participants said on this issue:

> *"They would give me an opportunity to have a second chance of attending the lectures so that I correct misunderstandings"* (S027, 2015).
>
> *"It will act as a reminder to students where some important points will be remembered easily"* (S028, 2015).
>
> *"Revising the work covered in class will be easy especially the areas that were not clear in class"* (S029, 2015).
>
> *"It makes us understand lessons easily as one is able to replay the*

materials when one did not understand" (S030, 2015).

"Recorded classwork gives us an opportunity to replay specific parts of the session which we missed in order to clearly comprehend taught aspects" (S031, 2015).

Convenience

Some participants stressed the point that the convenience that comes with portable recorded e-learning materials was very important in their learning. They believed that they would understand things better if they studied at their own pace without pressure, and recorded class sessions would provide just that. These materials would enable students to learn at their own pace and at a time they felt comfortable. Here are some sampled responses on the issue of convenience:

"I learn more when I am alone at home and this can save time because we have a small number of lecturers in our institutions and they cannot manage large number of students" (S032, 2015).

"Recorded work can be accessed any time without the hassle of reading many books, walking around with books or modules" (S033, 2015).

"Recorded work can be accessed at any time and place" (S034, 2015).

"These class sessions can be attended at my own time, and it can allow me to attend to other issues because these classes are not scheduled or confined to specific periods as we are doing currently" (S035, 2015).

"During rainy season, I may fail to go to class so I can use the recorded class sessions thereby making the learning process simple" (S036, 2015).

"Recorded materials are not restrictive. One can listen to them while in transit, in a bus, and or at the sports ground while watching soccer" (S037, 2015).

Some students felt that they could only learn by using the traditional face-to-face mode of instructional delivery. They needed the presence of the teacher in class delivering a lesson. Anything short of that would not do. These students felt that recorded instruction would give them a sense of getting direct information from an instructor. They indicated that they would feel as if they were part of an actual face-to-face class session when they watched or listened to recorded information even when they were studying at home alone. The videos and the voice of their lecturers would give them the much-needed *human presence*.

Access to information

Another area that was deemed important by some participants was access to information. They observed that recorded instructional materials enabled learners to have easy access to information as one does not waste time going into the library to search for information in books. The information could easily be stored and accessed any time one needed it. They also stated that use of recorded materials would eventually reduce overcrowding in small university libraries. The problem of scarcity of books would be reduced because the recorded class sessions would be alternative sources of information. Additionally, it was observed that information recorded on CDs, DVDs or memory sticks cover a wider range of formats such as text, graphics, audio, video, animation and interactivity. Hard copies cannot do all these things.

The issue of cost to students was also mentioned. One respondent indicated that it would be cheaper to access recorded instructional materials than printing and photocopying volumes of materials from lecturers. Instead, learners would access them easily if they were distributed online or offline using CDs, DVDs, smartphones, tablets or memory sticks.

Time saving

On the issue of time management, some respondents said that recorded class sessions would save time spent on live lectures. They stated that apart from taking a long time, face-to-face lectures were costly as many resources were used each session. These problems could easily be solved if each lecture session was recorded when it was being delivered and distributed to students in various electronic media. Recorded instructional materials were also commended for their ability to be stored for a long time and their ability to be used, reused and revised. Additionally, electronic materials were also considered as highly portable since they were not as bulky as hard copy books would be. These instructional materials are easy to transfer from one place to another, an element that also reduces transportation costs.

Technology advancement

Two participants said that they were ready to use recorded instructional materials because they did not want to be left behind since technologies were radically changing each time. This is what they had to say:

> *"I want to keep abreast with changing nature of the technology"* (S037, 2015).
>
> *"I am very excited because I have never experienced a recorded class session before"* (S038, 2015).

4.5.6.2 Responses of university students who were against using recorded class sessions

Twelve percent (12%) of the students who were against the idea of using recorded class sessions bemoaned lack of access to technology as a major obstacle. This was also identified by secondary school students. They lamented that most electronic devices that were used to access e-content were expensive and many students could not afford to buy them. After all, many students did not even have access to such technologies. Additionally, they complained that the Internet services were very expensive and sometimes connectivity was very slow. They also pointed out that the local area network at MZUNI was not efficient so that having classes using the University's website was problematic. The fact that Internet connectivity is slow is indeed true for Malawi, nevertheless, it should be noted that efforts are underway to improve both the local area network and Internet bandwidth both at MZUNI and in Malawi. MZUNI also has a backup generator to supply power to web servers to help when electricity from the national grid is interrupted. Another challenge of using recorded materials that was identified was lack of interactivity. This challenge was also stated by some secondary school students.

This is what was reported by two participants from MZUNI:

> *"I prefer live teaching because I will be part of the learning process since I will be able to ask questions and get responses immediately hence I will be attentive"* (S039, 2015).
>
> *"Recorded classes do not offer instant clarification when a student is lost and wants to ask questions on something"* (S040, 2015).

4.5.7 Access to electronic instructional materials

Students from the four sampled secondary schools and MZUNI were asked to indicate the media they felt were practical to access electronic instructional materials.

Table 4-13 Sustainable media for secondary school students

Media	**Frequency**			**Total**
	CSS-1	**CSS-1**	**CDSS-2**	
DVD player	35	12	16	63 (60%)
Internet	18	16	6	40 (38%)
Facebook	15	14	8	37 (35%)
Smartphone	10	9	3	22 (21%)
mp3 player	8	12	0	20 (19%)
Personal computers	5	8	5	18 (17%)
Memory sticks	7	5	4	16 (15%)
Institution's computers	6	7	1	14 (13%)
Blank DVDs	2	4	5	11 (10%)
Blank CDs	1	3	7	11 (10%)
YouTube	4	3	2	9 (9%)
iPod	2	3	4	9 (9%)
Tablet	4	4	0	8 (8%)
e-learning platform	6	1	0	7 (7%)
iPad	3	3	0	6 (6%)
Radio	0	5	0	5 (5%)

The top five electronic media in order of popularity that secondary school students indicated that they could use sustainably to access electronic instructional materials were DVD players, Internet, Facebook, smartphones and Mp3 players. About 40% of the secondary school students did not have access to those media they indicated they could be used sustainably. However, 60% of the students found DVDs sustainable and usable. The rest of the media were identified as not sustainable by the rest of the students. Therefore, a way to enable every student to have access to the electronic instructional materials must be found. Secondary schools that have computer laboratories only allow students who are studying Computer Studies to access computers in the laboratories. So far Computer Studies is an optional subject in Malawian secondary schools. If possible, other students can be allowed to have access to the computers on a rotational basis. Maybe head teachers could be asked to change policy on accessing computers in computer laboratories. For the CDSSs, another solution needs to be found if technology is to be integrated into the teaching and learning process since they do not have computers to be used by the students. Findings for university students are presented in Table 4-14.

Table 4-14 Sustainable media for university students

Media	Frequency			Total
	P1	P2	P3	
Personal Computer	5	12	38	55 (79%)
Cell phone	5	13	29	47 (67%)
DVD player	3	12	24	39 (56%)
Moodle	0	2	32	34 (49%)
Facebook	5	9	18	32 (46%)
University’s computer	5	4	21	30 (43%)
University’s Website	5	6	17	28 (40%)
YouTube	5	5	9	19 (27%)
Tablet	2	3	6	11 (16%)
Projector	0	0	3	3 (4%)

For anonymity, the three programmes of study at MZUNI where data were collected have been randomly assigned codes P1, P2 and P3. The top five electronic media in order of popularity which the university students indicated that were sustainable were personal computers, cell phones, DVD players, Moodle and Facebook. It has been observed recently that many students at MZUNI are bringing personal laptops to use on campus. Consequently, it is not surprising to find that 79% of the students preferred personal computers as a better way of accessing electronic instructional materials. It is surprising though, to find that only 43% found University computers accessible. There is need to urge management to do more to make computers more accessible to students.

4.5.8 Teachers' and lecturers' knowledge and skills of designing e-learning materials

The researcher wanted to find out the state of existing knowledge and skills of teachers and lecturers regarding designing of e-learning materials. The respondents were asked to indicate whether they had designed e-learning materials before or not. Majority (64%) indicated that they had not designed e-learning instructional materials before as shown in Table 4-15 below.

Table 4-15 Teachers' and lecturers' e-resources design experience

Category	**Frequency**		**Total**
	Secondary School Teachers	**MZUNI Lecturers**	
Have designed e-learning materials before	1 (3%)	12 (33%)	13 (36%)
Have not designed e-learning materials before	12 (33%)	11 (31%)	23 (64%)
Total	13 (36%)	23 (64%)	36 (100%)

Teachers and lecturers were asked to indicate media formats that they had used before. Findings showed that the most common format of e-learning instructional materials that was used by teachers and lecturers was PowerPoint. Video and audio media were not common modes of instruction in teaching and learning. This finding means that teachers and lecturers needed to be taught how to design and deliver lessons using these media formats. It was also found that a few teachers and lecturers who used e-learning materials mostly distributed the electronic instructional materials using flash disks. It could be that more lecturers used flash disks to distribute their materials to students who had personal laptops. Using CDs and DVDs to distribute electronic materials in addition to flash discs would increase the number of students with access to these materials because majority (63%) of students at secondary schools and a substantial number (56%) of students at MZUNI had access to DVD players. Media used for distributing e-learning instructional materials is summarised in Table 4-16.

Table 4-16 Media used for distributing e-learning instructional materials

Media	**Frequency**
Flash Disks	9 (25%)
Website	4 (11%)
Email	2 (6%)
DVDs	1 (3%)
Blog	1 (3%)

4.5.9 Use of supplementary e-learning instructional materials by university students

Student respondents were asked to indicate whether they used additional resources to supplement what they learnt in class. The data showed that 61% of the students did not use supplementary e-learning instructional materials. It was also established that the few students who used additional materials mainly got them from the Internet. The same was true of secondary school students. In case of the latter, 78% did not use any additional e-learning materials. The only source of their instructional materials was from their teachers. The few that used supplementary e-learning resources said that they found it difficult to access their teachers' computers since these computers were also being used by the teachers to prepare lessons. These findings seem to suggest that it is essential for teachers, lecturers and instructional designers to agree to design more e-learning materials to be accessed by their students off-line. Institutions should acquire more computers or tablets or other means of distributing electronic content to enable students access the electronic teaching and learning resources more easily.

4.5.10 Use of social media by secondary school students

The researcher was also interested to find out if social media could be used in teaching and learning. It was established that it would be easy to integrate social media into the education system if students were already using it. Given this, secondary school students were asked to indicate the type of social media they used. The findings on use of social media by secondary school students is shown in Table 4-17.

Table 4-17 Social media used by secondary school students

Social media	School			Total
	CSS-1	CDSS-1	CDSS-2	
Facebook	36	12	13	61 (58%)
WhatsApp	16	4	3	23 (22%)
Twitter	1	0	5	6 (6%)
Waplog	1	0	0	1 (1%)
Skype	1	0	0	1 (1%)
We Chat	1	0	0	1 (1%)
Viber	1	0	0	1 (1%)
Samsung Chat on	1	0	0	1 (1%)

The most widely used social media by secondary school students was Facebook but forty-four students did not use it. These students constitute 42% of the secondary school student sample, which is quite significant. A possible explanation for this state of affairs could be that many secondary school students did not have access to computers, tablets or mobile phones. It would therefore be problematic to use Facebook with this group of students for academic purposes unless the challenges of access to computers, tablets or smartphones were solved. A further probe into the purposes for which the students used social media revealed that many of them used it for social interaction and not for academic purposes. This is not surprising because social media like Facebook and WhatsApp are primarily meant for social communication. Thus, introducing it for teaching and learning in schools would be very difficult because access to computers is limited, the schools do not have Internet connectivity and students are not allowed to bring phones to school.

4.5.11 Policy on e-learning

The study wanted to find out from lecturers and teachers if there were policies on e-learning in their institutions. Their responses are presented in Table 4-18 below.

Table 4-18 Responses of teachers and lecturers on existence of policies on e-learning

Response	School					Total
	MZUNI	CDSS-1	CDSS-2	CSS-1	CSS-2	
Not sure	15	1	1	1	1	19
Do not exist	6	3	0	2	2	13
Exist	1	0	0	1	1	3
Total	22	4	1	4	4	35

Only three respondents out of thirty-five indicated that policies on e-learning exist at the learning institutions. At the moment e-learning is optional in educational institutions. One possible contributing factor to low uptake of technology in education could be lack of policy on e-learning. Given these realities, it is proposed that learning institutions should develop policies on e-learning and make it mandatory for members of academic staff and students to use. That way, people will be compelled to use e-learning in teaching and learning. Of course, enabling environment should be set up for this to be possible. In the absence of any policy, teachers, lecturers and students are not mandated to use e-learning. It is optional.

4.5.12 Formative evaluation of existing e-learning programmes

Some work had already started on e-learning at MZUNI before this study was conducted. The researcher felt that it was imperative to collect baseline data of what already existed to inform Phase Two of the study. Formative evaluation of these e-learning projects was done using Likert scale. The Likert scaling method is used to measure a positive or negative response to a statement. It is a five-point response scale on which respondents rate their level of agreement or disagreement with a statement. The values produced by questions on the Likert scale are numerical and can be treated as measurements from an interval scale (Gravetter & Forzano, 2009). The Likert scale is commonly used to measure the strength of attitudes and beliefs (Dyer, 1995).

The work that was assessed in the formative evaluation included an audio (mp3) module on Communication Skills, C-Programming interactive website, instructional materials on Moodle and WhatsApp. The following three sections present details of the findings on the formative evaluation.

4.5.12.1 Formative evaluation of audio (mp3) module on Communication Skills

Students at MZUNI who were pursuing a bachelor’s degree programme in education under the ODL delivery mode used print modules as their main source of instruction. Management at CODL, with the help of SMEs, repurposed a Communication Skills module from print to audio. They used Text-to-Speech software to carry out this conversion. It should be mentioned here that Text-To-Speech software was used because lecturers were not willing to voice-over the print modules. Fifteen first year students were asked to formatively evaluate the repurposed module. Only eight responded, giving a response rate of 53%.

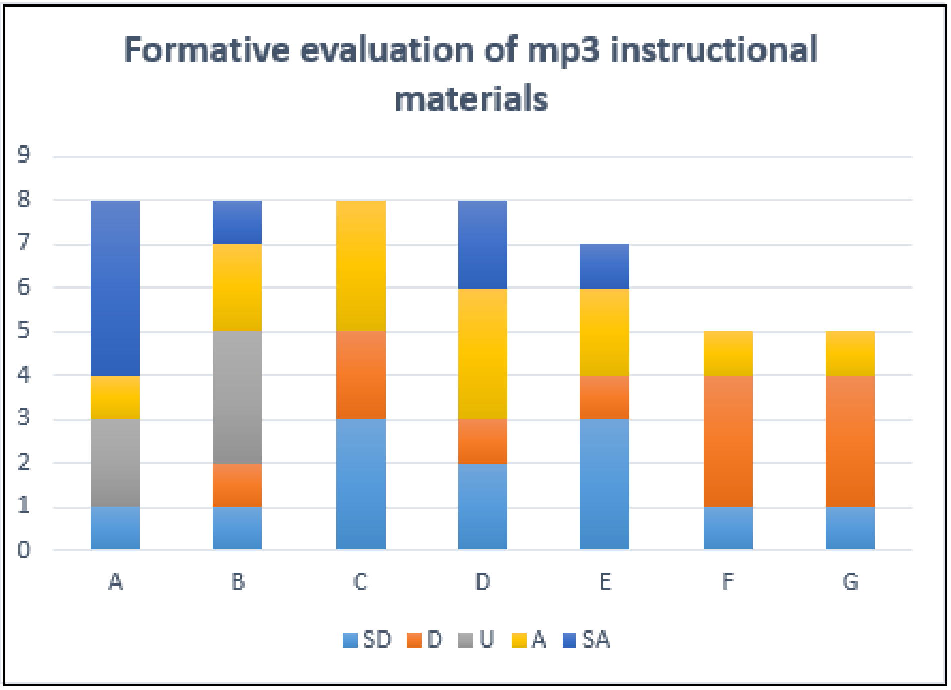


Figure 4-1 Formative evaluation of mp3 instructional materials

Key:

SD **-** Strongly disagree; D – Disagree; U – Undecided; A – Agree; SA - Strongly agree

The respondents were asked to indicate their opinion regarding the module using a five-point Likert scale. One participant did not respond to item E, while three participants did not respond to items F and G. Students' responses are shown in Figure 4-1.

The following table shows the seven statements that were used for the formative evaluation questionnaire and the responses that were given by the eight participants who had responded to the invitation to evaluate the audio module.

Table 4-19 Responses of students to statement A on audio e-Modules

Statement A: *It was easy to follow mp3 audio on Communication Skills.*
Students' responses: The graph (Figure 4-1) shows that most respondents (5 out of 8) found it easy to follow the mp3 audio presentation of the Communication Skills module. Two were undecided and one found it difficult to follow.

Table 4-20 Responses of students to statements B-E on audio e-Modules

Statement B: *The accent of the presenter of the mp3 Communication Skills lectures was easy to understand.* The opinions were divided on the accent of the presenter. Three respondents agreed while two disagreed. There were two participants who were not decided. The voice used to convert the text to speech was female American.
Statement C: *The print module on Communication Skills should be given to students alone without mp3 module.* Most respondents (5 out of 8) indicated that the print module should not be given to students without the accompanying mp3 audio module. A possible explanation for this finding is that sometimes the students may want to listen to the recording of the module without reading it. There may be times when they may want to read the module hence the need to have them in the two formats.
Statement D: *The print module on Communication Skills should be given to students with the mp3 file.* Most respondents (5 out of 8) indicated that the print module should be given together with the mp3 module. This question was asked to check for consistency in the respondents' answers. There was consistency in the answers provided in Statements C and D.
Statement E: *The mp3 file on Communication Skills should be given to students alone without the print module.* Four participants indicated that the mp3 module should not be given to students without the print module. Three participants indicated that the mp3 module could be given alone. One participant did not respond. The explanation for this statement is similar to the one given in Statement C.

Table 4-21 Responses of students to statements F-G on audio e-Modules

Statement F: *I found the mp3 module on Communication skills very helpful.* Out of the five participants who responded to this item, four respondents disagreed and one agreed. This means that many students did not find the mp3 module very helpful.
Statement G: *I could do without the mp3 files. They were a waste of time.* Out of the five participants who responded to this item, four respondents disagreed and one agreed with the statement to do away with mp3s. This finding seems to contradict the finding in Statement F. Although they found the mp3 module not very helpful, still they could not do away with it.

Summary: These findings showed that the students found the audio files helpful. What is needed is to find a Text-to-Speech audio accent that Malawian students can understand easily. The fact that the Text-To-Speech voice that was used was American might explain why some respondents could not easily follow the module since majority of learners are used to teachers with Malawian accent in many secondary schools in the country. Alternatively, MZUNI should encourage lecturers to produce mp3 audio modules based on the print modules and give both modules to students.

4.5.12.2 Formative evaluation of the C Programming website

In preparation for this study, the researcher had designed a C Programming website which was given to the five students who had registered in the second year of the bachelor’s degree programme in ICT in December 2014 to formatively evaluate. The website was designed to supplement the C Programming lecturer’s presentations. Formative evaluation is a step in the systematic design of instruction (Dick, Carey, & Carey, 2001). Their responses are shown the Figure 4-2.

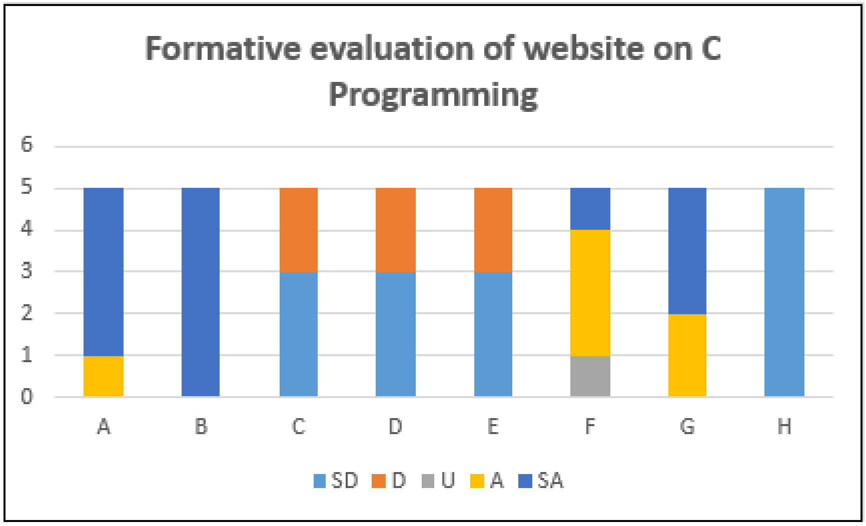


Figure 4-2 Formative evaluation of C-programming website

Key:

SD **-** Strongly disagree; D – Disagree; U – Undecided; A – Agree; SA - Strongly agree

All five respondents evaluated the website. The participants were asked to respond to eight statements in order to get their opinions on the website.

Tables 4-22 and 4-23 below present statements that were used for the formative evaluation and the summaries of responses that were given by the five students.

Table 4-22 Responses of students to statements A-B on the C Programming website

Statement A: *I found the exercises on the website very helpful.* All 5 respondents found the website on C-Programming very helpful.
Statement B: *I attempted to do the exercises first before looking at the solutions.* All 5 respondents strongly agreed with the statement. This means that they attempted the exercises first before checking the solutions. This is what the lecturer expected from the students although it was tempting to look at the solutions without tackling the questions.

Table 4-23 Responses of students to statements C-H on the C Programming website

Statement C: *I looked at the solutions first before attempting the exercises.* Three respondents strongly disagreed and 2 disagreed with the statement. This statement was included to check for internal consistency of the responses to Statement B above. The responses were consistent.
Statement D: *I would prefer if the website did not have solutions to the exercises*. All 5 respondents preferred the website to have solutions. Detailed solutions to the questions give immediate feedback to students and hence enhance learning.
Statement E: *I did not find time to use the website at all.* All the 5 respondents indicated that they found time to use the website. This finding was encouraging. One would hope that when such interactive websites were fully functional, they would be utilised fully for learning.
Statement F: *I used the website for revision.* Four respondents indicated that they used the website for revision while one respondent was not sure. This finding tells us that the website was useful to the students.
Statement G: *I used the website to prepare for classes ahead of time*. The results in Figure 4-2 indicated that all respondents used the website to prepare for classes. Just as the finding in Statement F, the website was useful for students' learning.
Statement H: *The website did not help me at all. I found it a waste of time*. This statement was included to check for internal consistency to the response to Statement (A) above. All respondents strongly disagreed with the statement, which means that the students found the website useful for learning. The responses were consistent.

When asked whether the students met any challenges when accessing the website on C programming, four respondents indicated that they did not meet any problem. One student did not respond to this item. The following is a summary of the suggestions that the four students made on how to improve the website:

- Publish the website on the Internet to enable more students access it
- Include content on C Pointers
- Include more exercises
- Include more elaborate solutions to the questions

Summary: Students found the website useful and preferred it to have solutions to the practice questions. The observations the students made were apt and were noted for implementation in Phase Two.

In addition to being given the C Programming website, students were also given mp3 files and mp4 videos of the C Programming class sessions to evaluate. After they had interacted with these multimedia files and the website, they were asked if these instructional materials had any effect on their studies. Three out of the five respondents found that the use of the electronic instructional materials had a positive effect on their studies as elucidated by the following responses:

> *"The instructional materials supplemented what was taught during class"* (S041, 2015).
>
> *"The effect was positive because it helped me pass the C exams"* (S042, 2015).
>
> *"Because I passed C exams easily"* (S043, 2015).

The two respondents who indicated that the electronic instructional materials did not have any positive effect on their studies did not explain why they said that. However, all the five respondents recommended that their lecturers should design more electronic instructional materials. The following were their reasons for making the recommendations:

> *"Because they act as backup. You can revisit them if you have forgotten the materials"* (S044, 2015).

> *"I recommend that the lecturers should continue designing more electronic instructional materials because it helps to remind students things they did not understand in class"* (S045, 2015).
>
> *"It is very easy to do revision"* (S046, 2015).
> *"It is very easy for a student to follow through if some details were missed during class"* (S047, 2015).
>
> *"It helps me study easier because I can study in any environment using my cell-phone along with my ear phones like how I do with music. I also get the song message easier just like with mp3 lecture notes"* (S048, 2015).

4.5.12.3 Formative evaluation of Moodle

One lecturer at MZUNI gave his lessons using Moodle. He uploaded all his lessons for all four levels of study on Moodle. He is one of very few lecturers at MZUNI who use this Learning Management System for teaching and learning. He had a total of fifty students in the four classes he was teaching. Forty-four responded giving an 88% response rate. The students who took his courses were asked to formatively evaluate the instructional materials that he uploaded on Moodle. The following is a summary of students' opinions concerning use of Moodle:

Table 4-24 Responses of students to statements A-B on Moodle

Statement A: *I found instructional materials on Moodle very helpful.* Majority of the respondents (87%) found instructional materials on Moodle useful.
Statement B: *I was able to download instructional materials from Moodle without problems.* Majority of the respondents (84%) were able to download instructional materials from Moodle without problems.

Table 4-25 Responses of students to statements C-G on Moodle

Statement C: *I would rather read instructional materials online than download them onto my computer hard drive to read offline.* Most respondents (66%) indicated that they would have preferred to download instructional material from Moodle and read them offline. All those who indicated that they would rather download the instructional materials have access to computers and smartphones. It seems that high Internet charges and slow Internet connectivity compel students to download instructional materials to use offline as opposed to reading online.
Statement D: *I was able to communicate with my fellow classmates using Moodle.* Almost half of the respondents indicated that they did not communicate with their classmates using Moodle. When the researcher interviewed the lecturer of the course, it was discovered that the students had not yet started using Moodle's discussion forum. This may explain why the students did not communicate using Moodle.
Statement E: *I was able to communicate with my lecturer using Moodle.* The results showed that the students were communicating with the lecturer using email but not using Moodle. Maybe there would have been more communication using Moodle if the class had been introduced to the Moodle's discussion forum.
Statement F: *I did not find time to use Moodle at all.* Majority of the respondents (91%) disagreed with the statement meaning that they found time to use Moodle. The lecturer uploaded all his presentations on Moodle and he expected all his students to download them. This could explain why majority of the students used Moodle.
Statement G: *I would recommend that all lecturers in the department use Moodle for teaching.* Most respondents indicated that they would recommend that all lecturers in the department should use Moodle for teaching and learning. Seven respondents indicated that they would not recommend use of Moodle by all lecturers in the department. In response to this statement, recommended its use when they were asked again later for their recommendation on the use of Moodle. The seven who held the contrary view did not explain why they held such a view. Internal inconsistencies were found with respondent who did not recommend use of Moodle by all lecturers.

Table 4-26 Responses of students to statements H on Moodle

Statement H: *Moodle did not help me at all. I found it a waste of time.* Majority of respondents (93%) did not find Moodle a waste of time. The respondents who did not find Moodle not helpful did not say why.

Summary: On the whole, students found Moodle useful and recommended that all lecturers should use it as a teaching and learning platform.

The same students were asked to indicate how often they used Moodle. Thirty-four percent of the students accessed the Learning Management System daily. Fourteen percent of the students accessed the instructional materials whenever the lecturer posted them on the platform. This means that about half (48%) accessed Moodle whenever the instructional materials were uploaded onto the system. It is interesting to note that about half (52%) of the students were not accessing instructional materials whenever lecturers posted them. One wonders where these students were getting the instructional materials from, if at all. A possible explanation could be that they were asking their classmates who had access to the system to share the information with them.

When the students were asked whether they faced problems accessing learning resources on Moodle, about three-quarters admitted facing some challenges. The major problem that a significant number of the students (36%) mentioned was the frequent electricity blackouts which rendered Moodle inaccessible. The demand for electricity in Malawi is higher than the national grid can supply. This makes it necessary for the Electricity Supply Commission of Malawi (ESCOM), the sole supplier of electricity in the country, to resort to load shedding. In ideal setting, the load shedding should not interrupt power to the web server at MZUNI because the University has a standby generator which should automatically supply power to the server which houses Moodle should the power supply from ESCOM fail. The web server also has an Uninterruptible Power Supply (UPS) which should ensure seamless power changeover should there be any problem with power from ESCOM or the standby generator. If students do not access Moodle every time they log onto the system, then the power supply system needs to be checked. A summary of the challenges students met are presented in Table 4-27.

Table 4-27 Problems faced by students when accessing Moodle

Problems	Frequency
Intermittent network due to unreliable electricity supply	18 (36%)
Lack of knowledge on how to use Moodle properly	5 (10%)
Slow Internet connectivity	5 (10%)
High Internet charges	5 (10%)
Moodle was locked sometimes	4 (8%)
Difficulty in downloading instructional materials	3 (6%)
Lack of Internet access	3 (6%)

Other problems cited by 10% of the participants included lack of knowledge on how to use Moodle properly, slow Internet connectivity and high Internet charges. MZUNI is currently upgrading its local area network and the Internet bandwidth has already been increased. This means that connectivity problems will be over soon but there is still need for the lecturers concerned to ensure that other problems are looked into to ensure that all students in their classes have access to educational materials they upload on Moodle.

Opinions of the students on whether lecturers in the department should continue using Moodle for instructional delivery were sought. Eighty-nine percent of the students recommended that lecturers should continue using Moodle because it enabled them to have increased access to instructional materials as they were able to access materials uploaded by lecturers anytime. Another advantage of using Moodle was that students did not have to be physically present in class in order to access learning materials. Some students (11%) were against the idea of continuing using Moodle for instructional delivery. The main reason was that they did not have access to computers and local area network at the University. Their suggestion was that the current problem of access should be sorted out first in their favour before continuing using Moodle. The data suggests that once the problems of Internet access and connectivity are sorted out, the use of Moodle will be an acceptable mode for delivering instructional materials. Detailed responses on this issue are summarised in Table 4-28.

Table 4-28 Reasons for recommending continued use of Moodle

Reasons for recommending Moodle	Frequency
Moodle increases access to instructional materials	23 (46%)
Moodle is a good communication method between lecturers and students and among students	11 (22%)
It reduces cost of instructional materials	3 (6%)
Need for students to be abreast with technology advancement	2 (4%)
The novelty of this mode of instruction is exciting	2 (4%)

Participants were asked to suggest how to improve Moodle as a channel for delivering instructional materials. The major suggestions were that Internet connectivity should be improved and increase the number of computers so that students could have better access. They also suggested that more orientation sessions should be held to enable beginners to learn how to use Moodle.

4.5.12.4 Formative evaluation of Year 3 class WhatsApp group

The Centre for Open and Distance Learning (CODL) at MZUNI had students in years 1, 2 and 3 during the time data were collected for Phase One of the study. These students were pursuing Bachelor of Arts Education and Bachelor of Science Education degree programmes. The researcher created a WhatsApp account for each group in June 2014 to facilitate information flow between the Centre management and the students as well as among students. A focus group discussion was conducted on 2nd December, 2014 with a class of open and distance learners who were in third year of study to formatively evaluate the class WhatsApp group. The focus group discussion included all the fifteen students who were this class. It was revealed during the discussion that only ten students were on the class WhatsApp. Five students who did not join the WhatsApp group said that they had failed to do so because their phones did not have the capability to install WhatsApp.

It was established during the focus group discussion that all participants had been willing to join WhatsApp because they had felt that this social medium was a cheaper way of communicating with one another. The five whose cell phones did not have WhatsApp capability planned to buy mobile phones that would enable them install WhatsApp. Events that followed indicated that they did not acquire the upgraded cell phones. When there was important information to communicate to the class by lecturers, students who were not on WhatsApp got messages from their colleagues through Short Message Service (SMS), phone calls or verbal (interpersonal) communication.

All the participants found WhatsApp useful because it was cheap. They said that with little credit in one's phone one could communicate with others. However, many participants complained about the behaviour of some members of the class WhatsApp group who abused the system. The class's WhatsApp group was formed with the aim of discussing academic matters but some members were posting social, personal and non-academic messages. It was agreed that students who wanted to discuss non-academic matters should create their own WhatsApp account. To overcome this challenge, participants agreed to abide by the following resolutions:

- No one should post messages that were not academic on the academic WhatsApp account, rather, they should post them on individual accounts;
- The administrator should block individuals who posted non-academic materials on the class account, and;
- Civic educate members of the group on the purpose for creating an academic WhatsApp account.

The participants recommended that the class WhatsApp account should continue to be used for academic purposes. It was proposed that the Student Support Services

Manager for the Centre for Open and Distance Learning should be the administrator of the WhatsApp account. The group did not recommend to use Facebook because they believed that students would not use the facility for academic purposes in a serious way. Another challenge that was encountered by some participants was network connectivity.

4.5.12.5 Formative Evaluation of Year 1 and 2 WhatsApp groups

Two more WhatsApp accounts were created for students who were in the first and second years of the Bachelor of Arts Education and Bachelor of Science Education ODL programmes. The students who were registered on the WhatsApp groups were asked to evaluate how the platforms were used for a period of six months. A total of twelve students responded. All the respondents indicated that WhatsApp was useful. However, they noticed that some students were posting unnecessary information on both WhatsApp accounts. The following is a summary of students' observations on the type of information that was posted on the WhatsApp accounts and suggestion for improvement.

Useful Information	**Useless information**	**Suggestions for improvement**
• Exam results • Academic calendar information • Assignments • Useful information with colleagues • Fees information • Timely information from lecturers • Official information from CODL	• Personal messages • Unnecessary comments • Posts on non-academic issues	• Caution members who discuss personal matters • Add more members to the groups • Post updates on important issues more frequently • Advise members who make unnecessary comments to stop • Remove people who make unnecessary comments from the group • Members should concentrate on academic issues only

Summary: All students who evaluated the WhatsApp academic accounts found the platform useful and urged others to join them. The big problem was that there were few individuals who abused the platform by posting unnecessary information. The group suggested that students who did not follow rules of the WhatsApp groups be removed from the account. Interventions that were done following this feedback are presented in the following chapter.

4.6 Opportunities and challenges to integrate technology in education

A few opportunities that could be utilised for successful implementation of technology integration and the challenges that could hinder efforts to integrate technology in education were detected in the baseline study. These are summarised in sections 4.6.1 and 6.4.2 below.

4.6.1 Opportunities

The following is a brief account of the opportunities that are likely to make implementation successful. Availability of teachers, lecturers and students with some knowledge of modern technology is a plus. This means that time will not be wasted on teaching them how to use technology from scratch. Institutions will simply build on the knowledge they already have. It is fortunate that teachers and lecturers have teaching and learning materials which can be repurposed for e-learning. This will provide institutions with a ready source of materials for instructional design. Another opportunity that will greatly ease the integration process is the readiness of all players to use locally available resources when carrying out the project.

4.6.2 Challenges

The challenges that will negatively affect the implementation of the project include the following:

- lack of resources such as computers at community day secondary schools;
- limited access to computers by students at secondary schools for those schools that have computers;
- frequent electricity outages and *No Phone Policy* at secondary schools.

What has been done to take advantage of the opportunities and surmount the challenges is presented in the following chapter.

This chapter presented findings on availability of resources for implementing technology integration and assessed opportunities for integrating technologies in education and challenges that would negatively affect the success of using technology in schools and universities. It also presented a formative evaluation of the existing e-learning instructional materials with the aim of improving them. The next chapter presents findings of Phase Two of the study, which was interventional in nature. The findings that are discussed include data that were collected from observations of C Programming and Physical Science classes, questionnaires administered to students and interviews conducted with various members of staff at MZUNI.

Chapter 5: Study findings of Phase Two

5.1 Introduction

Chapter 4 presented findings of the baseline study which informed the design of Phase Two. The reasons for conducting a baseline study on technology integration in the teaching and learning process were to find out the resources that were available locally for integrating technology, evaluate existing e-Learning instructional materials and assess opportunities and challenges of integrating technologies in education. This information was necessary for the design of an intervention that would be done in the subsequent phase of the study.

This chapter reports on findings of Phase Two of this study. The chapter includes findings from the Electronic Voting System (EVS) that was used in C Programming and Physical Science classes, results from questionnaires that were administered to students in a C Programming class, and interview sessions with lecturers who had produced e-Modules for the ODL learning delivery mode at MZUNI. It also presents results of interview sessions with lecturers who had integrated Moodle LMS and Turnitin anti-plagiarism software in their teaching as well a computer technician.

Electronic Voting System was chosen as an intervention in Phase Two of the study having observed that many students in the sampled institutions were not participating actively in class. The researcher therefore, thought that an EVS would encourage students to participate actively in class. The EVS sessions were modified from the 'True EVS' because students in secondary schools were not allowed to bring cell-phones to class, not all students in the C Programming had cell-phones and the researcher did not have a clicker system. Online Student Response System like Participoll could not be used for the same reasons.

A total of six C Programming class sessions were observed, four sessions were conducted for CDSS 2, and one EVS session was done at SS-1. Interview sessions were designed to get an insight into how lecturers were integrating technology in their daily classes. The researcher wanted to find out their success stories as well as challenges they faced when using technology. He used locally available resources to conduct the modified EVS sessions.

The first research question was as follows: How can education institutions with limited resources sustainably use locally available resources to repurpose existing paper-based instructional materials for electronic delivery? To answer this research question, the researcher and the lecturer in C Programming designed an EVS using Open source php source code which was downloaded from the Internet and modified for the local context. The locally available resources that were utilised were print-based instructional materials, a laptop, a multimedia projector, the Internet, eXe software, Web and instructional design skills of the researcher and programming skills of the ICT lecturer. The researcher followed an ICT class for six weeks in a mini case study. Results from the six class sessions are presented below.

5.2 Introductory C Programming lesson

Session 1

A home-designed EVS was used in all the six sessions. The first session was an introductory class in C Programming. Thirty-three students attended the class. The question which was used to evaluate students' understanding of the concepts that were covered in this class session is shown below.

Q1. Which of the following source codes would produce the output shown below?

Choose the correct answer from the source codes below.

Answers:

(A)
```
#include <stdio>
int main (void)
{
printf("Welcome to Programming");
return 0;
}
```

(B)
```
#include <stdio.h>
int main (void)
printf("Welcome to Programming");
return 0;
}
```

(C)
```
#include <stdio.h>
int main (void)
{
printf("Welcome to Programming");
return 0;
}
```

(D)
```
#include <stdio.h>
int main (void)
{
printf("Welcome to Programming")
return 0;
}
```

Figure 5-1 below shows the results of students' voting which was conducted at the end of an introductory lesson in the C Programming class.

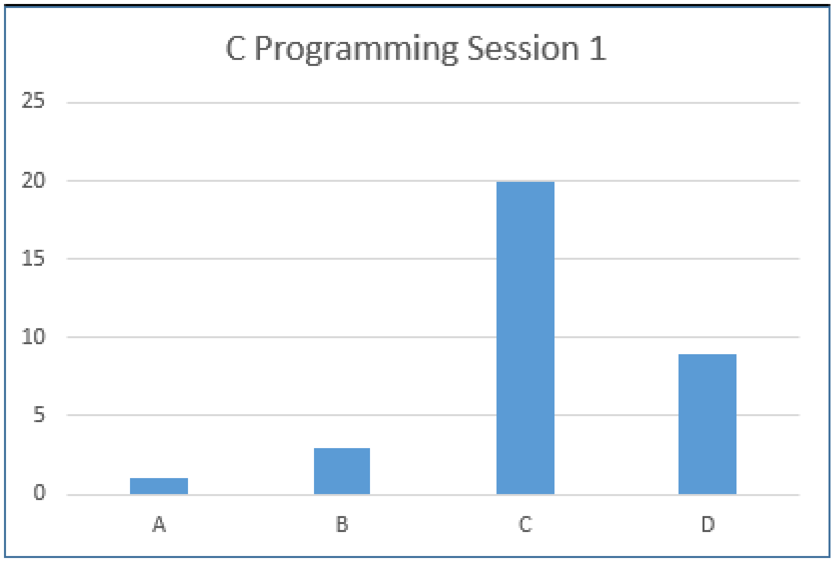


Figure 5-1 EVS Results 1

The results of the votes showed that twenty out of thirty-three students, which represented 61% of the class chose option C, which was the correct answer. Thirteen students chose wrong alternatives. This feedback was shown to the students by projecting the results of voting. Although the answers were projected, the students were not told what the correct answer was. The idea behind showing the students how they voted was to enable each learner to check his or her response against the rest of the class. Afterwards, the students were asked to discuss the results for two minutes in pairs as buzz groups. This was done to encourage peer learning. After discussions, the students voted again secretly. This time, the percentage of students who chose the correct option rose from 64% to 94%, with only two who chose wrong alternatives. This finding may have suggested that the discussions (peer learning) had a positive effect on the students' understanding of the topic. It is assumed that students were not biased towards the correct answer when they saw that majority had chosen option C. Each alternative of the multiple-choice question was discussed by the whole class why it was wrong or right before the class was dismissed. The results of the second voting session were as shown in Figure 5-2.

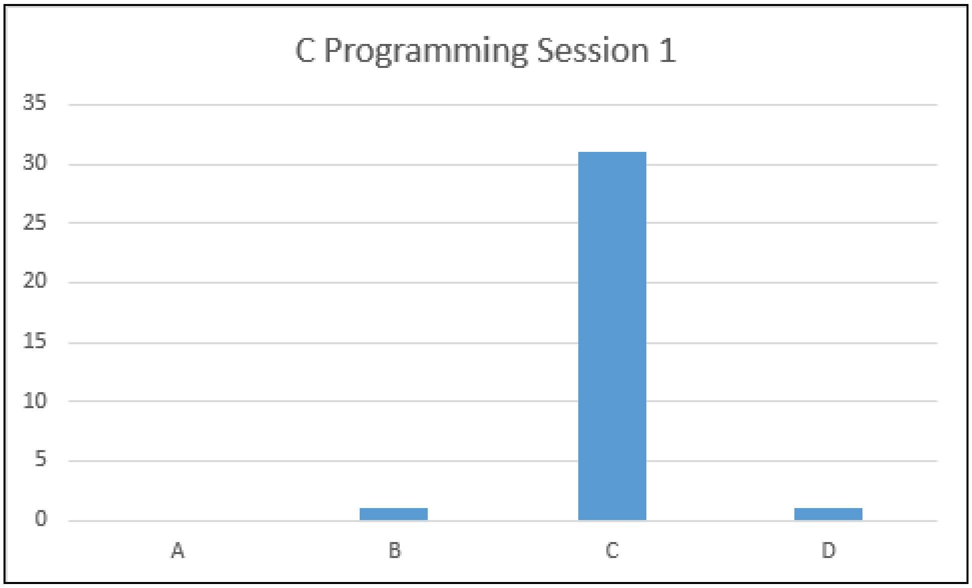


Figure 5-2 EVS Results 2

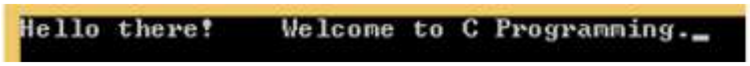
Session 2

A week later during the second lesson, the lecturer wanted to find out if the students still remembered what was covered in the first lesson. At the beginning of the lesson, he asked them to answer the same question he had asked them in the first lesson. Alternatives of the multiple-choice question were randomised. The findings showed that 95% of the students chose the correct answer. Still, 5% of the class chose the wrong option. The results prompted the lecturer to revise some important aspects of the lesson that had been covered in the earlier lesson prior to presenting the new material. He wanted those who did not understand the concepts to do so before he continued teaching. The second lesson was on *Escape Sequences and Variables*. However, the students did not vote at the end of the lesson because time had run out. This shows that proper lesson planning was required to incorporate EVS in class.

Session 3

The third lesson started by asking learners to answer three multiple choice questions using EVS. The first two questions were on *Escape Sequence* and the third one was on *Variables*. The following question was on *horizontal tab escape sequence* as shown:

Q1 Which source code will produce the output shown below?



Choose the correct answer from the source codes shown below.

(A)
```
#include <stdio.h>
int main(void)
{
        printf(“Hello there!\n”);
        printf(“Welcome to C Programming.”);
        return 0;
}
```

(B)
```
#include <stdio.h>
int main(void)
{
        printf(“Hello there!/t”);
        printf(“Welcome to C Programming”);
        return 0;
}
```

(C)
```
#include <stdio.h>
int main(void)
{
        printf(“Hello there!/n”);
        printf(“Welcome to C Programming”);
        return 0;
}
```

(D)
```
#include <stdio.h>
int main(void)
{
        printf("Hello there!\t");
        printf("Welcome to C Programming");
        return 0;
}
```

The correct option for this question on was D. The students were given five minutes to go through each option and decide what the correct option was. The questions required students to do a dry run of each option in order to find the correct one. In all three questions, there were subtle differences between the correct option and incorrect alternatives. This required careful scrutiny by the students to identify the correct alternative. For the first question, the main difference among the multiple-choice alternatives was in the following *printf* statements:

```
printf ("Hello there!\n");
printf ("Hello there!/t");
printf ("Hello there!/n");
printf ("Hello there!\t");
```

The second question tested the same concept as the first question but the difference was that this time, the lecturer was interested in the *newline* sequence. The question was as follows:

Q2 Choose the correct source code that will produce the output shown below.

```
He said, "Hello there!"
"Hi!", I responded.
```

(A)
```
#include <stdio.h>
int main()
{
        printf("He said, "Hello there!"\n");
        printf("\"Hi!\", I responded.");
        return 0;
}
```

(B)
```
#include <stdio.h>
int main()
{
        printf("He said, \"Hello there!\"\n);
        printf("\"Hi!\", I responded.");
        return 0;
}
```

(C)
```
#include <stdio.h>
int main()
{
        printf("He said, \"Hello there!\"\n");
        printf("\Hi!"\, I responded.");
        return 0;
}
```

(D)
```
#include <stdio.h>
int main()
{
        printf("He said, \"Hello there!\"\n");
        printf("\"Hi!\", I responded.");
        return 0;
}
```

The correct answer for this question was D.

The third question was testing the students' mastery of the concept of *variables*. Here, the students needed to pay particular attention to detail otherwise they would easily have gotten the answer wrong. Question 3 was as follows:

Q3 Select the correct source code for program which asks a user to input two numbers and produces the sum of the two numbers as illustrated below:

```
Enter two numbers: 6
9
The sum of the numbers is 15
```

(A)

```
#include <stdio.h>
int main(void)
{
        int num1;
        int num2;
        int sum;
        printf(“Enter two numbers: ”);
        scanf(“%d”,&num1);
        scanf(“%d”,&num2);
        sum=num1+num2;
        printf(“The sum of the numbers is sum);
        return 0;
}
```

(B)

```
#include <stdio.h>
int main(void)
{
        int num1;
        int num2;
        int sum;
        printf(“Enter two numbers: ”);
        scanf(“%d”,&num1);
        scanf(“%d”,&num2);
        sum=num1+num2;
        printf(“The sum of the numbers is %d, sum);
        return 0;
}
```

(C)
```
#include <stdio.h>
int main(void)
{
        int num1;
        int num2;
        int sum;
        printf("Enter two numbers: ");
        scanf(num1);
        scanf("%d",&num2);
        sum=num1+num2;
        printf("The sum of the numbers is %d,sum);
        return 0;
}
```

(D)
```
#include <stdio.h>
int main(void)
{
        int num1;
        int num2;
        printf("Enter two numbers: ");
        scanf("%d",&num1);
        scanf("%d",&num2);
        sum=num1+num2;
        printf("The sum of the numbers is %d,sum);
        return 0;
}
```

The correct answer for this question was B. After students had voted on all questions, the results of voting were projected for the students to see and they were told what the correct answers were. For each question, the class discussed each alternative and reached a consensus on what was right or wrong with each option. This discussion served as an immediate feedback to each learner on their understanding of the concepts. From the results in Figure 5-3 below, it could be argued that majority of the students had understood the concepts that were covered in this lesson.

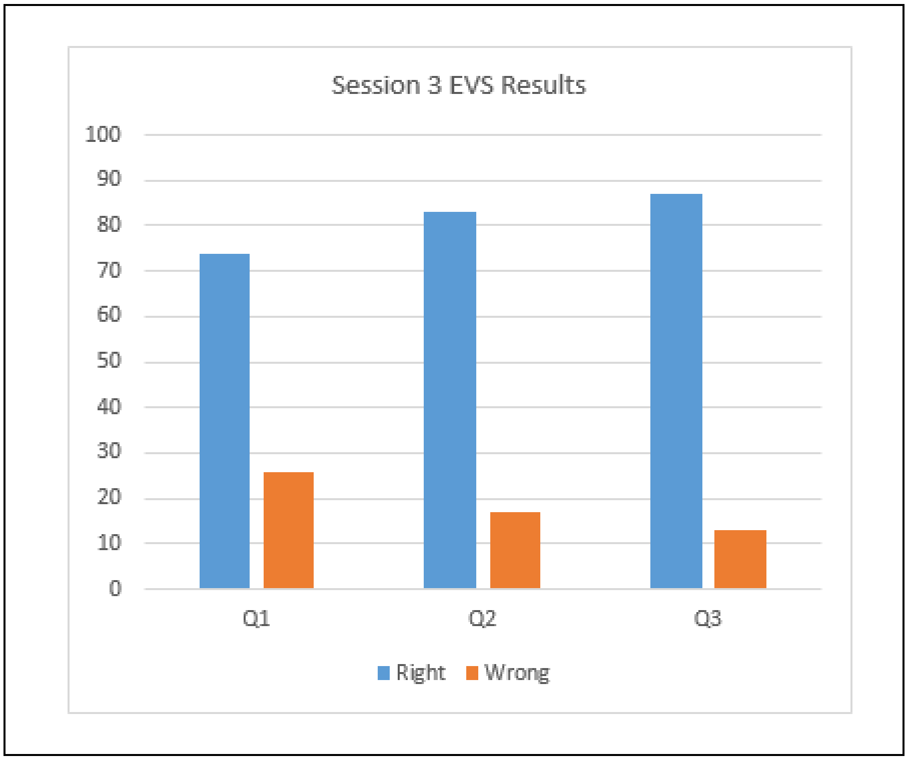


Figure 5-3 EVS Session 3 results

Session 4

The fourth lesson was on *Mathematical Functions* and *IF Statements*. These exercises were given to students as a way of evaluating their understanding of the lessons. The results showed that many students had problems with *Mathematical Functions* and *Temperature Conversion* but had a fairly good understanding of the concept of *IF Functions*. Students' answers were discussed in class and misconceptions were cleared. Basing on the results of the EVS, the lecturer decided to revise the concepts on *Mathematical Functions* to ensure that all the students were conversant with the topic. Their responses to the questions are summarised in Figure 5-4.

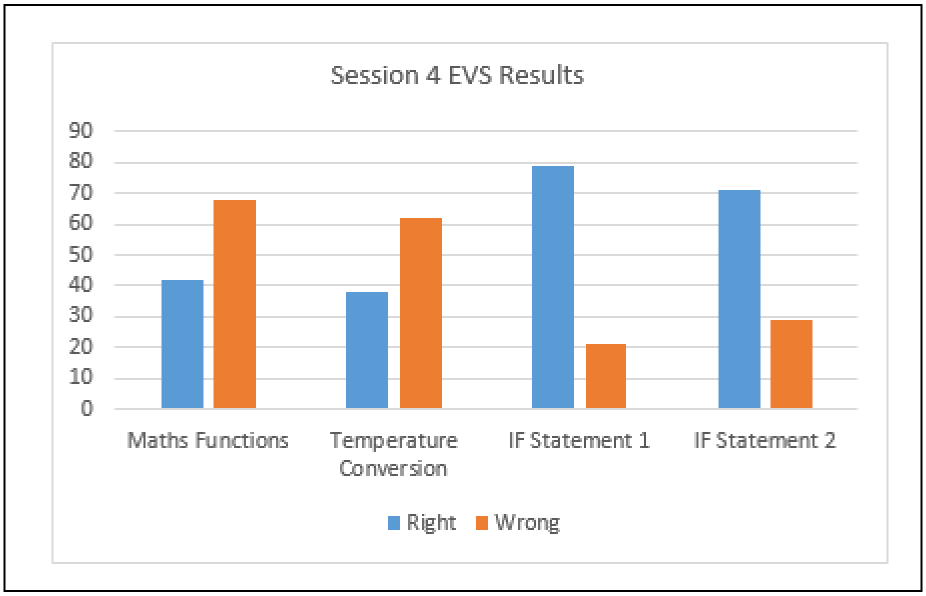


Figure 5-4 EVS Session 4 results

Session 5

In this session, the lecturer wanted to get feedback from the students on how well they understood the lesson. He conducted a secret opinion poll at the end of the lesson in which students voted using the EVS. Figure 5-5 shows how the students responded when they were asked to rate their understanding of the lesson.

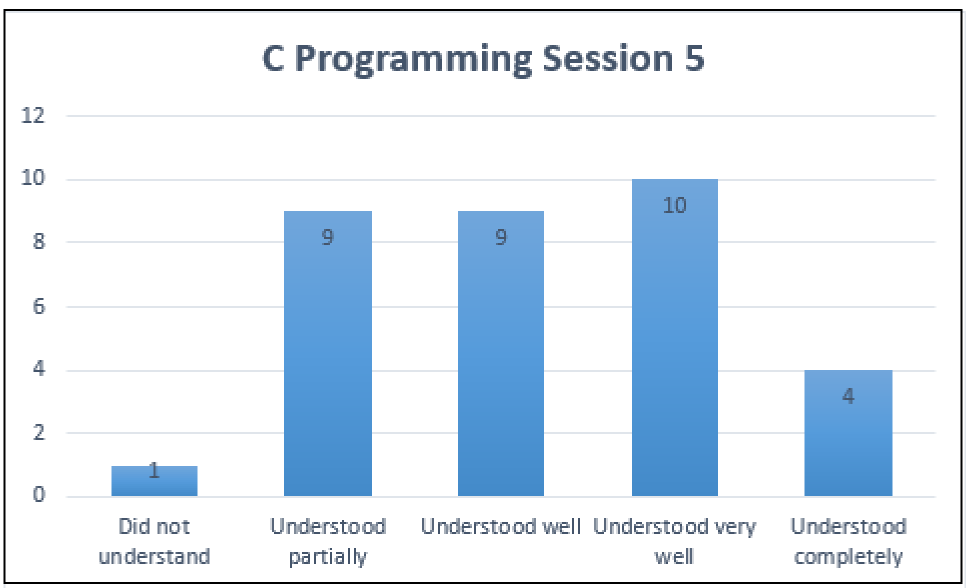


Figure 5-5 Students' feedback on Session 5

The results showed that majority (23 out of 33) of the students understood the lesson well. The researcher discussed students' feedback with the lecturer. There was a concern that ten students had difficulties in understanding the lesson. These students needed help before they proceeded to the next lesson. The lecturer was particularly interested to know the students who did not understand the lesson so that they could be supported. However, it was difficult to identify the students because the voting was anonymous. Students voted anonymously to encourage them to provide responses without fear of reprisal from the lecturer. An announcement was made calling upon students who had problems to seek help from the lecturer.

Session 6

The sixth lesson was for revision. Students worked in pairs to answer thirty multiple-choice questions on pieces of paper which were then collected for analysis. They were given feedback on their performance the following day because the analysis took time. It was noted that the performance of all the pairs was excellent. The scores on the quiz ranged from 92% to 97%. When asked how they managed to get these very high scores, the students explained that they owed this to collaborative learning. They explained that they could not have achieved such high scores if they had worked individually.

The EVS concept was tried on secondary school students as well because it was noted that very few students were participating actively in class. The EVS sessions were done after school hours because they could not be fitted within class time as teachers wanted to cover the syllabus before government examinations. The following section describes the findings of an EVS that the researcher had designed as a prototype and tried out at two secondary schools, CDSS-2 and CSS-1.

5.3 Study Findings for Physical Science Classes

Data collection was done at the two secondary schools only instead of all the four selected schools because of time constraints. The procedures the researcher used in data collection have been presented in Chapter 3 (Section 3.10). A total of four sessions were conducted at CDSS-2 and three sessions were conducted at CSS-1.

5.3.1 Findings from Physical Science class at CDSS-2

The first session was organised to introduce the concept of EVS in education. Because the session was introductory, students' performance on *Graphs of Motion* was not recorded. The researcher used students' notes and a prescribed book by Mwanza, et.al, (2012) to set a multiple-choice quiz.

During the second session, the students were asked nine multiple-choice questions on the topic *Electricity and Magnetism*. All questions were taken from the prescribed textbook by (Mwanza, et.al, 2012). The voting procedure has already been presented in Chapter 3. The performance of the class during this session is shown in Figure 5-6.

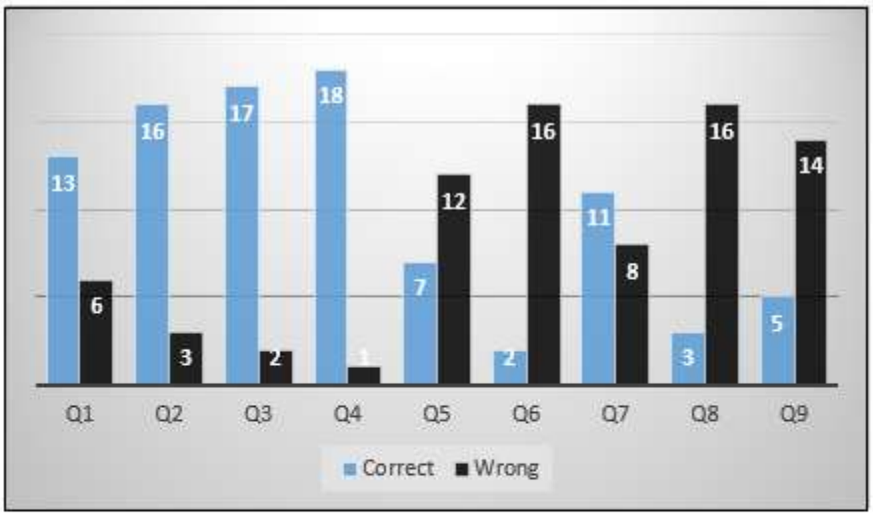


Figure 5-6 Feedback on Electricity and Magnetism - Exercise 1

The students performed well on the first four questions which asked them to: calculate resistance of a wire given voltage and current (Q1), calculate current given voltage and resistance (Q2), and calculate effective resistance in series (Q3 and Q4). Students had problems with questions that asked them to calculate effective resistance in parallel (Q5), electrical energy (Q6 and Q7) and power (Q8 and Q9). At the end of the session, feedback was given to the teacher after analysing the students' performance. The teacher decided that another quiz on the same topic should be conducted again during the subsequent session because the performance of the students was not satisfactory.

The third session was on *Electricity and Magnetism* again because the teacher wanted to find out if the students had revised the topic following their dismal performance in an earlier quiz. The class performance was not satisfactory as shown in Figure 5-7, which meant that the students had not mastered the topic. Feedback on students' performance was then given to the teacher who arranged for a remedial class on the topic before students sat for the end of term examinations.

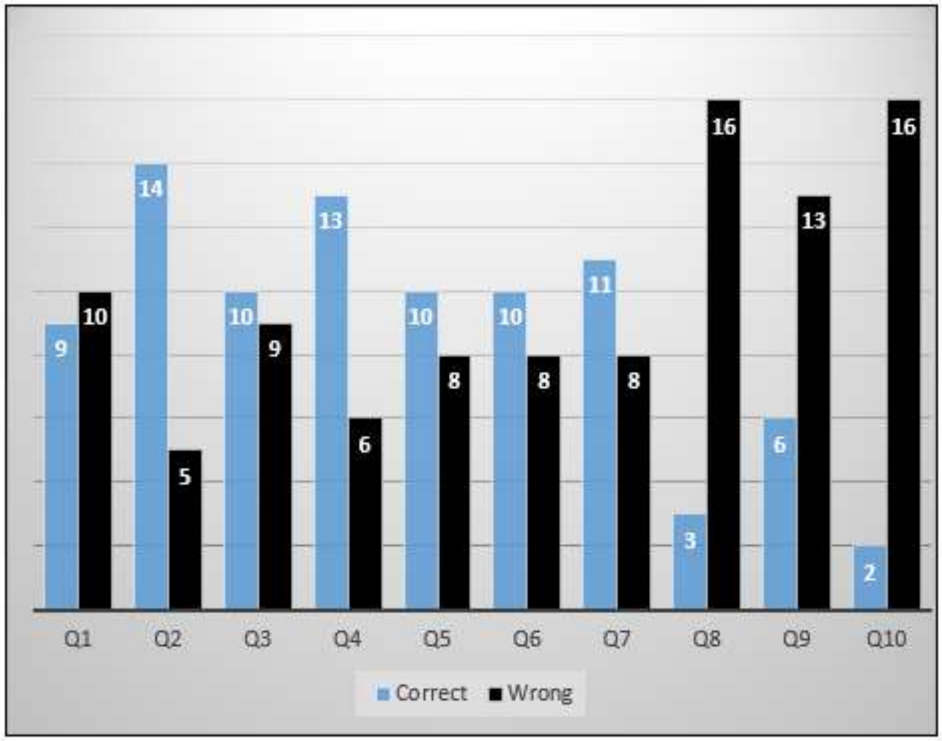


Figure 5-7 Feedback on Electricity and Magnetism - Exercise 2

As already elucidated in Chapter 3, the researcher decided to conduct the fourth EVS session at MZUNI because he wanted the students use computers in one of the computer laboratories at the University as opposed to conducting a mixed (paper-based and computer-based) EVS session. The students did two exercises. The first exercise was on *Electricity* and the second was on *Carboxylic Acids*. This time, the students worked in pairs to encourage peer learning. Except for pair number seven (G7 in Figure 5-8), the students' performance on both exercises was very impressive.

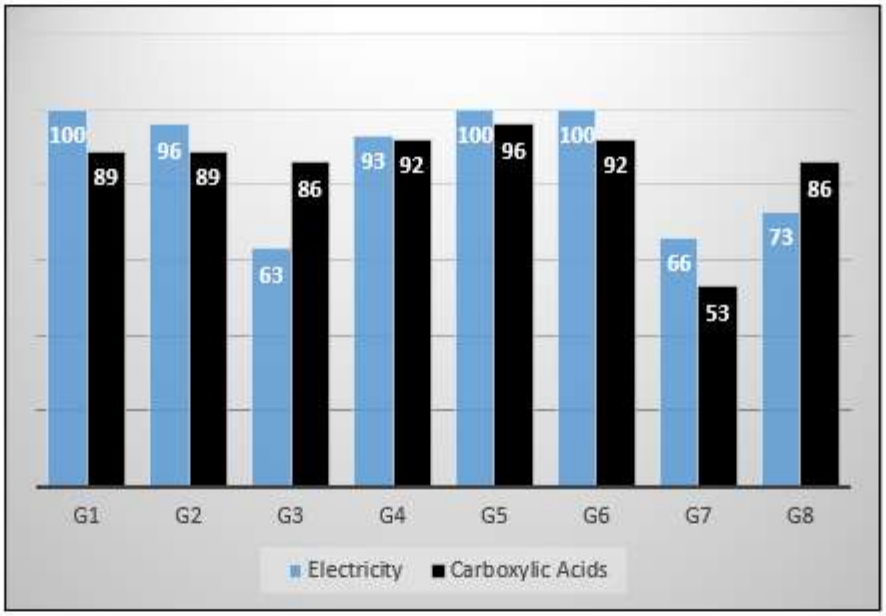


Figure 5-8 Effect of collaborative learning

At the end of the exercise, the students were asked to explain reasons for this high performance. They reported that they had revised the topic on *Electricity* before. They also stated that collaborative learning helped them so much, especially on the exercise on *Carboxylic Acids*, as they were able to confer when answering the questions.

5.3.2 Findings for Physical Science class at CSS-1

In the first exercise, Form 4 students were asked to vote on the topic *Speed, Velocity and Acceleration.* This was a Form 3 topic which these students had already covered. The teacher decided to give them the exercise as a 'surprise test'. The students performed well on the exercise (Figure 5-9) except for one question (Q7) where majority failed.

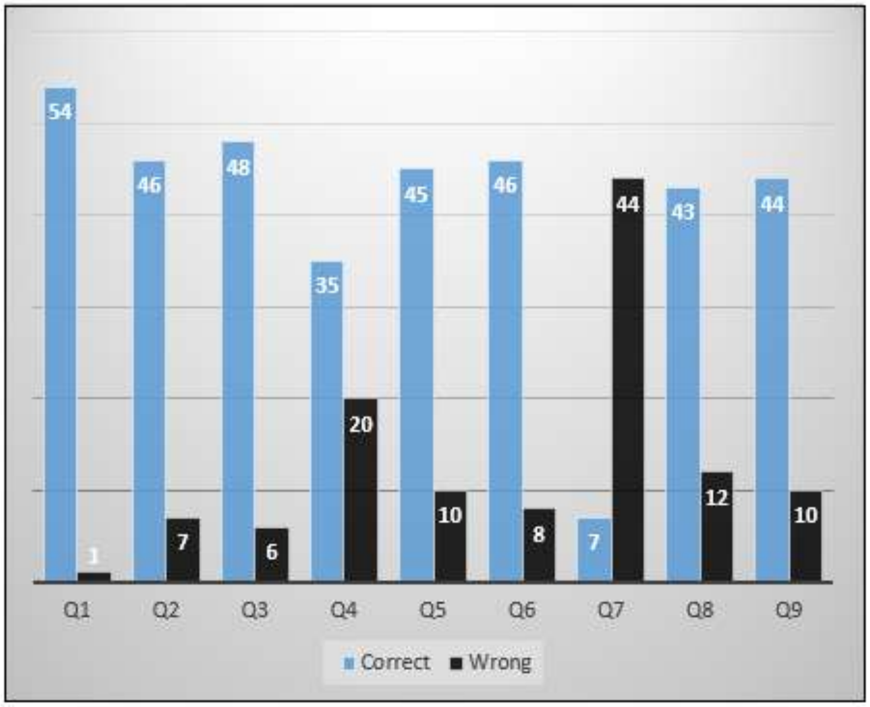


Figure 5- 9 Feedback on Speed, Velocity and Acceleration

The same students were asked to write another multiple-choice quiz a day later. This time, only thirty-six students were present.

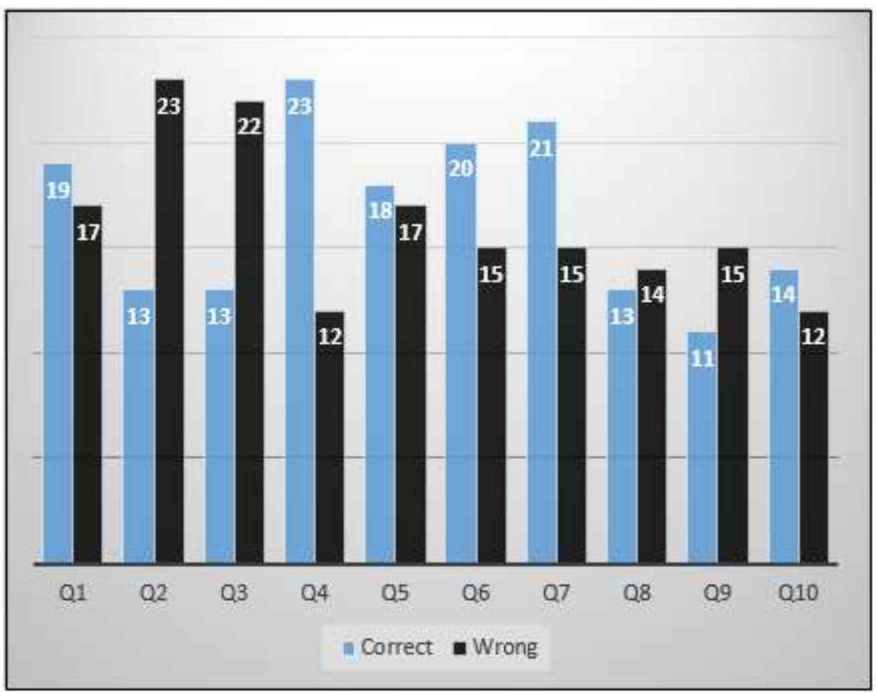


Figure 5-10 Feedback on Graphs of motion

The exercise was on *Graphs of Motion*. This was a revision quiz designed to prepare the students for the Malawi School Certificate Examinations (MSCE).

After analysing their scores, it was discovered that their performance was disappointing as shown in Figure 5-10. About half of the students gave wrong answers. This meant that only half of the class still remembered concepts that were covered in class about a year earlier. The teacher took note of the students' results and planned to revise this topic with them before the 2016 MSCE. Apart from assessing the preparedness of the students for the examinations, this exercise also showed how helpful a simple analysis of the students' scores can be for teachers in discovering gaps in students' knowledge. The analysis was done using Microsoft Excel.

An EVS session was conducted with Form 3 students. The procedure on how the session was conducted with a Form 3 physical science class at CSS-1 has been presented in chapter 3. The only question that was used for evaluation of the class is shown below. The results of voting were as shown in Figure 5-11.

Q1. What is the valence of carbon?
A 1
B 2
C 3
D 4

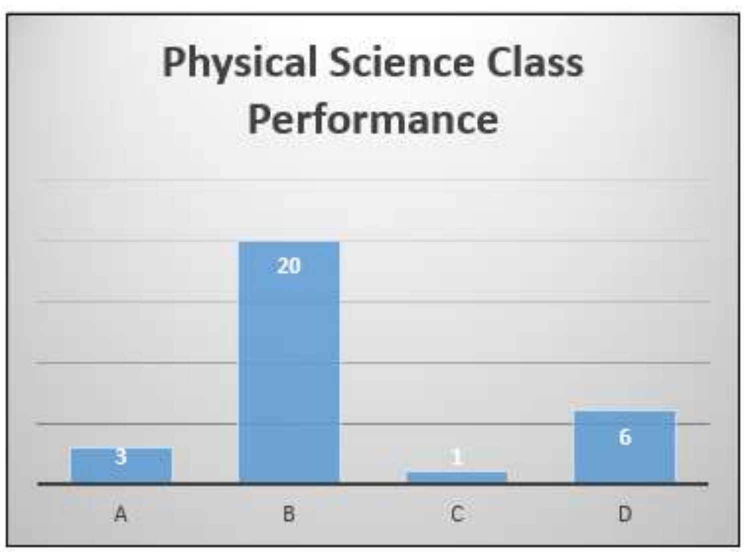


Figure 5-11 EVS results on valence of carbon

The correct answer was D. Students' responses were collected and analysed graphically during class time. The results of the analysis were projected on the screen as feedback for the students. Only six students out of thirty chose the correct answer. This showed that most students did not understand the concept of valence of carbon. This finding concurs with what more than half (19 out of 30) of the students indicated when they were asked at the end of the lesson to rate how well they understood it. The question that was used is shown below.

Q2. How well did you understand today's lesson?

Rate your understanding using the following key:

A = Did not understand the lesson at all
B = Understood the lesson partially
C = Understood the lesson well
D = Understood the lesson very well
E = Understood the lesson totally

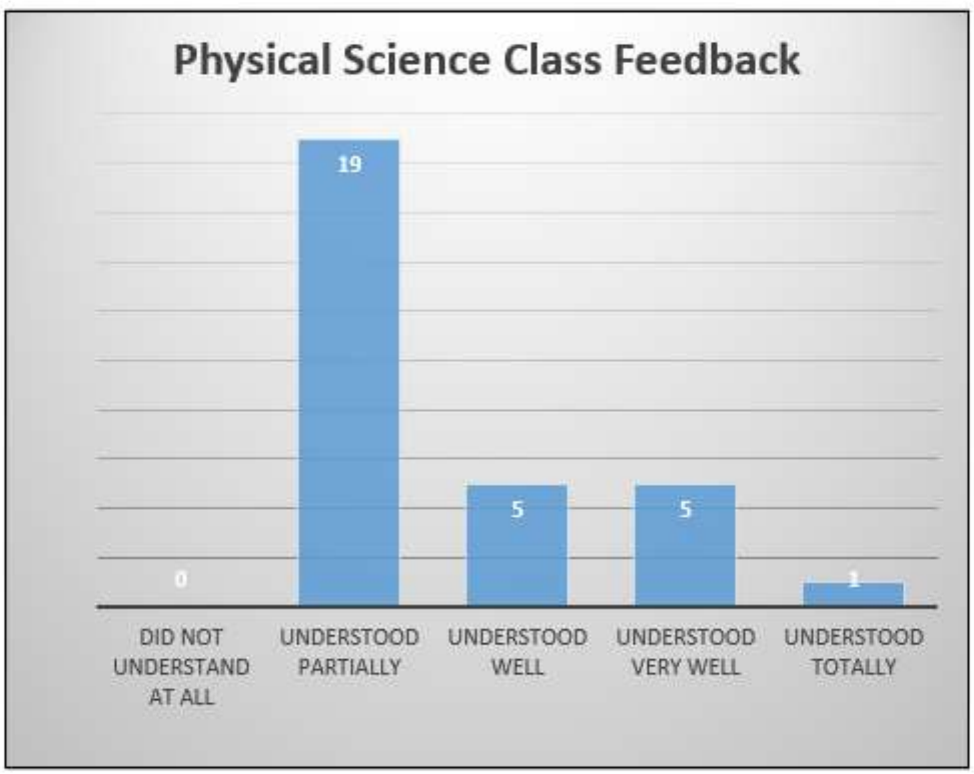


Figure 5-12 EVS lesson feedback on valence of carbon

The teacher decided to repeat the lesson because of the feedback he received from the students' voting.

Apart from designing an EVS, the researcher and the C Programming lecturer designed an interactive website using an open source web editor called eXe (eLearning XHTML editor). They repurposed existing C Programming notes for electronic delivery. The following is a summary of students' formative evaluation of the website.

Formative evaluation of C Programming website

Students were asked to use the C Programming website which was formatively evaluated by five students who were in the second year of the bachelor's degree programme in ICT in December 2014. At the end of the semester in July 2015, a second cohort of thirteen students were asked to evaluate it again. All respondents indicated that they found time to use the website. This was an encouraging finding because the lecturer would be encouraged to put more of his lessons on the Web for the students to study thereby promoting e-learning. Only eight respondents used the website for revision. The lecturer expected all the students to use the website for revision but obviously this was not the case. A mechanism needs to be devised to ensure that all students use the website for revision. One way of doing this would be to include more questions in order to cover the whole syllabus. The lecturer could also tell students that some questions on end of semester examinations would be based on what was covered on the website. That way the students would be compelled to use the website. Only five respondents used the website to prepare for classes ahead of time. It was expected of students to prepare for class by studying materials they were given as advance organisers but this seems not to have been the case here for many of the students. It appears that students wait until class time to start studying. Learners were asked whether they found the exercises on C Programming that were on the website helpful or not. A total of thirteen students responded to this item. Nine found the website helpful and three found it neither helpful nor unhelpful. One respondent did not find it helpful at all. It is encouraging to note that many respondents found the exercises useful because this will encourage the lecturer to design more exercises in future. The website had answers to the exercises to provide immediate feedback to the learners. The researcher was interested to know whether the learners did the exercises before checking the answers or they checked the answers first. Twelve respondents attempted the exercises first before checking the solutions. This is what the lecturer expected the students to do. There was only one respondent who indicated that he looked at the solutions first before attempting the questions. Students who are serious with their studies and want to learn always attempt to solve problems first before checking the solutions but this requires a lot of discipline. It is very tempting to check solutions first especially for students who find the going tough. In future designs, the instructional designers decided that solutions to exercises would only be accessible to students after attempting exercises. When asked whether the website should have solutions or not, majority of the respondents (10 out of 13) preferred the website to have solutions. It was important for the students to do self-assessment as they went through the questions. This would be possible only if solutions to the questions were given to the students as a form of feedback to them.

Although the website was easily accessible and friendly to use, the respondents made some recommendations on how to improve it further. They suggested that the appearance of the interface needed to be improved to make it more appealing to users. It was felt that many users would be attracted to use it if it were more attractive. They also recommended that more content covering all topics in the C Programming course should be added to the website. The twenty practice questions that were on the website were deemed not to be adequate because mastery of C Programming required more of hands-on practice. This recommendation was noted and more questions were added for subsequent semesters. The recommendation that the website should be made more interactive was an apt one because the website had very little options for interactivity. A further scrutiny also revealed that there was no provision for students to write their codes on the website, and instead they had to write their codes on pieces of paper and compare their answers with the model answers. To improve interactivity, the researcher included spaces (Text boxes) on the website for students to practice writing program codes. Apart from the recommendations stated above, the students also indicated the need for embedding mp4 videos of class recordings on the website. This recommendation was likewise taken on board. Links to all videos of the C Programming class sessions were included on the website. Students also suggested that the website should be published on the MZUNI website to increase access to users in addition to distributing it offline. This was a welcome suggestion and arrangements were made with the webmaster of MZUNI to link the C Programming website to University website. A final recommendation was that the questions should have been timed to encourage students practice time management skills. This was discussed with the lecturer and it was felt that a timing element should be included in the practice questions and an agreement was reached to write a code that would time students as they answered the practice questions. The students found the website useful but they wanted it to have more solutions to the practice questions to serve as feedback.

The last part of the questionnaire solicited students' opinions regarding interactive questions. Opinions of students on the interactive questions they were asked to answer in preparation for the end of semester examinations. Twelve students responded to all five statements in this section of the questionnaire.

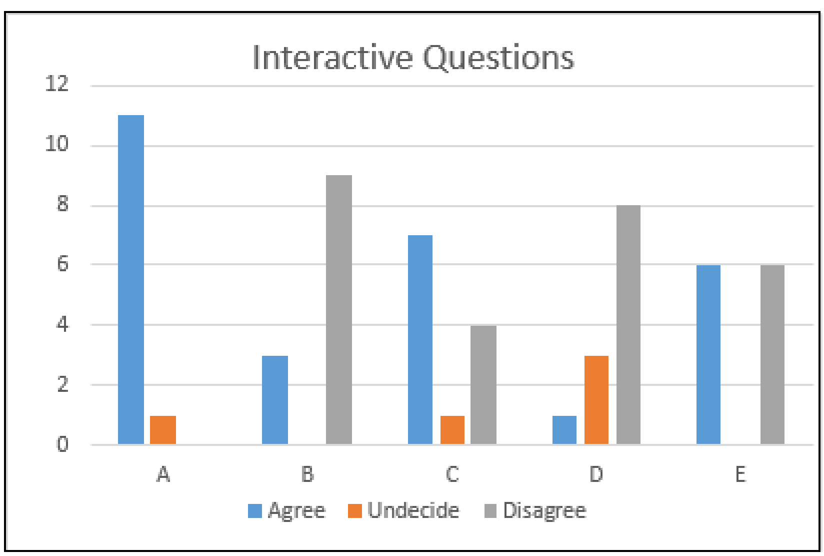


Figure 5-13 Students' opinions on interactive questions

Key:

SD - Strongly disagree; D – Disagree; U – Undecided; A – Agree; SA - Strongly agree

A to E – Statements that students were asked to either agree or disagree with.

Statement A: *I found the interactive questions on C Programming very helpful.*

Statement B: *I did not find time to attempt all questions at all.*

Statement C: *I used the interactive exercise questions for revision.*

Statement D: *I used the interactive exercise questions to prepare for classes ahead of time.*

Statement E: *The interactive exercise questions did not help me at all. I found them a waste of time.*

Eleven respondents found the interactive questions very helpful and one was undecided. It is pleasing to note that all respondents but one found the interactive questions useful. This finding has encouraged the lecturer to design more questions of this type for future lessons. Nine respondents found time to attempt all the questions. It was pleasing to note that the students found the interactive questions useful but very disappointing that they some did not find time to attempt all the questions. The questions that were included in the exercises covered all sections that were taught in the C Programming sessions during the semester. If the students had managed to answer all questions correctly, they would have had a very good chance of passing the end of semester examinations. There is need to find out why some students did not find time to go through all the questions they were given for practice. Only seven students used the interactive questions for revision. This was a disappointing finding. These exercises were meant to be used for revision but not all the students used them as intended. A mechanism needs to be found to encourage students to use the interactive questions to prepare for the examinations. Only one student used the interactive questions to prepare for classes ahead of time. This was a surprising finding in that one would have expected students to prepare for class if they had been given instructional materials to be covered in subsequent sessions. This shows that many students do not actively prepare for lessons. This means that if they were not given assignments, they would wait until class time before they started working.

It seems that many students used the interactive questions and found the exercises helpful. It was expected that all students would use the exercises but this was not the case. For the subsequent cohorts of students, the lecturer decided to upload the questions on the University's LMS and let students log in so that he should track those who were using the system and those who were not. It was felt that this setup would provide authentic information on the use of this learning resource.

When asked whether the students faced any difficulties when answering the interactive questions on C programming, one respondent out twelve had problems. His main challenge was that he found the questions without answers confusing as he had nowhere to cross check his responses. Even those questions with solutions did not explain as well as mp4 videos would. Although many students felt that the interactive questions improved their knowledge and understanding of C Programming, some suggested that the questions should be varied in accordance with the Blooms Taxonomy. A quick look at the questions proved that they went as far as the analysis level on Blooms Taxonomy. Most students found the exercises straight forward and easy to understand. The strength of the exercises was their interactive nature. Some respondents cited the ability to check their answers, whether they were right or wrong, as a big plus for the exercises.

Students were asked to make recommendations for improving the interactive questions on C programming. The students encouraged the ICT Department to continue making more interactive questions like those already made. They suggested that the questions should include more up-to-date content on C Programming which should be distributed to the students using many outlets like the Internet, MZUNI website and CDs. They also suggested that the difficulty level and the number of questions should be increased. The researcher and the lecturer were also asked to provide more descriptive solutions in the interactive exercises. Some respondents suggested that all content in the interactive exercises should be accessible in mp4 format. The researcher thinks that creating interactive exercises using mp4s would demand a lot of creativity but it can be done. This recommendation will be considered although it is known that it will take time to design such instructional materials.

The last item on this questionnaire was intended to find out how the respondents felt about whether the lecturers should continue to design more electronic instructional materials or not. All the thirteen respondents indicated that the lecturers should design more electronic teaching and learning materials. One reason that was advanced was that interactive questions helped students during revision for the end of semester examinations. Some even suggested that C Programming examinations should be conducted electronically to reduce examination time and enhance practical hands-on knowledge of programming. The students found that interactive questions kept them busy and enabled them to follow concepts that were covered in class by revisiting the work using interactive questions. Another reason the students gave was that these items catered for students with different learning abilities.

Following the recommendations from the students after they had formatively evaluated the e-learning materials, the researcher and the lecturer modified the C Programming website to include a text area where the students would write their source code before comparing it to the expected answer for each question. Also, the practice questions were increased from 20 to 75 to give students more practice opportunity. The students also recommended that the C Programming e-learning materials should be uploaded on the University website to enable them easily access the materials. In response to this recommendation, the researcher designed an SRS interactive website which was based on the multiple-choice interactive website he had designed earlier. All the e-learning materials on C Programming were uploaded onto MZUNI website to enable prospective students to use the materials for practice.

Apart from designing EVS, website for C Programming and interactive questions on C Programming, some lecturers in faculty of Education had already produced e-Modules for ODL students. The following section presents interview sessions which were conducted with some lecturers who were involved in e-Module production using Camtasia.

5.4 Study Findings for ODL e-Module production

The researcher wanted to find out experiences of lecturers on the technology integration in the teaching and learning process in general, and e-Module production processes in particular. A total of three lecturers were interviewed.

5.4.1 Interview with a lecturer in History

The researcher conducted an interview session with a history lecturer, who will be called John for anonymity. John joined MZUNI in 2012. He had been using technology since July 2015 although he was only using films and videos when he was teaching at secondary schools before he joined MZUNI. He had recorded two mp4 e-Modules which the students were already using. In addition to the e-Modules, he had been using WhatsApp for class group discussions. Other technologies he was using to communicate with his students were emails, phone voice calls and SMSs.

5.4.2 Interview with a lecturer in Linguistics

The researcher also conducted another interview with one lecturer in linguistics. She was one of the early adopters of technology at Mzuzu University. She will be given a pseudonym of Walinase.

Walinase had been teaching Linguistics and Communication since 2001. She rated herself as an average user of technology. She was conversant with the following technologies: multimedia projectors, Camtasia, Microsoft Word, PowerPoint and Excel. Walinase mostly used PowerPoint presentations in her class (about 150 students) and distributed her lesson notes to students using email. When asked why she choose this mode of communication with students, she said:

> *"Most of our students have laptops and phones and can access emails easily. Sometime photocopying is not that easy and students have to pay a lot. Yet students do not pay to access the Internet on campus. I normally avoid using flash disks for fear of viruses".*

When she was asked what prompted her to start using technology in her teaching, she said that chalkboard limited amount of content coverage in a lesson. On the other hand, technology enabled lecturers to distribute large amounts of information. She explained that when one was teaching using multimedia projector, one could talk about many things in a short time unlike when one was using the chalkboard.

The e-Module that Walinase recorded was used by ODL students after it was edited. She avoided giving the e-Modules to students in the Face-to-Face delivery mode because most of them had a tendency of not attending classes. Giving them e-Modules would give them a license to miss classes. On promoting use of technology in education, Walinase was willing to encourage other lecturers to join her and this is what she said:

> *"I understand that at the mean time there are some lecturers who have not started recording their lessons. It's just a matter of sharing the ideas including the advantages of technology especially when handling large numbers of students. Also considering that some students come from remote areas, we can just give them these notes even after we are done with teaching. These can be very helpful. Promotion can be done through chatting with colleagues through one-on-one discussions."*

5.4.3 Interview with a lecturer in Chemistry

This section presents an interview session that was conducted with a lecturer in Chemistry who will be called Chisomo for anonymity. Chisomo had been teaching at MZUNI since 2003. He rated himself as an intermediate user of technology. He used Excel, LCDs, PowerPoint, Moodle, eBooks and the Internet. He also converted Word documents to PDF and uploaded them on Moodle. He did not distribute his lectures in flash disks for fear of viruses. Although he recommended PowerPoint and e-learning, he cautioned that we should not ignore whiteboards. What made him to start using technology was the fact that he wanted to reach more students with ease.

When asked if he would promote technology for education, he agreed. He also pointed out that one way of encouraging faculty to use technology would be through short courses organised by the university.

Instructional design process requires that instructional materials being designed should be formatively evaluated by users before they are finalised. In keeping with this requirement, the researcher gave some of the e-Modules to students to evaluate. The following section presents findings of this exercise.

5.4.4 Responses of ODL students on e-Modules

Nine e-Modules in MP4 format were given to Level Four ODL students to supplement print modules. After the students had studied them, the researcher wanted to find out their opinions regarding the suitability of the e-Modules. Questionnaires were distributed to fourteen students who were pursuing a Bachelor of Arts (Education) programme through ODL delivery mode and one student pursuing a Bachelor of Science (Education) degree. This fourth-year class had only fifteen registered students, twelve males and three females. The aim of collecting data from the students was to get their opinions on this innovative use of technology in education since it was the first time for these students to use such technology. The first part of the questionnaire sought to gather demographic data of the respondents in terms of gender, age and their level of experience in using electronic technology.

Gender, age and experience in using electronic technology

Ten students responded to this section; eight males and two females. All respondents were between 20 and 49 years and all were experienced users of technology which meant that they did not find problems using the mp4 e-Modules they were given.

Access to electronic media

This section of the questionnaire was meant to find out whether the respondents were able to access the instructional materials. The following were the e-Modules the students were given at the beginning of their fourth year: Population and Resources (Geography), Linear Algebra (Mathematics), Mathematics Methodology (Mathematics), Language and Gender (English), Semantics (Linguistics), The European

Novel (Literature), Historical Research Methods (History), Curriculum Theory in History (History), and Adolescent Psychology (Education). These instructional materials were distributed using DVDs and flash disks. All the respondents indicated that they had access to the e-resources that were given and they all used them before they came to write the end of semester examinations. Except for two e-Modules, all respondents but one found all e-Modules helpful. The reason the respondent who did not find the one e-Module helpful was that he discovered that some information he was looking for was not included in the e-Module. The one who found the other module not helpful did not give any reason. The respondents were asked to indicate the media they used to access the instructional materials. It was established that some ODL students at MZUNI had laptops which they used for their studies. Eight students used their computers, five used smartphones and two used tablets. This shows that the TALULAR (Teaching and Learning Using Locally Available Resources) concept was working for ODL students at MZUNI. The students were using locally available resources to study because they were not given any resource to use to access the e-Modules. No student used university computer. The fact that the students spend most of their time (sixteen weeks per semester) studying at home may explain this finding. When asked to indicate the media they preferred when distributing e-learning materials, students responded as shown in Table 5-1.

Table 5-1 Preferred instructional media by ODL students

Media	**Frequency**
CDs	3
Flash discs	3
Cell phones	2
Computers	1
Memory cards	1
DVD players	1

The researcher wanted to find out opinions of the students on the e-Modules they were given. The following is a summary of findings. All students found the accent of the lecturers of all e-Modules easy to understand. In general, the students did not find problems with all e-Modules. They preferred to be given both the print and the e-Modules because they complemented each other. They suggested that the e-Modules should have more information that explains the concepts covered in the print modules rather than simply being the replica of the print modules. All respondents felt that the pace of presentations of all the e-Modules but one was right.

The following is a summary of the suggestions that the students put forward for improving the e-Modules. In general, the e-Modules should include end-of-module tests and lecturers should include model answers for the tests. Lecturers should explain theories in detail so that the students can understand and practice them. They should explain the theories as if the students were present in class face-to-face. It was recommended that e-Modules should be given to the students together with their corresponding print modules. Students suggested that there should be some involvement of learners as they listen to the presentation. Learner involvement could be in form of answering or asking questions. Video clips should be used so that students can see the lecturer. The final general recommendation was that the students needed to see the lecturer's gestures in video than just seeing the PowerPoint presentation and hearing the presenter’s voice without him or her.

The last item on this questionnaire sought to find out if the respondents were willing to recommend the lecturers to continue designing more e-resources. Nine respondents indicated that the lecturers should design more electronic teaching and learning materials but one recommended that they should stop. The reasons that the students who were positive towards this issue gave are summarised below:

- Electronic modules were like virtual lecturers in the absence of the lecturer. These could be carried easily and played anywhere on DVDs and anytime.
- The e-Modules supplemented print modules. Students felt that it was easy to follow presentations on e-Modules even if one was tired.
- It was possible to listen to class presentations at one's comfort at work or home.

- E-Modules were helpful when one was unable to attend classes. Since e-Modules were portable, they were easily accessed anytime especially when they were on smartphones. For lecturers, it is faster to prepare e-Modules than print modules and hence faster to have the modules ready for the students.
- E-Modules assisted the students to understand the print modules. They were found to be helpful because they cleared some grey areas that were in print modules. The students were able to refer to what they had read in print modules using e-Modules.
- The students felt that lecturers explained issues better in e-Modules than in the print modules.

The student who did not find the e-Modules useful bemoaned the fact that students who did not have access to electricity, laptops or smartphones because they were poor would not use the e-Modules. To ensure that as many students as possible had access to the e-Modules, a deliberate effort was made to distribute the e-Modules using various means such as uploading them onto YouTube, Screencast.com, Moodle, Institutional repository on DSpace and saving them on DVDs, CDs and flash-disks.

Production of e-Modules since 2013

The researcher started promoting the use of screen capture technology to produce instructional materials in 2012. He approached many lecturers at MZUNI with the idea but it was only a year later that one lecturer bought the idea and produced an e-Module in communication skills. In 2014, two more joined. In 2015 and 2016 the number grew to 21 and 26 respectively.

Interpersonal communication about this innovation was used by contacting individual lecturers. With reference to Roger’s Diffusion of Innovation theory that was discussed in Section 2.3.4, some elements were utilised to diffuse the innovative idea of producing e-Modules at MZUNI.

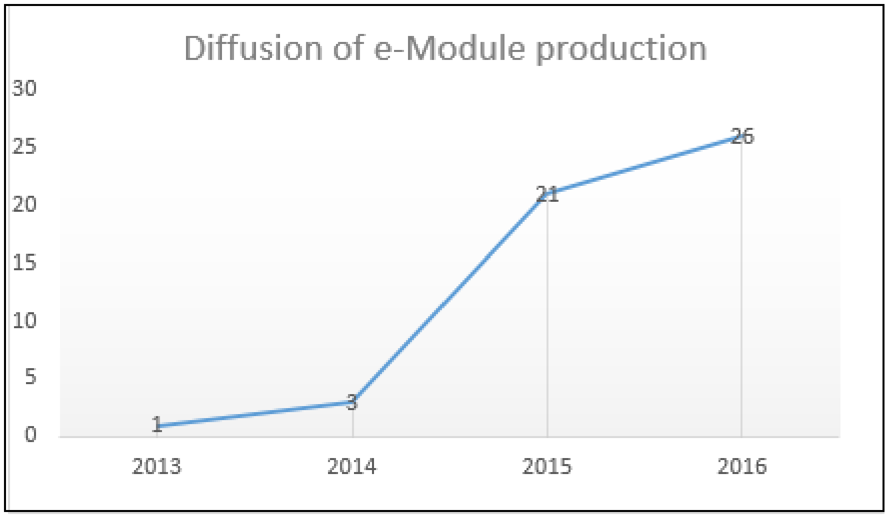


Figure 5-14 Number of lecturers who produced e-Modules for ODL

The elements that were used included triability, observability, optional innovation-decision, peer influence, influence of early adopters and positive attitude of adopters toward use of technology in education. The researcher believes that the variables mentioned above helped to achieve the diffusion rate as shown in Figure 5-14.

The focus of the second research question was to find which electronic media resource-challenged institutions use to sustainably integrate digital technologies in secondary schools and universities in Malawi. Findings on this research question are presented below.

5.5 Sustainable Electronic Media for Students

The following section presents data on the media respondents found sustainable to interact with the e-learning resources (mp4s and mp3s, interactive questions, website on C Programming) which were given to them.

5.5.1 The C Programming ICT class - Findings from a self-administered questionnaire

The purpose of collecting data on these technologies was two-fold; to find out if the students could access them sustainably and secondly, to formatively evaluate the learning materials in order to improve them. Questionnaires were distributed to thirty-three students but only fifteen responded, representing a response rate of 45%. The first part of the questionnaire sought to gather demographic data of the respondents in terms of gender, age and level of experience in using electronic technology for teaching and learning.

Characteristics of the respondents

The ICT class had a total of fifteen students and was dominated by males. There were thirteen male respondents and only two females. This is what one would expect in a Malawian tertiary education institution since the number of females who reach university is very limited in the sciences. The second section of the questionnaire asked respondents to indicate their age brackets. All respondents except one were in the age bracket of 20 – 29. The respondent who was outside this bracket was below 20 years of age. All respondents were users of technology as would be expected of ICT students who were in the second year of their training.

Access to electronic media

This section of the questionnaire sought to find out whether the respondents had accessed the instructional materials that were given by their lecturer. The respondents indicated that they all had accessed and had used the e-resources before they came to write the end of semester examinations. Table 5-2 shows the media which the students had used to access the instructional materials.

Table 5-2 Locally available media used by university students

Electronic media used to access e-materials

Media	Frequency
Student's own computers	15
Smartphones	8
University's computers	5
Tablets	1

Many students at MZUNI have acquired laptops which they use for their ICT programmes. The table shows that all respondents used their personal computers to access the electronic instructional materials. In addition, about half of the students used their smartphones. This showed that TALULAR concept was working. Students were using locally available resources for studying. An explanation for this finding is that all students who applied for the ICT programme were encouraged to purchase computers. The students did and still do a lot of work using computers. It would be very challenging if they were only to access university computers for their projects. Some students used university computers only when it was convenient for them to do so.

The students were also asked to rate the e-resources they were given for studying C Programming. Their rating on how useful they found the different formats of the instructional materials is summarised in Table 5-3.

Table 5-3 Rating of instructional media by university students

	Mp4 Videos	Interactive questions	Website on C Programming	Mp3 audio
Response	Frequency	Frequency	Frequency	Frequency
Not helpful	0	0	1	2
Slightly helpful	1	0	2	2
Helpful	3	3	3	0
Very helpful	6	3	1	2
Extremely helpful	1	4	2	2
Total Responses	11	10	9	8
Average Rating	2.2	2	1.8	1.6

The findings show that the students had found the mp4s most useful. An explanation for this finding is that students in Malawi are used to the traditional lecture methods of teaching where the teachers stand in front of a class and lecture to the students using chalk and board. The MP4 videos are very close to this type of teaching save that students cannot ask questions immediately. Teaching methods that depart from the typical lecture methods are alien to the students and these innovative ways of teaching will take some time to be accepted. Seven students out of ten found interactive questions helpful. The reason many students found these questions useful was that they were interactive. The students were able to find out which alternatives of multiple-choice quiz or True/False questions were correct or wrong. This immediate feedback was very important to enable them learn C Programming quickly.

When asked to indicate the media they preferred for distributing e-resources, the students responded as shown in Table 5-4.

Table 5-4 Preferred instructional media by students for e-resources distribution

Preferred media for distribution of e-resources

Media	Frequency
mp4s	10
Email	2
YouTube	1
Video conferences	1
Recording	1
mp3	1
Computer and projector	1
Oral presentation	1
Interactive exercises through mp4	1

The fact that many students at MZUNI had access to computers and that mp4s were very close to lecture method, influenced them to recommend distribution of electronic learning materials in the mp4 format. Using video in teaching and learning is very advantageous. Students use senses of sight and hearing when they access mp4s. Learners quickly forget information and facts if teaching involves hearing only. They remember things they learn better if instruction involves more than one sense. It is said that when teachers ask students to do things, they easily understand such things. Using more than one sense enhances learning. Another advantage is that videos can be distributed using a wide variety of channels like YouTube, Screencast, websites, DVDs, emails, memory cards, institutional repositories, and flash discs. The availability of many methods of sharing videos has increased access to teaching and learning beyond the classroom. Videos also enable students to learn at their own convenient time using PCs, tablets, smartphones and DVD players. They can access them in the classroom or at home anytime. They can also pause the video and take notes if they wish. They can replay them as many times as they feel like in order to understand the materials. Even though videos use one-way communication, students can use other media like emails, SMS, Facebook, WhatsApp, LMS or phones to ask their lecturers about aspects they did not understand.

5.5.2 Interview with the lecturer in C Programming

Apart from gathering data from the ICT students, the researcher also interviewed one lecturer in C Programming concerning the instructional design process. The following is a description of his experience. This lecturer, who will be called Chidongo for anonymity, had been teaching at MZUNI since 2012. He taught several courses in the ICT Department including C-Programming, Introduction to Programming, Web design, Algorithms and Data Structures, Object Oriented Analysis and Design, and End User Computing. The researcher chose to work with him in this project because he had experience in using electronic technologies in teaching and learning. Chidongo had been using Microsoft Office products to prepare his teaching and learning materials but the researcher taught him how to design e-learning materials (mp4s) using Camtasia Studio in 2014. The lecturer normally used memory sticks to distribute the videos to students because many students had flash disks. When asked why he preferred flash disks to other modes of distribution, he said that he did not opt for online distribution because not all the students had access to the Internet. When asked what prompted him to start using e-learning instructional materials in his lectures, he said:

> *"I figured that class room learning can be supplemented with these materials and students can access them at their convenient time. Where necessary, a number of media can be used including flash disks, compact*

> *disks and online. This is to give a chance to all students to be able to access the materials if they don't have either of the medium."*

Being one of the advocates of technology integration in teaching and learning, Chidongo was upbeat about recommending use of e-learning to management and other members of the teaching staff. His reasons were that the use of electronic instructional materials was one way of engaging students to work extra hard after class. Well-designed electronic materials made it possible for more coverage of content and gave students wider knowledge and understanding than face-to-face lectures. Chidongo suggested that institutions could sustainably integrate digital technologies into teaching and learning if their management accepted the fact that modes of teaching and learning were evolving each and every day. Classroom mode of delivery alone could not meet all learners' requirements. Traditional teaching and learning had to be supplemented with other modes. Provision of enabling environment for the creation of e-learning materials was a first step. Additionally, there was need to support individuals who were trying to implement this innovative mode of instructional delivery. He emphasised that, *"For two academic years doing this, it has proved to be a successful delivery mode for students to improve understanding in conceptual areas of course work."* He went further to state that Malawi as a nation was encouraging using technology in teaching and learning. To achieve this objective, it was time to embrace technology in the field of education. We are living in a technological world and access to information is crucial. Integrating technology in education will not only see Malawi meet its strategic plans but will also change the way we approach learners in the teaching and learning process in order to improve their understanding and performance.

5.5.3 Interview with Computer Technician

The researcher wanted to find out experience of a computer technician who was working on this project. The computer technician will be called Yahaya for anonymity. He was the systems administer of the two secondary schools which had received computers from the Fair-Denmark Project (see Section 3.7.1). He was the one who installed the Interactive Physical Science exercises on the computers of the secondary schools' computers under Fair-Denmark Project. He said that students were able to access Physical Science resources and that the project had gone on well. Challenges were there but minimal. The setup required a server which he successfully installed. The main challenge was teaching the students how to use the system but eventually they mastered it. Yahaya wished if many schools benefited from Fair-Denmark Project initiative. Unfortunately, Malawi did not have such setup in many schools because the project was in its pilot phase. The system was running on Linux and Ubuntu. A cluster of computers was connected to a server running on Ubuntu. It was encouraging to note that students were using the system and were looking for more content. There was a time when students stopped using the system because servers were being upgraded from Ubuntu (Long Term Support) LTS 12.04 to 14.4. Students continued using it after the system upgrade. This finding shows that the students had positive attitude towards using technology in education. Generally, the laboratories were open to all students but it was observed that more users were coming from science subjects, like Mathematics and Physical Science although the content on the server was for both Arts and Sciences.

Finally, Yahaya recommend that:

> "*This programme should be rolled out to other schools. More content for other subjects like English, Geography, History and other subjects should be added because the first setup had more to do with science subjects. It will be a tool that will help students. It will bring more interaction with computers and at the same time it will make learning easier*".

5.6 Study Findings on Moodle LMS and Turnitin

In the following section, interview sessions that were conducted with two lecturers who were using Moodle e-Learning platform for their classes are presented. They shared with the researcher their success stories and challenges they faced when using Moodle and Turnitin.

5.6.1 Interview on use of Moodle with Lecturer 1

The first interview session that was conducted on use of Moodle as an e-Learning platform at MZUNI was with one of the pioneers of this LMS who shall be given a pseudonym Waliku. After making some introductory remarks and explaining the purpose of the study and seeking his consent, he agreed to be interviewed.

Waliku joined MZUNI in 2010. He had been teaching Introduction to Politics and Government, Political Theory, International Relations, Public Policy Analysis, Regional Integration and Cooperation, and Security and Gender. He had been using Moodle in all his classes since 2013. When asked what prompted him to start using technology in his classes, this was his response:

> *"It was just a question of enriching my teaching and my interaction with my students. I was looking for tools that would do some kind of blended teaching and learning. So, I thought that there was an opportunity because the University already had Moodle, the e-Learn platform which was not being utilised and I thought I should give it a try. The students responded effectively and since then every student in my class was introduced to Moodle. Most of the time, I tell them that I am going to upload lectures there so they have no choice but to use it. Even for assessment, I encourage them to submit their assignments using Moodle."*

Apart from uploading content and assignments, Waliku used Moodle to hold discussions and communicating with students. Although implementation of Moodle had been generally successful, access to the Internet by students had been a challenge. The University was in the process of improving access to e-resources by improving the local area network. Several wireless hotspots were being installed on campus for this purpose. When the researcher asked him if he had taught other members of faculty how to use Moodle, he said that he had taught one colleague in his department, although she did not use it frequently. Waliku planned to continue his quest to encourage more members of staff in his department to start using

Moodle. He had even contacted the Vice Chancellor and Deputy Vice Chancellor about his mission to bring awareness to faculty about the benefits of using Moodle.

Apart from Moodle, Waliku was using Turnitin, an anti-plagiarism software. His students had accepted using it although they had some reservations when he first introduced it. When asked if he was going to continue using technology in his classes, this is what he said:

> *"Yes. It is all about personal motivation. I find the use of electronic teaching aids as one of those things that are improving my teaching and learning experiences. The more I am doing this, the more I discover that even peers in other universities are doing the same and that offers me a chance to learn from them."*

Waliku had truly integrated technology in his teaching and learning process and recommended that the University should have a policy on use of technology to compel faculty to use platforms like Moodle in their courses. On facilitating diffusion of technology at the University, this is what he said:

> *"There should be a policy. I think it can start from faculty level. Let the deans impress upon the heads of department. I am sure there's a difference also in the age of lecturers. What I have noted is that younger lecturers are more into technology than older ones. If we were to send a strong message about integrating technology to management, there might be a positive response. For the few colleagues who I have interacted with on this issue, it seems they are all waiting for some induction on how Moodle works. Maybe we should have somebody who is a dedicated manager for e-learning. We need someone who is really into Information Technology (IT) and is passionate. Another way is to have periodic seminars. This would be an element about electronic teaching and learning. People with experience with e-learning would share their experiences. This would motivate them."*

He further suggested that the University should encourage use of electronic teaching aids since there are not enough books in the library. The only resource the University had was access to e-resources on the Internet.

5.6.2 Interview on use of Moodle with Lecturer 2

The second interview on Moodle was with a lecturer who was using Moodle and Turnitin software in some of her classes. What follows is an account of her experience. This lecturer, who will be called Temwa for anonymity, had been teaching at MZUNI since 2012 and had been using Moodle in her classes for five months prior to this interview. She was using Moodle in third and fourth year classes. The average number of students in these classes was sixteen. However, she did not use technology in first year class because she felt these students needed to be taught basic computer skills first. She used Moodle to upload content of her class, which students downloaded. Students sent messages to her if they faced problems. She had not yet started using the platform for assignments. Most students logged into Moodle, downloaded what she had uploaded and read the content offline. Apart from downloading lecture materials from Moodle, students also used this platform to communicate with her when they wanted more information. Sometimes they used WhatsApp especially when the lecturer was off-line. When asked why she preferred WhatsApp when communicating with her students, Temwa said that WhatsApp was faster and convenient. When she got messages from her students on WhatsApp about problems they were facing on Moodle, she used to log onto Moodle and rectify the problems. She found WhatsApp handy because she did not check her e-mails regularly. She used e-mails mainly when she wanted to communicate with students during holidays.

Apart from Moodle, she also used Turnitin with the fourth-year students. She used it to check students' essays and projects for originality. She found that the levels of originality in students' work varied from 75% to 82%. She thought this good rating was because the students were warned beforehand that their work would be subjected to Turnitin. She reported that most students found it difficult to use Turnitin. Their view was that Turnitin was too strict because it checked even some phrases such as *submitted in partial fulfilment* and reported them as plagiarised content.

Temwa was motivated to use technology by her colleague who was a regular user of technologies. In turn, she encouraged another member of staff in the department. She anticipated that two or more members of staff would start using technology soon.

It can be seen here that one-on-one communication was helping in diffusing technology in teaching. In general, the attitude of students towards using technology in class was positive. The students prefer learning using Moodle because they found it easy to access learning materials as they were able to download lessons onto their devices and study at their own convenience. They preferred to study using softcopies than printed materials. However, they had negative attitude towards Turnitin because it picked on the trivialities. To deal with the trivia concerns, Temwa used personal judgment when grading the students' works to make sure that they were not penalised for such subtle issues. In the subsequent semester, Temwa planned to ask students to start submitting their assignments using Moodle. The students would be given an assignment rubric that would be used for grading the assignments. Temwa did not use any other technologies apart from those mentioned above but she was willing to learn how to use those technologies that would enhance students' participation such as Participoll and Socrative.

Initially, Temwa was hesitant to start using Moodle in her classes because of problems of Internet connectivity and lack knowledge on how to use it. She started using Moodle after her colleague showed her how to use the platform step-by-step. After seeing its benefits, she recommended that other departments at MZUNI should incorporate this technology in their teaching and learning process. She also felt that students who were pursuing degrees using the ODL delivery mode could benefit from this technology. She recommended that the University should encourage departments that were not using this technology to learn from those departments that were already using Moodle. This could be done easily through workshops and seminars. Temwa was willing to be a resource person in training others to use Moodle.

5.6.3 Use of Turnitin by lecturers and students

In general, usage of Turnitin by lecturers at MZUNI was disappointingly low. Statistics of how the lecturers and students used Turnitin were collected from January 2014 to February 2016. Analysis of usage of Turnitin revealed that only 26% of lecturers and 74% of students registered on the platform. Out of 32 registered instructors, only 20 used the platform. Only 9 out 32 registered lecturers had students who used the platform. An even smaller number of 3 registered lecturers had more than 10 students who actively used the platform.

5.7 Challenges of education institutions with limited resources

The third research question focused on challenges that education institutions with limited resources met when integrating digital technologies in education. Data on this research question were collected from interview sessions with lecturers.

During interview with Chidongo, it was discovered that the design process of C Programming website and interactive questions did not proceed without challenges. The main challenge that Chidongo faced was time constraint. Time was not enough to create all e-learning instructional materials for the whole syllabus. Another challenge was that some students did not have computers for viewing videos. The only solution was to use university computers in the computer laboratory which was not open all day. To mitigate these challenges, he suggested that the ICT Department should provide more time for computer laboratory sessions to enable students utilise the materials. Additionally, better Internet connectivity would enable students to access and download online materials easily. Chidongo was willing to promote the use of technology in teaching and learning but he said that the challenge was that the necessary resources were not available for him to achieve his plans. The Faculty of Information Science and Communications was trying to create more electronic materials to be accessed by the students through the institutional website and institutional repository to provide downloadable materials.

More challenges were cited by John when he was recording e-Modules and communicating with students using WhatsApp. He faced some challenges which included slow Internet connectivity and background noise. While the recording processes did not directly call for use of the internet, sourcing information online for such modules required access to the Internet. Moreover, John was recording his lessons in a room that was not sound-proofed and hence was hugely subjected to background noise. The main challenge he noticed when using WhatsApp was that some students did not differentiate between using social media for education purposes and mere social interaction. He recommended that lecturers who intended to use social media for educational purposes should first set rules in order to guard against potential abuses. This is exactly the same as what the researcher experienced with the WhatsApp groups for the ODL classes. This aside, WhatsApp was found to be useful for academic purposes. Another challenge regarding communication with students was that some students used to phone or send WhatsApp messages to the lecturer during odd hours. Sometimes it was difficult to have fruitful conversation with some students, especially those living in remote rural areas, because of poor telephone lines. John also found that many students did not use e-journals that he had downloaded and distributed to them. His explanation was that the students did not use these electronic learning resources because they lacked computers or smartphones needed for accessing the e-resources.

Another lecturer, Walinase, faced some challenges when producing e-Modules using Camtasia. When the researcher asked about her experience, this what she said:

> *"It was good but with some challenges though. It was a good experience because we have been introduced to technologies that we did not know about. We are also able to help students who are learning using the ODL mode with these technologies. The main challenge was that we didn't have enough training on how to use Camtasia. Moreover, the environment we were in when recording instructional materials wasn't good. There was a lot of unwarranted noise from people and music from clubs. Given enough training, we can produce the materials at our own homes which might be quieter than the lodges though homes would also be disruptive sometimes.*

> *So, the ideal place would be away from town in a remote area and away from night clubs and bars."*

She recommended that the duration of module-writing training should be three days and the lecturers should be taught how to record, edit and distribute video and not only showing them how to record as was the case.

A lecturer who recorded a chemistry e-Module said that a challenges he faced was limitation of Microsoft Word to accommodate symbols and diagrams for chemistry. He recommended Chemidraw for drawing complex molecules though this software was expensive. Chisomo was unable to complete repurposing his lessons into mp4s because of hardware and software problems. He also cautioned that there was need for patience when redesigning teaching and learning materials into e-format particularly for chemistry.

5.8 Effects of repurposed instructional materials and digital technologies

The fourth research question was: What are the effects of repurposed instructional materials and digital technologies on staff's teaching and students' learning experience? To answer this question, the researcher asked lecturers who produced instructional materials for e-learning to share their experiences. The first respondent to be interviewed was Chidongo. When asked if the e-learning instructional materials he had designed had any effect on his teaching and students' learning, he said that these materials had a positive effect. After he started using the e-learning materials, he spent less time in class to explain concepts because the recorded materials performed this job. Recorded e-resources enabled him to cover the syllabus on time. In addition, he found it easy to teach using e-materials because sharing what he covered in class became convenient. He thought that because the students were able to use e-learning materials in the form of recorded tutorials repeatedly, they were able to grasp concepts easily. Chidongo observed that the students' rate of understanding the materials had improved. In general, there was improvement in students learning. Their level of understanding changed so much and there was so much interest in the students to use more of the e-learning instructional materials.

The researcher was interested to find out whether there was a significant difference in academic attainment of the students after they had started using the repurposed electronic instructional materials. The lecturer stated that the students' academic performance was higher than before. He attributed this higher performance to the fact that the students had more time to practice programming using the e-resources because they had ample time to do so after class. He observed that although there were some students who still had problems, he estimated that about 85% of the class had benefited from the materials.

The second interview was with John. He reported that using technology helped him to continue discussing academic issues with his students even after class time. He discovered that some students who were shy to make contributions in class were able to do so outside the classrooms through WhatsApp. He also felt that WhatsApp discussions helped his learners to understand the concepts better. On use of technology, he suggested that it should be mandatory for each department to have multimedia projector instead of using chalkboards. He asserted that management should take a leading role in promoting technology to ensure that staff members adopted technologies. He suggested that management should buy laptops and distribute them to lecturers to enable them use technology when teaching.

Another lecturer who was asked to share her experience of using repurposed instructional materials was Walinase. She reported that students liked the idea of recorded lectures. She gave them her PowerPoint slides and made them listen to mp4 recordings after class. The students said that the PowerPoint slides made sense when used together with the videos. Generally, she observed that mp4 recordings had positive effect on students' learning. Although she hadn't made any assessment if the videos improved learners' academic performances, she however, noted that if one used PowerPoint that had visuals, one's class became lively unlike using the chalkboard. Teaching became easier when one used illustrations and videos. She therefore recommended that management should make it mandatory that lecturers used mp4 recording in their teaching. Commenting on how MZUNI could promote technology integration, she said:

> *"MZUNI still has some members of staff who are afraid of technologies. We need to find ways of convincing them how useful technology is in the teaching and learning process. There is need to bring awareness to members of staff and tell them that computer packages are user friendly and that they are not that complicated."*

Temwa was another lecturer who was interviewed. When asked whether there was significant change in academic performance of her students before and after she started using technology, this is what she said:

> *"For the third year students, I've seen them grow to be a little bit more critical. Even my approach to teaching was a little bit different."*

Before she started using Moodle, she used to teach using the traditional lecture method and PowerPoint presentations. In this type of teaching, there was no deep analysis of issues. Her approach to teaching had changed when she started using Moodle because she had incorporated technology. In her new approach to teaching, she uploaded a number articles on Moodle. The students were supposed to download and analyse them after giving them guiding questions to use when critiquing the articles. Temwa had found that the students were able to critically analyse the articles and bring out the real issues. She felt that this approach had helped them to some extent. She thought that this new approach to teaching and learning had encouraged students to become active participants in their learning.

Final interview was with Chisomo. The researcher wanted to find out from him if he had observed any improvement in student performance since he started using technology. His answer was that it was difficult to say since no study had been conducted save to say that students' attitude towards technology was generally positive. However, he had noticed that some students found it difficult to follow lessons when he was using PowerPoint because they found lesson presentation fast. In response to this challenge, he would slow down and leave his PowerPoint slides for the students after class. To improve use of technology at MZUNI, Chisomo suggested that there was need to have classrooms with ceiling suspended multimedia projectors where lecturers could teach using PowerPoint. He also proposed that the university should teach members of staff how to use Moodle.

5.9 Chapter summary

This chapter has presented findings on the implementation of a home-made EVS that was piloted with C Programming class at MZUNI, CDSS-2 and CSS-1. It also highlighted the findings on mp4 e-Modules that were developed for ODL students to supplement print modules. In addition, the findings for Moodle LMS were presented. Generally, there was support for technology integration in teaching and learning at MZUNI and the selected secondary schools. Lecturers, teachers and students alike are using locally available resources to ensure that technology was integrated into the teaching and learning processes. In the next chapter, general discussions of the findings and recommendations on what should be done to successfully integrate technology in education at MZUNI and the selected secondary schools are presented.

Chapter 6: General Discussion

The aim of this study was to investigate how institutions with limited resources could use locally available resources to integrate technology in teaching and learning. This research was exploratory in nature in that the researcher wanted to find out what institutions can do with the limited resources they have to integrate technology in teaching and learning. The research was conducted at MZUNI and four selected secondary schools in Mzuzu City. Two of these were CDSSs and the other two were conventional secondary schools. The study aimed at extending knowledge on how appropriate technology can be used to solve problems in the classroom in the Malawian context. In this chapter, the researcher will present an overview of the study together with the findings. He will discuss the implications of this study in terms of the theory of diffusion of innovations. In order to explain how technology can be integrated in teaching and learning, the researcher addressed the following four research questions:

1. How can education institutions with limited resources sustainably use locally available resources to repurpose existing paper-based instructional materials for electronic delivery?
2. Which electronic media can resource challenged institutions use to sustainably integrate digital technologies in secondary and higher education in Malawi?
3. What challenges do institutions with limited resources meet when integrating digital technologies in education?
4. What are the effects of repurposed instructional materials and digital technologies on faculty's teaching and students' learning?

The study was divided into two phases. Phase One aimed at collecting baseline data that helped in designing data collection methods for Phase Two of the study. The research study was informed by Rogers' (2003) DOI Theory. In this phase, the researcher wanted to find out the factors that would impact on the use of technology in education as a tool to solving problems in education. A mixed-methods approach was used to collect data in order to address these questions. The main question was: How can education institutions with limited resources sustainably integrate e-learning technologies into traditional teaching and learning?

6.1 Research Question One

How can education institutions with limited resources sustainably use locally available resources to repurpose existing paper-based instructional materials for electronic delivery?

To answer this question, the researcher was inspired by aspects of the following quotation by Theodore Roosevelt:

'Do what you can, with what you have, where you are.'

The researcher will start by looking at what educational institutions already have. Although this research was conducted on the premise that teaching and learning resources in Malawi are scarce, this study has established that educational institutions that have limited resources can use whatever they have to integrate technology in the teaching and learning processes if they share the little they have. This study has shown that use of locally available resources can facilitate diffusion of innovation. The researcher has demonstrated that resources we use every day can be used innovatively to spread use of technology. The use of the TALULAR concept in spreading acceptance and use of technology in education is the major contribution of this study to the current body of knowledge. For instance, this study found out that 93% of the teachers and lecturers had some experience in using technology. Most of the participants were already familiar with MS Word, Excel and PowerPoint. MS Word is one of the most commonly used package by the teachers. According to the University of Sydney (2016), Microsoft Word is used for many purposes including creating worksheets and notes, letters, memos and permission slips, student reports and compiling school newsletters. Additionally, Smith (2016) asserted that slide presentation software such as PowerPoint has become an intrinsic part of instruction in many institutions, especially in large classes and in courses more geared towards information exchange than skill development. These resources can be used as a starting point of technology integration in teaching and learning. However, MAGNA Publications (2016) cautions that like so many instructional practices, PowerPoint is not in itself inherently good or bad but it is the way one uses it. When the researcher asked one lecturer to tell him what technology she uses in her classes she said, *"I mostly use PowerPoint when teaching. I no longer use chalkboard though sometimes I use whiteboard markers."* She explained that she decided to use PowerPoint because she teaches large classes (about 150), and therefore finds it easy with PowerPoint. She also uses emails to distribute her lesson notes to students because she discovered that most students had laptops, smartphones and an email account. Another lecturer said that he uses Excel, multimedia projectors, PowerPoint, eBooks and the Internet. He also converts Word documents to PDF and uploads them onto Moodle.

The study has revealed that not many lecturers at MZUNI use Moodle. A similar observation has been made by Mtebe and Kondoro (2016) who have stated that the potential of LMS has not been fully exploited as there are few users even though there is an increased adoption in the Sub-Saharan region. They also emphasised that the low use of LMS does not justify the high infrastructure investment costs. This assertion is correct if institutions use proprietary software like Blackboard, which is expensive, although the cost can be reduced significantly if free-courseware such as Moodle is opted. One lecturer who uses Moodle at MZUNI uploads her lessons in PDF format which her students download to read offline. The fact that students download instructional materials means that they have electronic equipment which enables them to use this platform.

In Malawi, another initiative to increase access to online instructional resources to university students is use of Online Learning and Training (OLAT) which is championed by Lilongwe University of Agriculture and Natural Resources (LUANAR). According to Mkweu (2016), OLAT is a web-based LMS that supports any kind of online learning, teaching, and tutoring with few educational restrictions. This study has revealed that another technology some lecturers at MZUNI use apart from Moodle is an anti-plagiarism software called Turnitin. They use the software to check students' essays, and dissertations for authenticity. The fact that some lecturers use Moodle and Turnitin gives one hope that more lecturers will join them when the environment is right. It is pleasing to note that MZUNI has taken a step towards antiplagiarism war.

The University conducted a sensitisation workshop for academic members of staff in June 2015. Plagiarism is a growing problem globally as pointed out by Will Murray, Vice President of Turnitin International. To highlight the importance of keeping plagiarism in check, academics from across Africa gathered at the first ever series of African Academic Integrity Seminars that were held in South Africa in 2016 on May 20 and 24 at the universities of Cape Town and Johannesburg respectively to discuss plagiarism prevention and detection. There was an additional seminar on May 23 for university heads. The event was hosted by Turnitin, the world-leading originality checking and plagiarism prevention tool (Turnitin, 2016). Many universities across the United Kingdom use Turnitin for formative as well as summative assessments by asking students to make a declaration as to the authenticity and originality of any submitted piece of work. The universities require students to provide electronic versions of any submitted assignment to check for plagiarism. This is in concert with what a few lecturers do at MZUNI for students' essays and dissertations. Turnitin can be used as one part of a structured, scaffolded and supported learning activity.

Although majority of the lecturers use technology in their teaching and learning at MZUNI, the study found that 15% (Table 4-5) of respondents were non-users of technology. This group could be taught how to use technology by tapping from the knowledge pool of those who are already using it. This study also found that most lecturers (about 83%) had the following *basic skills* needed to integrate technology into teaching and learning: converting documents into PDF format and finding instructional materials on the Internet. It is however sad to note that many lecturers did not have knowledge and skills that are critical for designing e-learning resources. Critical skills like designing web pages and blogs, podcasting, producing instructional videos and using Learning Management Systems were unknown to them. This is evident when 64% of the teachers and lecturers indicated that they had never designed any e-learning instructional materials before. The most common format for e-learning instructional materials that educators are conversant with is PowerPoint. Other media of instruction such as video and audio are not well known though. These findings concur with what Odora and Matoti (2015) found in their study titled 'The Digital Age: Changing Roles of Lecturers at the University of Technology in South

Africa'. They found that majority of lecturers had access to a wide range of digital technology but the findings did not suggest that the technologies were used in teaching and learning. Furthermore, their study revealed that almost 88% of the lecturers used a computer for producing documents everyday while 64% did not use a computer to create web-pages. A very small percentage of respondents (5%) indicated that they used a computer for creating and editing audio and videos.

Educators nowadays are expected to know how to upload materials onto the Web in order to help learners access content easily. Although many lecturers do not have the necessary skills of designing e-content, hopes are high that one day many will adopt it given that many of them have positive attitudes towards e-resources and are willing to learn. Instructional designers with this knowledge are also prepared to transfer their skills to their colleagues. Moreover, many lecturers who are using technology have personal laptops. In addition, many students have laptops and smartphones which they use for their studies. What has been mentioned above shows that TALULAR concept may one day become a reality. Both staff and students are increasingly using locally available resources for teaching and learning respectively. Dunn (2015) stressed the point that it can be overwhelming for a content provider who is working with minimal resources. This is where TALULAR comes in handy by providing an alternative way out to teaching and learning. TALULAR enables every teacher to think outside the box and see the wealth of ready materials around him or her. These are materials that are used daily in other aspects of life and may not come to mind immediately that they could be used in the classroom. TEVETipedia (2010) argued that many teachers who are familiar with TALULAR promote a radical change in the way they view and utilise their locally available resources in order to move closer to sustainable development which will, in turn, provide quality education. It is further stressed that the process of designing and developing a TALULAR-alternative usually enriches the education process. This finding implies that if MZUNI management increased the number of computers, then access to e-resources would be simplified since Internet access on campus is free for staff and students.

The study found out that at least 50% (Table 4-6) of the teachers and lecturers had access to computers, printed materials, PDF convectors and time to convert lecture materials to e-format. These are raw materials SMEs and instructional designers need for repurposing print instructional materials for electronic delivery. The remaining respondents who do not have access to these resources can be empowered if educational institutions can increase investment in technology. Many public institutions do rely on donations. Institutions of higher learning should encourage the spirit of sharing and promote use of open educational resources (OERs). This is an initiative the University of Malawi has already taken. The UNIMA does provide cost-effective learning resources using OER through grants from the Open Society Initiative for Southern Africa (OSISA) and the William and Flora Hewlett Foundation, the International Association for Digital Publications and OER Africa (OER Africa, n.d.). Importantly, Global Economic Symposium (2016) noted that it was important to heavily invest in education because it was a fundamental right for everyone and was a key to the future of any country.

The fact that majority of respondents (94%) (Table 4-6) have access to computers is encouraging because a computer is at the heart of technology integration. In addition, MZUNI has open-access computing facilities like many other universities such as Vanderbuilt Peabody College (2016) and the University of Glasgow (n.d.) for staff and students, subject matter specialists, instructional designers, website developers, Internet and systems administrators and access to FLOSS. The researcher feels that MZUNI has some resources that can be used to start integrating technology into the system. What could usefully be done is to promote teamwork and to engage management for continued investment in technology.

Having discussed available resources, let us now turn our attention to the first phrase in Theodore Roosevelt's quotation, *'Do what you can'*. The first thing we can do is to encourage more academic staff and students to use Moodle. Nevers (2012) outlined ways of doing this. Some lecturers, who we have called early adopters of technology according to Rogers (2003), already use Moodle LMS to upload lessons, though the number is small. It has been observed in this study that once lecturers have uploaded instructional materials, majority of their students access them and download them onto their gadgets easily. Those students who do not have PCs can still access the content on Moodle using university computers. It has already been shown that students are keen on accessing instruction using Moodle as evidenced by the 87% (Section 4.5.12.3) who found Moodle useful. This result concurs with what Kamarulzaman, Madun, and Ghani (2011) found in their study that the 62% of the students had positive attitude towards Moodle. Furthermore, 89% of the students who participated in the study recommended that lecturers should continue using the LMS. They made this recommendation because Moodle enabled them to have increased access to instructional materials since they were able to access the materials uploaded by lecturers anytime. A recommendation from students to introduce free Internet services on campus has been implemented. There is now an optic fibre backbone on campus with several wireless hotspots where registered users can access the Internet for free. However, the number of computers on campus needs to be increased and ensure that Moodle is available to many users. More so, power outage is still a big problem, and students' orientation on how to use Moodle must be done. As stated earlier on, alternative sources of power should be found to supplement the ESCOM. According to ESI Africa (2016), ESCOM has perpetually warned the public that Malawi would experience prolonged blackouts due to low water levels at its hydropower plant. To mitigate this problem, institutions can work with charity organisations like ENERGY4IMPACT to install renewable energy in their institutions.

Many lecturers at MZUNI have lesson notes that are in soft copies. These are raw materials that can be converted to PDF and uploaded onto Moodle. Perhaps this a good point of departure. If management can officially organise short courses on how to use Moodle, many users may go for this platform. The big advantage here is that faculty members who use Moodle are willing to teach others, and those who do not know are willing to learn. It only requires management to provide a conducive environment for this to happen. The same lesson notes can be used to produce web-pages, blogs, podcasts and educational videos.

In 2005, the Government of Malawi introduced Computer Studies as an examinable subject at MSCE but to date the subject is still optional. In order to face the future with confidence in the present socio-economic environment that encourages the youth to aim for self-employment, entrepreneurship and further education, there is need for our students to have skills that will enable them use computers competently. However, Gondwe (2013) observed that computer education in Malawian Secondary Schools is yet to start in earnest. He attributed this to the fact that the number of computers for students is unbelievably small due to inadequate effort by the government to put in place the needed infrastructure. In addition, the government needs to have robust policy on e-Learning in all educational sectors. Many NGOs such as Centre for Youth and Development and Malaptop have supported government schools with refurbished computers (IT Schools Africa, n.d.; InterConnection.org, n.d.; Computer Aid International, 2015; FAIR Denmark & FAIR Norawy, 2016). This study recommends that schools that offer Computer Studies should not use their computers for Computer Studies only but also as servers to host diverse educational content for the benefit of the educational system. The Malawi National Policy for ICT states that the Government shall facilitate the development of education in the country by introducing ICTs. This shall be done at all levels of education. Going by this declaration and to enable teachers in schools integrate technology in education, MZUNI staff who are technologically savvy can train secondary teachers to develop instructional materials. Integration of local content generated from lesson notes into e-learning platforms has been tried at two sampled secondary schools and the results were promising according to the computer technician. He recommended that the programme should be extended to other schools. He also proposed that content for other subjects like English, Geography, History and others should be added because the pilot project targeted Physical Science only. He believed that such a programme could be a tool that would help students. It would bring more interaction among learners and as a result make learning easy. Schools which do not have computers can be assisted to write proposals to acquire basic equipment like computers, multimedia projectors and plasma television screens to use for e-learning. Plasma screens can be used to receive live instructional television broadcasts (Bitew, 2008) or play recorded lessons that have been saved on flash disks or DVDs. Integration of technology in education requires teamwork and collaboration.

Secondly, apart from the technologies mentioned above, educational institutions can promote production and use of recorded class sessions either as mp3s or mp4s which can be distributed offline and or online to students for free. Freemake (2016), Adoreshare (2016) and Chapman (2016) provide descriptions of top sites that host videos for free. These could be potential channels for distributing the content. Teachers and lecturers who are willing to record class sessions believe that recorded lessons increase students' access to instructional materials and enable them to revise classwork at their (learners') convenient time. They also believe that this delivery mode simplifies teaching and learning. The fact that majority of learners are willing to use recorded materials gives this innovation the impetus for adoption. In addition, recorded educational materials are convenient for study because students can use them repeatedly. The University of Queensland (2016) and iSpring Solutions (2016) outline more advantages of video presentations in teaching and learning environs. MP4s can be played on different equipment such as computers, tablets, smartphones and plasma televisions. In fact, this mode of delivering lessons has already been successfully tested in this study. For example, when eight e-modules were distributed to ODL learners, they all indicated that they had access to the e-resources. They all used them before they came to write end of semester examinations. The institution used DVDs and flash disks to distribute these videos. All respondents but two found the e-modules helpful. Students used their own resources to study these materials because they were not given any resources during their home study. This was the first time that students at MZUNI were given this type instructional materials. This shows that with determination, technology integration in education is possible. Students learning under the ODL delivery mode do most of their studies at home where there is no face-to-face contact with their lecturers. When they study using recorded material, they get a sense of the presence of their lecturers through hearing and seeing the teacher in videos. The same was echoed by EducationDIVE (2014) who observed that lecture capture brings a face-to-face experience to ODL learners and must hence be encouraged.

A third technology that educational institutions can integrate in education is EVS. This concept has been piloted at MZUNI, one conventional secondary school and one community day secondary school. Even though this home-grown EVS has not been perfected yet, the principle has shown that it is workable. One important outcome of using EVS is that every student is encouraged to participate and gets feedback immediately. The system also allows shy students (Tech Decisions, 2015) to participate in class because students answer questions anonymously. Students provide answers without fear of reprisal because they are assured that the lecturer will not know who answered what. This learning environment encourages students to participate actively. Lecturers are also able to adjust the way of delivering instruction based on feedback they get from EVS. For example, the C Programming lecturer decided to revise the concept of *Mathematical Functions* after he noted that most students had not understood the concept. This study has also shown that conferring facilitates peer learning as observed by Trees and Jackson (2007). This has a positive effect on students' understanding of what is being presented in class. For example, when students were asked to answer thirty multiple choice questions in pairs during a C Programming revision class, it was observed that their performance was outstanding as the scores ranged from 92% to 97%. The students themselves attributed this high performance to collaborative learning. Some of the advantages of pair-work as outlined by TESS India (n.d.) include enabling students to learn from each other; giving students a degree of privacy and allowing them to try ideas under wraps, and giving responsibility for learning to the student. Baud, Cohen, and Sampson (1999) however, cautioned that, ways of assessing the value of peer learning together with its implementation strategies must be explored if it is to play a part in university experience. Christudason, (2003) advised that teachers must provide 'intellectual scaffolding' to students to realise the benefits of peer learning.

Electronic voting system was tried at the two sampled secondary schools: CDSS-2 and CSS-1 where there were scarce resources for conducting such an innovation. Similar effects of feedback that was observed at MZUNI were also seen here. For instance, when the Physical Science teacher saw that students' performance during the *Graphs* *of Motion* Physical Science quiz was bad, he decided to revise the areas students did not understand. Students got feedback on areas that needed more work. Another effect of EVS was the synergistic effect of pair work. Students worked in pairs to encourage peer learning just like it was at MZUNI. It was observed that except for pair number seven (G7) students' performance was extremely good (Figure 5-8). Another explanation of this high performance was that the students had revised and practised questions on the topic *Electricity* because they were told beforehand that they were going to be asked questions on that topic. In a similar study to evaluate the implementation of a Personal Response System (PRS) in physiology lectures undertaken by undergraduate science students, Gauci, Dantas, Williams, and Kemm (2009) found that students improved their examination results when compared with previous years. The students also rated the use of PRS in lectures highly. Perhaps one of the most positive findings of the study by Gauci, Dantas, Williams, and Kemm (2009) was that overwhelming majority (89%) of student respondents thought that the use of the PRS motivated them to think. Clicker technology is a new concept in Africa as seen from the Distance Education and Teacher Education in Africa (DETA) Conference, held at the Mauritius Institute of Education, Réduit, Mauritius, from 20th to 24th July 2015, which was sponsored by Participate Technologies. For many of the participants, this was their first exposure to audience response technology commonly referred to as clickers (Participate Technologies, 2015). Judging from the findings of this study, clicker technology promises to take root in education in Africa once it is introduced.

The interactive websites that were used for the EVS in C Programming class can also be used for students' self-assessment either online or off-line. The exercises have already been posted online on MZUNI website. What the researcher and the C Programming lecturer need to do next to improve the site is to include user authentication system and comprehensive feedback to each question to help students with self-assessment as they go through the questions. If students want to have the exercises off-line, the required software (WAMP Server) can easily be installed on their computers. Having produced a prototype, the next stage will be rolling out the project to include other subject areas. It is hoped that the interactive exercises will help students as they prepare for their examinations because all students who went through the interactive exercises found them useful. Part of the source code for the website is presented in Appendix E.

Fourthly, education institutions can incorporate social media in teaching and learning. If well managed social media such as WhatsApp can be a very useful vehicle for e-learning. WhatsApp is used to send and receive messages to and from individuals or groups. Messages can be sent using a variety of forms such as text, images, audio, video, and links to web resources. Ideally, WhatsApp is a social network that allows people to access information quickly. In this study, the researcher tried using WhatsApp as a tool to communicate academic issues with ODL students. Although all participants were willing to join WhatsApp because they felt that this social medium was a cheap way of communication, some did not join the groups because their phones could not support the facility. Typical information that was communicated through WhatsApp in this study was announcement of examination results, sending and receiving assignments and sharing useful links on various subjects with students. Recently the popularity of WhatsApp has risen. According to Bouhnik and Deshen (2014) class WhatsApp groups are used for four main purposes: communicating with students; nurturing the social atmosphere; creating dialogue and encouraging sharing among students; and as a learning platform. In their study, Bouhnik and Deshen (2014) noted the following as academic advantages of using WhatsApp: accessibility of learning materials, teacher availability, and the continuation of learning beyond class hours thereby reducing dead hours. These findings are similar to what this study found. In as much as WhatsApp is a brilliant application, it has some disadvantages. Khan (2014) noted the following disadvantages, among others: (1) people can chat to friends who only have smart phones supporting this application and to friends having their account on WhatsApp, and (2) you need to have access to Internet to send and receive messages via WhatsApp. It was observed in this study that lecturers found it easier to communicate with their students using WhatsApp in spite of a few challenges they faced when using this application. For example, one lecturer asked her students to use WhatsApp all the time instead of email to communicate with whenever they encountered problems with Moodle. She found out that WhatsApp was a more convenient mode of communication unlike using emails.

6.2 Research Question Two

Which electronic media can resource challenged institutions use to sustainably integrate digital technologies in secondary and higher education in Malawi?

The general rule of thumb that should be observed when initiating a technological innovation according to (Trucano, 2015) is to use the technology that people already have, know how to use and can afford. This assertion does not mean that people should not use new technology but rather, it reminds everyone that existing technologies which people know how to use should not be discarded. This study found that among the top five electronic media that students and lecturers at MZUNI, and teachers in schools found sustainable for distributing electronic resources were the Internet, Facebook, memory sticks, personal computers and cellphones. Very few respondents had access to tablets, iPads, iPods and Moodle. Like in some universities (Roach, 2003), Internet at MZUNI is free for staff and registered students. This means that they can use Internet resources like Moodle, blogs, podcasts and others easily although connectivity is sometimes abysmal. For those who are off campus like ODL students who spend most of their time studying at home, have to pay to access learning materials that are hosted online. Internet access for teachers and secondary school students is problematic because they too must pay. More so, Internet in Malawi is expensive (Mdeza, 2015 & Internet Society, n.d.) which means that many secondary schools may not afford to access online instructional materials sustainably unless Government convinces Internet providers to charge concessionary rates to educational institutions.

Facebook is very popular in schools and colleges (Mashable, n.d.); U.S. News, 2011; Rasmussen College, Inc, 2010; ee J. , 2009). Because of this fact, many educators have opened institutional Facebook accounts for academic purposes. The use of Facebook for educational purposes may be a viable option since it can be accessed on computers, tablets and mobile-phones. Moreover, Facebook bundles are not very expensive. Whether students would be willing to use their money to buy Facebook bundles to access academic materials instead of socialising or not is a question that begs an answer. Additionally, lecturers, teachers and students must be convinced that social media like Facebook can be used for academic purposes (Oxford University Press ELT, 2016; Ketineni, 2016). Strict rules governing the use of WhatsApp and Facebook for academic purposes must however be set up first and agreed upon by all parties to avoid abuses. Once this is done, the platforms can be used for distributing and discussing academic content. At MZUNI, some lecturers are already using Facebook though they are yet to start using WhatsApp for educational purposes.

Memory sticks are relatively cheap, so staff and students can afford to buy them. Distributing e-resources using memory sticks is very sustainable, but there’s need to guard against transmission of viruses. Best practices on use of portable USB devices should be developed (TechTarget, 2010) if educational institutions are to control spread of computer viruses. Effective antiviruses need to be purchased to scan every flash disk before it is used for content distribution.

Personal computers may be used for e-learning but using students’ computers is not a good option. The owners may withdraw them any time they wish. Institutions therefore need to buy more computers instead of relying on staff or students’ computers.

Ordinary cellphones have limited application in e-learning. They can only be used for making voice calls and sending SMSs. Even if students had access to smartphones, secondary school students would not benefit from them because they are not allowed to bring cellphones to school (Nyondo, 2016 & Trucano, 2015). However, university students are allowed to use their cellphones on campus. In addition to this, students at MZUNI use personal laptops on campus as evident from the findings of this study where 79% indicated that they use PCs and found them sustainable. Although this is the case, there is still 21% of students without PCs. This is where management can come in and procure more computers to savage the situation.

Using DVDs as a means of distributing lessons that teachers and lecturers have recorded should also be explored because a significant number of respondents: 64% of MZUNI students, 70% of secondary school students and 67% of teachers and lecturers have access to DVD players. To make this feasible, recorded DVDs should be kept in libraries and lend them out to students when needed. Since these resources will be used by students at home, wear and tear will be high. Therefore, there is need to have a backup stock of DVDs to replace damaged ones.

This study found out that all groups of respondents have access to the following technologies: Internet, Facebook and ordinary cellphones. Although these media are common to all groups, it is worth noting that about half of secondary school students do not have access to e-learning instructional materials using these modes. This means that technology integration should be introduced gradually to accommodate such students. The answer to this predicament is to use both print and electronic resources as institutions integrate technology in education until such a time when majority has access to e-resources. This was evident from students' responses when ODL students who were given mp4s were asked about their experiences. All students preferred to be given both print and e-modules because in their experience the two complemented each other. Their recommendation though, was that lecturers should elaborate more in e-modules by providing more information that explains concepts covered in print modules rather than the lecturers simply repeating what was in print modules. Best practices on creating online module (Towse, 2009) need to be followed if academic institutions are to produce good quality e-modules. Recommendations from students on e-modules revealed the need for more training on e-module design to make them more helpful to ODL students. Educators should be mindful to use multiple channels of distribution when sharing electronic instruction to maximise access to as many students as possible.

6.3 Research Question Three

What challenges do institutions with limited resources meet when integrating digital technologies in education?

In this section, the researcher will discuss challenges that institutions that have limited resources face when trying to integrate technology in education. These challenges include: intermittent electrical power supply; lack of resources for e-learning; resistance to use recorded e-resources; challenges with e-module production and using WhatsApp for educational purposes.

Intermittent electrical power supply

According to eLearning Industry (2016) there are three main challenges that hamper effective implementation of e-learning in Africa. These are (1) Internet access or connectivity, (2) availability of locally developed content and curriculum online and (3) training and professional development. Internet connectivity in many institutions is slow and tariffs are very high. Malawi is experiencing persistent power outages because of the declining outputs from ESCOM which is from 351 megawatts (MW) to 135 MW due to low water level (Chimjeka, 2016). The problem of power outage makes it very difficult to be connected to the information super highway all day. As Chaputula (2012) observed, frequent electricity blackouts at MZUNI render online services like the Internet and Moodle inaccessible. In addition, there are some secondary schools (especially Community Day Secondary Schools) that do not have electricity at all. Efforts are being made by government to increase supply of electricity by tapping power from Mozambique but this is a long term solution. A more immediate and lasting solution for universities in Malawi must be found in order to ensure uninterrupted power to servers. This could be use of renewable energy technologies. Luckily, the MZUNI has the Department of Energy Studies which can offer advice on how this can be done. In fact, a feasibility study was done a couple of years ago and a report was produced which was sent to management. It only needs political will to implement recommendations in that report. The challenge of electricity provision is common in many developing countries. For example, Mungai (2011) cited lack of electricity as one of many challenges that schools in Kenya face. This is the case with Zambia, Zimbabwe and Namibia.

Lack of resources for e-learning

Lack of resources such as computers at CDSSs and limited access to computers at conventional secondary schools and universities makes it difficult for students to access online information. At MZUNI the situation is better off because students can access the Internet using personal laptops, smartphones and/or tablets but this is not the case in secondary schools. A solution to the challenge of Internet access for those institutions which have computers but are not connected to the Internet is to develop institutional repositories where students and staff can access instructional materials offline or using local area networks. Like many other educational institutions worldwide (University of Nottingham, UK, 2016), MZUNI has an institutional repository although it is still in its infancy stage. Where Internet connectivity is a problem, users can download information from local servers and save on flash disks for offline use. To mitigate challenges of access to e-resources, MZUNI should extend the time of accessing computers in all its laboratories, say up to 10 pm or midnight every day to enable students utilise e-resources that are hosted both locally and online. When this is done, computer technicians will have to work in shifts to ensure that adequate time to access computer services is provided to staff and students. Alternatively, entry into computer laboratories can be secured using Door Access Control Systems (DACS) such as biometric or swipe card locking systems. Currently computer laboratories close at 4:30 pm, a state of affairs which limits access to already limited resources even further. In some universities worldwide, computers can be accessed up to 2am (The University of Glasgow, 2016) or for 24 hours (University of the Sunshine Coast, 2016; Texas A&M University, n.d.; University of Chester, n.d.; Kingston Univeristy London, 2016). All that is required is an ID swipe-card to access the room and/or the building where computers are located. The same could done at MZUNI.

Resistance to use recorded e-resources

There is resistance from some lecturers concerning recording their class sessions and distributing them to students. The main reason for this resistance is that they want to protect their intellectual property. With an Intellectual Property Rights Index (IPRI) of 4.6, and a global ranking of 89 (The International Property Rights Index 2016, n.d.), intellectual property rights in Malawi are not secure. Lecturers are afraid that if they give students their recorded class sessions, they would have no control over their materials. They want to protect their intellectual property from unscrupulous people who are good at copying and using other people's work without permission. One way round this challenge would be to ask the concerned lecturers to publish and sell their work. Lecturers should understand that nowadays more institutions are sharing their digital resources over the Internet for free as OERs although learning resources are considered as key intellectual property (Hylen, n.d.).

Another issue that some respondents, especially teachers and lecturers, raised against distributing recorded class sessions to students was that students would become less attentive in class and some would even skip classes since they would access recorded class proceedings later. A significant number of students (23%) were also against the idea of using recorded class sessions as a way of instruction. They concurred with teachers and lecturers when they observed that recorded materials would distract them from learning. Instead of concentrating on what teachers would be teaching in class, they would not pay attention knowing that even if they missed something in class they would access the whole session afterwards. To overcome this challenge, some lecturers keep roll-calls to ensure that students attend classes and even award marks for class participation. This may work for small classes but would be difficult for larger classes unless the lecturers concerned used EVS clickers that are allocated and mapped to students over the length of a course (Bruff, n.d.). What needs to be done though is to educate students on the importance of active participation in class. Students should be informed that the aim of recording class sessions is for revision and consolidation of what is covered in class. They should also be advised that they learn better when they interact with others in class than simply listening to or watching what was covered in class in their absence.

Perhaps the most compelling concern against using recorded e-resources that this study has found is that some learners would not have access to recorded class sessions because they do not have access to computers, DVD players or mobile phones. This finding agrees with the assertion of World Health Organisation (2014) which states that the level of access to information technology infrastructure in Malawi is still low although the country has experienced growth in ICT and telecommunications in the past ten years. Twelve percent of student respondents from MZUNI were against the idea of using recorded class sessions. They indicated that lack of access to technology was a major challenge. The same problem was mentioned by secondary school students. Some students cannot afford to buy electronic devices that are used to access e-resources because they are expensive. This study found that about 40% of the secondary school students do not have access to these media and only 60% of the students have access to DVD players. The rest of the media are not sustainable for use by the rest of the students. In such a situation, Bouhnik and Deshen (2014) recommended that teachers should be sensitive and keep the connection open with those students who do not have access to technology through other means, usually by simple text messages. A way round this problem is for institutions to have basic digital libraries (Trivedi 2010; Nagesh, 2015) where teachers and students could access digital resources. Library users can either use the e-resources within the digital libraries or can take them out on loan. For schools without resources like community day secondary schools, Government could make a deliberate effort to purchase basic equipment like a laptop, multimedia projector and plasma television set for each CDSS for technology integration. Although some people may be against the idea of using recorded e-resources, it should be noted that 61% of MZUNI students and 78% of secondary school students, do not use supplementary instructional materials. Apart from the Internet, their only source of information is from their lecturers or teachers during class time as libraries do not have adequate stock.

Challenges with e-module production

Time constraint for producing instructional materials for e-learning was one of the challenges that some lecturers faced. MZUNI found a way to solve this challenge by finding time during vacation when lecturers were gathered at one place away from the campus to produce mp4 video instructional materials. Production of educational resources of good quality requires instructional design skills, adequate time, patience, teamwork and commitment (Kurniati, Aminudin, & Sri, 2007). The e-module production exercise that MZUNI embarked on faced a few challenges. Firstly, the exercise was done in a hurry and as a result there was inadequate time to train lecturers how to use the screen capturing software properly.

Coupled with this challenge, slow Internet connectivity or unavailability of Internet at times caused immense problems for some lecturers because they could not find relevant reference materials. Slow or expensive Internet connectivity seems to be a common problem in developing countries. For example, Mungai (2011) identified slow connectivity as one of a dozen challenges facing implementation of computer education in Kenya.

Another challenge that the lecturers faced was that the environment that they were subjected to was not ideal for recording instructional materials because it was noisy. Some lecturers had to wait until midnight when everybody was asleep in order to record the e-modules. MZUNI does not have a purpose-built studio for recording instructional materials. All the e-modules the University has produced so far were recorded either in lecturer's offices or motel rooms which did not have sound proof walls. Since most of these modules were recorded during the day they had some background noise.

A final challenge was lack of special software for writing symbols and diagrams especially in science subjects like Chemistry. One lecturer in Chemistry recommended that the University should buy Chemidraw for drawing complex molecules although this piece of software is expensive. The Directorate of ICT should consider budgeting for this product together with other pieces of software the University is planning to purchase.

Challenges with using WhatsApp

Several challenges when using WhatsApp were met. Firstly, there was the technical difficulty in that not all students had smartphones. Students found a way of helping those who did not have. Whenever there was important communication from the researcher through WhatsApp, students either lent their smartphones to their classmates or alerted others through Short Message Service (sms), phone calls or verbal (interpersonal) communication. Eventually more and more students acquired smartphones. In their study, Bouhnik and Deshen (2014) met similar challenges when using WhatsApp. They found out that teachers were flooded with irrelevant and nonsensical messages. The same was observed in this study. In one of the four classes, a few students used to post personal, irrelevant and rude messages to their classmates despite informing them beforehand the purpose for creating an academic WhatsApp account. When this happened, the researcher cautioned them. After a couple of days of obedience, they started again. The researcher then removed the culprits from the group and this sent a warning to others. Those who were removed apologised and were reinstated. Afterwards the malpractice diminished although sometimes one or two students posted jokes or irrelevant messages just to test the waters. Bouhnik and Deshen (2014) observed that some teachers were flooded with too many messages from students to the extent that they were burdened and annoyed. They also found out that other teachers were bothered by messages that were sent very late at night. The same happened in this study especially with one WhatsApp group that had about 140 participants. Some teachers in the study that Bouhnik and Deshen (2014) conducted had a solution to these problems. They muted the alert signal and chose when to read the messages and when to respond. The researcher in this study used to disable mobile data at night so that he did not receive any communication that required data connection and switched back the connection the following morning. Later, he managed to convince the students to desist from posting anything on the group's WhatsApp late at night. One interesting thing he discovered in the course of using WhatsApp was that students advised each other not to abuse the facility thereby establishing internal control.

Another challenge was that some students resorted to using less formal language when communicating using WhatsApp. Some were using slang, creoles and short forms. Some students wanted to get answers to their problems immediately. It did not matter to them whether it was at night, during weekends or holidays. They expected the lecturer to be available every time they had problems. The researcher felt that laying ground rules prior to establishing WhatsApp groups would eliminate these problems. Save for these few challenges, WhatsApp was very good for e-learning.

Opportunities

Having discussed challenges that institutions face when integrating technology in education, the researcher will now discuss some opportunities that can be utilised to promote e-learning. The findings of this study showed that there was a general willingness from majority of the participants to attend workshops on use of e-learning. Common areas of need from students, teachers and lecturers identified were '*access to information*' and '*knowledge and skills acquisition*'. E-learning can diffuse easily in educational institutions if people are empowered with knowledge and skills through Continuing Professional Development (CPD). In the institutions sampled, training participants how to use new technologies in teaching and learning cannot be difficult because majority of respondents already have some knowledge of modern technology. Both hard and soft forms of instructional materials are readily available to be used for this purpose. Some lecturers have already started appreciating the importance of using technology in education because they have seen benefits of various technologies. For example, some are now able to cover more content in class within a short time. The strength institutions can draw from this is the fact that lecturers who have already adopted innovation have positive attitude and are ready to share with others. Some lecturers have already started demonstrating to their colleagues using one-on-one interpersonal communication, the benefits of using technology in education. Although one-to-one interpersonal communication (Rogers, 2003) is working in spreading the innovation, it is felt that the University should use mass communication as well through conducting short courses to sensitise people on various technologies that can be used in education. There are many opportunities nowadays of accessing instructional materials. Apart from using proprietary software, educators can also use open source software, OERs like the ones offered at Yale University (Yale Open Courses, 2016), free webhosting, free LMS like Moodle and Social media like Facebook, Twitter and WhatsApp. To promote diffusion of innovation further, MZUNI should develop a policy on e-learning. One interviewee has recommended that it should be mandatory for every department to have a multimedia projector instead of using chalkboards for teaching. He asserted that management should take a leading role in promoting technology to ensure that lecturers use technology when teaching. He also suggested that management should buy laptops and distribute them to lecturers to enable them use technology when teaching. Without a policy, it is very difficult to force staff and students to use technology. However, there is a consolation; management of the University is aware that there are a few lecturers who are consistently using technologies like Moodle who would like to create a forum where lecturers with experience in using technology can teach others how to use Moodle. But more needs to be done if technology integration into teaching and learning is to diffuse quickly. Few lecturers (bricoleurs and early technology adopters) are internally motivated to work on e-resources but majority needs to be externally motivated by giving them incentives to enable them use technology. Interpersonal communication about the benefits of e-learning in education was used intensively in this study to convince some lecturers to start producing e-resources. Examples of e-modules that were already produced by some lecturers were used as evidence (Rogers, 2003) to compel those who were lagging behind. So far, the strategies the researcher had used seem to have worked because by the time of writing this report, the number of lecturers who had produced e-modules had grown from three in 2013 to twenty-six in 2016 (Figure 5-14).

6.4 Research Question Four

What are the effects of repurposed instructional materials and digital technologies on faculty's teaching and students' learning?

This study has found out that repurposed instructional materials used by some lecturers had positive effects on the way they delivered lessons and on the study skills of the students. The lecturer in C Programming found that the students' academic performance was higher after he started using recorded (mp4) class lessons. He thought that this improved performance was the result of the students spending more time practicing C programming questions on the interactive website after class. He however, observed that some students still had problems but he estimated that about 85% of the class benefited from the repurposed materials. This percentage (85%) was a guesstimate that needs to be verified by conducting a scientific study but suffice to say that majority of the students benefited from this innovation. The lecturer observed that students' level of understanding had improved after he started using the repurposed materials. Another lecturer in linguistics observed that students liked the idea of using recorded lessons in mp4 video format. She found out that giving students a combination of PowerPoint slides and mp4s was very useful because the videos supplemented what was on the slides. In general, there was improvement in students learning after they started using technology.

A History lecturer also found technology integration useful. His teaching style changed because he was able to continue discussing academic issues with his students using WhatsApp after class time. He also discovered that some students who were shy in class were able to do so outside class through WhatsApp. He felt that WhatsApp discussion groups helped his learners to have better understanding of concepts covered in class. If capabilities of WhatsApp can be harnessed properly and ensure that participants of WhatsApp groups follow the purpose for which the groups are created, it can be a very useful tool in education.

One lecturer was cautious when talking about the effects of technology on teaching and learning. He observed that it was difficult to say whether the repurposed instructional materials had an effect or not since no study had been conducted. He however admitted that the students' attitude towards technology was generally positive. He also noticed that some students in his class found it difficult to follow his lessons when he was using PowerPoint because they found lesson presentations very fast. They could not cope with notetaking.

6.5 Revised Conceptual Framework

The following section presents how the empirical work tested Roger's Diffusion model.

Innovation characteristics - Interpersonal communication and Triability

The researcher started promoting the use of screen capture technology to produce instructional materials in 2012. He approached many lecturers at MZUNI with the idea but it was only a year later that one lecturer bought the idea and produced an e-

Module in communication skills. In 2014, two more joined. In 2015 and 2016 the number grew to 21 and 26 respectively. Interpersonal communication about proposed innovations in teaching and learning was used by the researcher throughout this study by contacting lecturers individually.

Triability was another element of Roger's Model that was tested. The innovations that were tried in Phase One were production and use of mp4 e-Modules and website in C Pragramming. Five students who were in the second year of the bachelor's degree programme used the website in December 2014 and generally gave feedback. The feedback from this cohort was used to revise the website in readiness for a second trial with another cohort which was done in July 2015. The website has been revised further to try it with more cohorts in future. Results of these trials have shown that the interactive website should continue being used as one of successful modes of teaching C Programming.

Another innovative teaching strategy that was tried was use of e-Modules with Open, Distance and e-Learning (ODeL) students. This mode of delivery was used on trial basis when the traditional print modules for ODeL were not available. The feedback from the users (students) during Phase One of the study was positive, in general. The e-modules were tried again during Phase Two and were seen to be successful. Now more and more lecturers are producing the e-Modules and there is more demand for the modules by students.

Observability

Observability was another element of Roger's Diffusion model that was tested. In 2016, one lecturer in Physics recorded a lesson on *Gauss's law for magnetism* using a camcorder. He uploaded it on YouTube for the students. Two weeks later, a Head of Physics Department from one of the public universities in Malawi so the video on YouTube and came to MZUNI to find out how the video was produced so that he could use the innovation for his classes as well. Although this is an isolated incident, it is evidence enough to say that an innovation that was open to the public was seen by someone who was willing to diffuse the technology further.

Nature of Social System - Influence of early adopters

There were five early adopters of technology at MZUNI who had accepted and used innovations in this study when this research started. They influenced their colleagues to start using technology as stated in Sections 5.6.1 and 5.6.2. The influence of these early adopters and the interpersonal communication were responsible for the diffusion of e-Module production innovation. These early adopters are continually contacting their peers to convince them to start using technology in teaching and learning.

External Change Agents Promotion Efforts

Most computers and their accessories at MZUNI were either donations from Computer Aid or bought through government loan from the African Development Bank under the Higher Education Science and Technology (HEST) project. These computers have helped Mzuzu University staff and students to have access to computer technology. Very few computers were bought using the university's own funds. Were it not for these donations and the HEST project, many members of staff and students would not have access to computer-based technology.

For secondary schools, the computers were donated under the Fair-Denmark Project. These computers came with preloaded instructional materials for secondary school curriculum. Interview with the Computer Technician for this project showed that students had access to computer technology because of this project. These were the only computers that students had access to. This clearly shows that the efforts of the external change agents (Fair-Denmark Project) had promoted acceptance and use of technology in these secondary schools.

Adopters characteristics - Attitudes toward use of technology in education

The study has shown that majority of lecturers and teachers (86%) and students (88%) had positive attitude towards use of technology in education. This is shown by the teachers' and lectures' willingness to have their class sessions recorded and distributed to students as well as students' favourable responses towards using these resources.

Additionally, the interview on the use of Moodle with Lecturer 2 indicated that students preferred learning using Moodle to print materials because they found it easy to access learning materials as they were able to download lessons onto their computers or phones and study at their own convenience. Another indication that students had positive attitude towards use of technology was when the Computer Technician stated students had briefly stopped using computers donated by Fair-Denmark project because servers were being upgraded from Ubuntu (Long Term Support) LTS 12.04 to 14.4. Students resumed using the computers after the system upgrade. The students would have stopped using the technology after the upgrade if they had negative attitude. Finally, an interview with Chisomo revealed that the students' attitude towards technology was generally positive though it was difficult to say whether use of technology had a positive effect on students learning since no study had been conducted.

The following section presents additional elements that were studied to check if they had effects on diffusion of innovation in this study. These elements are policy, continuing professional development, infrastructure, equity and culture of sharing.

Policy

(Cambridge University Press, 2019) defined policy as a plan of what has to be done in particular situations. The purpose of policies is to establish boundaries, guidelines, and best practices for acceptable behavior at the workplace. Policies enable employers to communicate to their employees the way they are expected to behave on the job. Mzuzu University has an ICT Policy but empirical data shows that many lecturers do not know that it exists. In that case, employees would not know best practices for acceptable behavior at the workplace, hence they would not know whether using technology in teaching and learning was mandatory or not. If use of technology by lecturers was mandatory and lecturers knew that it was imperative for them to do, they would be compelled to use it in their classes. In the long run, one would expect that lecturers would be used to using technology and eventually, this would become second nature.

Continuing Professional Development

Continuing Professional Development is the process of tracking and recording the knowledge, skills and values that one gains both formally and informally as one works, beyond any initial training. (Allen M. , 2009). It presents an opportunity to expand the knowledge base of all employees as most of them have some weaknesses in their workplace skills. Mzuzu University has conducted several CPD sessions on e-Module development in 2015, 2016, 2017 and 2018. More lecturers have started using technology, especially e-Module production for Open, Distance and e-Learning mode as a result of CPD. Management at MZUNI is planning to intensify CPD in use of computer-based technology as the University is migrating from print-based delivery of instruction to e-Learning.

Infrastructure

This study has shown that infrastructure challenges have affected diffusion of innovation at Mzuzu University. These include intermittent network connectivity due to unreliable electricity supply and slow Internet connection. Infrastructure challenges also exist at secondary schools. These include lack of Internet access, lack of resources such as computers at community day secondary schools and limited access to computers by students at secondary schools for those schools that have computers. Proper infrastructural development is very important for the spread of technology.

Equity

The findings of this study showed that there was no equitable access to technology among the respondents. This inequity poses a challenge to diffusion of technology. (Masters, 2019) viewed equity in education as equivalence or sameness. A more useful way to view equity is through the lens of ‘fairness’. Although the findings of this study showed that the common media that lecturers, teachers and students found most suitable were DVD players, the Internet, Facebook and cell-phones, and that these media had the potential to facilitate the exchange of academic information among lecturers, teachers and learners there were some students who did not have access. These students would be left out. To ensure equitable access to technology, MZUNI has computers on campus that students can use for free. There is also free Internet access for staff and students. The number of computers and Internet access points can be increased to match the growing numbers of users. This increase, especially students, calls for increased bandwidth. in addition, the university can use technologies like Speech-to-Text to convert audio files into text that students can download and print so that they have access to recorded audio classes inform of text. Lecturers can convert their audio files to text using Google Docs, which is available free of charge. This will increase diffusion of technology and improve equitable access to technology. It is assumed that if there is equitable access to technology, then more people will use it and thus, technology will diffuse quickly.

In this study, inequitable distribution of resources was shown in cases where resources for repurposing instructional materials were available to 50% of the teachers and lecturers. These resources were computers, printed notes, printed books and print modules. It was revealed during formative evaluation of Year 3 class WhatsApp group that ten students out of fifteen were on the class WhatsApp forum. The students (five) who did not join the WhatsApp group failed to do so because their phones did not have the capability to install WhatsApp. This clearly shows that the five students were unable to use the WhatsApp technology due to inequity. In an attempt to ensure equity in terms of access to technology by students in an Introductory C Programming lesson, the researcher connected a laptop which hosted the interactive website and questions to a projector that enabled the whole class (thirty-three students) to actively participate in class irrespective of whether a student had access technology or not. The same strategy was used in secondary schools where students did not have computers or smartphones. All students actively participated.

Culture of sharing resources

The study established that the culture of sharing resources is still being practiced in institutions. For example, it was observed in Section 4.5.12.4 that when there was important information to communicate to class by the lecturer using WhatsApp, students who were not on WhatsApp got the information from their classmates through Short Message Service (SMS), phone calls or verbal (interpersonal) communication. The same culture of sharing was observed in Section 5.5.1 where ICT class was using many methods of sharing videos which increased access to teaching and learning beyond the classroom.

In Malawi, the culture of sharing resources is being practiced in some institutions as well. For example, the University of Malawi has initiated use of OERs. In addition, public universities in Malawi started depositing mp4 videos using PANOPTO on one server in 2018. Another spirit of sharing in Malawi was demonstrated by the College of Medicine in conjunction with other colleges in the field of health. These institutions have developed a website where users can share healthcare resources online (College of Medicine, 2019). This culture of sharing is not only restricted to Malawi only, but it is also in the SADC Region. For example, the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) introduced the knowledge sharing hub. Other examples the culture of sharing of knowledge in Africa is shown by the establishment of National Research and Education Networks. These are national organisations involved with Internet Connectivity that promote African Research and Education Networking. Examples of resource sharing include OER Africa, Commonwealth of Learning's online institutional repository for learning resources and publications. The sharing culture that has been demonstrated in this study is not restricted to Malawi alone but it is an African culture called Ubuntu. The word *ubuntu* is a Zulu/Xhosa/Ndebele/Sesotho/Shona word, roughly translated as *humanity towards others* (New World Encyclopedia, 2016). It is also used in other Southern African Bantu languages. Some of the values that Ubuntu embodies are sharing and unselfishness. Capitalism, whose primary motive is profit (Tucker, 2018) seems to have diluted the spirit of sharing in Africa but if the Ubuntu philosophy is maintained and cherished in education institutions that have limited resources, diffusion of innovation will spread easily.

In response to this empirical work, Diffusion of Innovations model has been revised as shown in Figure 6-1. The elements that have been added are policy, continuing professional development, infrastructure, equity and culture of sharing. Another contribution to new knowledge is the addition of the elements mentioned above as factors that influence the diffusion of innovations.

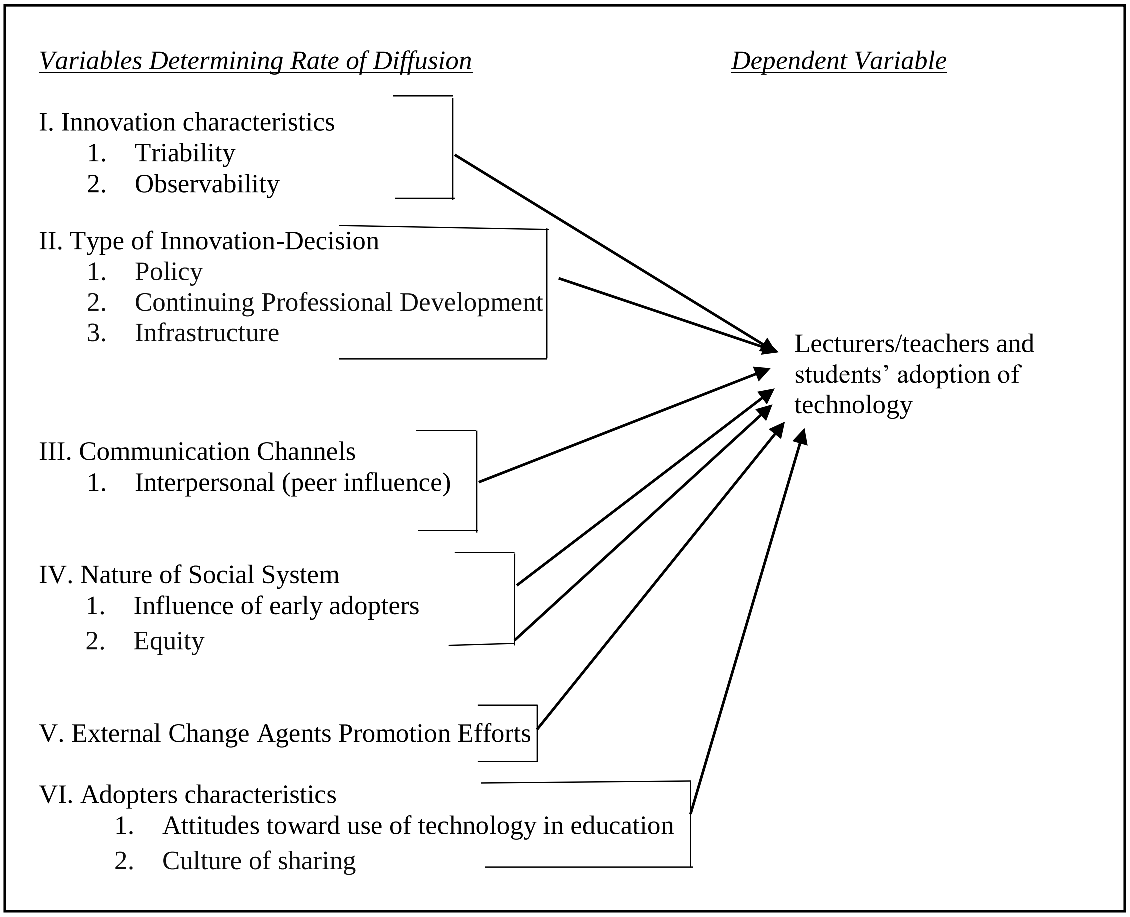


Figure 6-1 Revised Version of Diffusion of Innovation model
Source: Adapted from Rogers (1983)

Chapter 7: Conclusions and Recommendations

7.1 Conclusions

This study looked at strategies for integrating e-learning technologies in teaching and learning in secondary school and higher education system with scarce resources. The study was conducted at four selected secondary schools and MZUNI in Mzuzu City. This study makes a number of conclusions based on the research questions.

The first research question that this study tackled was: *How can education institutions with limited resources sustainably use locally available resources to repurpose existing paper-based instructional materials for electronic delivery?* The research found that educational institutions that do not have adequate resources for integrating technology in education can use whatever resources they have to get started. Diffusion of technology will take place faster if institutions networked and shared resources. The study has shown that some teachers in the sampled secondary schools and many lecturers and students at MZUNI are using personal laptops and smartphones for teaching and learning purposes. This finding implies that the TALULAR concept is working. Furthermore, it was found that at least half of teachers and lecturers had access to raw materials which are needed for repurposing print instructional materials for electronic delivery. The resources that are available include computers, learning materials in print format, time to convert lecture materials to electronic format, and software to convert documents into PDF.

Another major finding of this study was that teachers and lecturers have basic knowledge and skills to use technology but they lack critical skills for designing e-learning educational materials. Most teachers and lecturers are conversant with Microsoft Office products. Microsoft PowerPoint is the application they use most for teaching. They do not however, have critical skills like designing web pages and blogs, podcasting, producing videos and using Learning Management Systems. Although this is the case, they are willing to learn.

The second research question was: *Which electronic medium/media can resource challenged institutions use to sustainably integrate digital technologies in secondary and higher education in Malawi?* This study established that the following five media were among the top of the list of technologies that respondents found to be sustainable: The Internet, Facebook, memory sticks, personal computers and ordinary cell phones. Very few respondents had access to tablets, iPads, iPods and Moodle. It was found that Internet tariffs in Malawi are prohibitive, which makes access to online instructional materials by teachers and students difficult. It was found that access to the Internet at MZUNI is free to enable lecturers and registered students to access online educational resources. However, this facility is not available off campus. There is no provision for free Internet access in all the secondary schools that were included in this study. The findings of this study showed that Facebook is very popular in schools and colleges. Both teachers and students use this social network for academic and social issues. Some lecturers have opened institutional Facebook accounts for academic purposes. This medium is a potential mode for technology integration in education.

Another medium that respondents found sustainable is flash memory. Memory sticks are relatively cheap and affordable for staff and students. Although this is an easy and sustainable method of distributing e-resources, there's need to guard against spreading computer viruses. The study established that many respondents, especially at MZUNI, use personal computers for teaching and learning because institutions do not have enough computers for common use. Respondents found that ordinary cellphones are sustainable for technology integration in education. Although this is the case, ordinary cellphones have limited application in e-learning. They can only be used for making voice calls and sending text messages. Those phones that can play mp3 audio however, could be used to play recorded instructional materials that are distributed in mp3 audio format. The study, furthermore, noted that students in secondary schools are not allowed to bring phones to school. This means that even if the students had access to smartphones, they would not benefit.

The third question that the study was interested in answering was: *What challenges do institutions with limited resources meet when integrating digital technologies in education?* The study found the following challenges: intermittent electricity supply; lack of resources for e-learning; resistance to use recorded e-resources by some students; challenges with e-module production and using WhatsApp for educational purposes. Electricity blackouts in Malawi are quite frequent. These power outages are negatively affecting access to online educational resources such as Moodle at MZUNI. The study also established that lack of resources such as computers at the community day secondary schools and limited access to computers at conventional secondary schools and MZUNI makes it difficult for students to access online information. It was found that students at MZUNI do not have enough time to access online instructional materials because computer laboratories close early at 4:30pm.

Another challenge that this study unearthed was that some lecturers are not willing to have their class sessions recorded and distributed to students. The main reason for this resistance is that they want to protect their intellectual property because piracy of recorded work in Malawi is rampart. It was also discovered that some teachers and lecturers had reservations about distributing recorded class sessions to students because they felt that they would become less attentive in class and some would even skip classes. It has been observed that many students at MZUNI have a tendency of staying away from class when they feel that they have 'adequate' instructional materials in their possession. In that case, they do not see any reason for attending classes. In addition, the study found that some learners do not have access to recorded class sessions because they do not have access to computers, DVD players or smartphones. Most of these learners were against using e-resources for teaching and learning.

Production of e-learning materials posed a few challenges. Time constraint was one such challenge. Production of good quality educational resources demands a lot in terms of resources. Instructional design skills, adequate time, patience, teamwork and commitment are some of the resources that are required. The study found that the environment in which the e-modules were recorded was not ideal for the purpose because of background noise.

Using WhatsApp for academic purposes created its own challenges. Firstly, there were some students whose phones could not support WhatsApp, so they could not be part of the academic WhatsApp group. Secondly, some students flooded lecturers with irrelevant and nonsensical messages some of which were sent very late at night. Another experience with using WhatsApp for academic purposes was that some students wanted to get answers to their problems immediately they posted them. It did not matter to them whether it was at night, during weekends or holidays. They expected lecturers to be available every time they posted problems.

On a positive note, the study has found that majority of respondents were willing to attend workshops or short courses on production of e-learning resources. It was also observed that one-to-one interpersonal communication was effective in spreading the use of technology in education, especially production of e-modules using screen capture technology.

The last research question was: *What are the effects of repurposed instructional materials and digital technologies on faculty's teaching and students' learning?* This study has found that repurposed instructional materials that were used by some lecturers had positive effects on their instructional delivery and on the study skills of students. In general, it was found that students' academic performance was higher after lecturers started using recorded (mp4) class lessons than before. This observation needs to be treated with caution because no empirical study has been conducted to ascertain it. Although use of technology had a positive effect on many lecturers, one lecturer noticed that some students in his class found it difficult to follow his lessons when he was using PowerPoint because they found lesson presentation very fast. They could not cope with notetaking.

7.2 Recommendations

From the analysis of the findings, it has been noted that the sampled secondary schools and MZUNI have limited e-learning resources but can use whatever little they have to start integrating technology in education. The study recommends the following strategies to ensure that electronic technologies are integrated into teaching and learning.

1. Mzuzu University and other institutions which have limited resources for teaching and learning should integrate technology in education using whatever resources they have by making use of TALULAR. Instead of solely relying on proprietary software, educational institutions should take advantage of FLOSS, OERs, free webhosting, free Learning Management Systems, online student response systems and social media like Facebook, Twitter and WhatsApp for implementing technology integration. In addition, teachers and lecturers should be taught how to repurpose existing instructional materials for e-learning using CPD. The developed e-resources should then be deposited in institutional repositories. Secondary schools and institutions of higher learning in Malawi should collaborate with other institutions locally, regionally and globally to form e-learning networks which they can use for sharing e-resources.

2. To mitigate challenges of access to e-resources, MZUNI should ensure that there is uninterrupted electricity supply to servers by investing in renewable energy technologies such as solar and/or wind energy technologies. Further to this, the University should extend the time for accessing computers by students and staff in all its computer laboratories, say up to 10 pm when the library closes. MZUNI is further encouraged to invest in basic technology infrastructure including purchasing of electronic voting system to foster active learning in large classes.

3. To promote diffusion of innovation further, MZUNI should develop a policy on e-learning. The policy will govern how e-learning resources are developed and

used including how to protected intellectual property rights of developers of instructional materials. The University should make it mandatory for all lecturers and students to adopt e-learning.

7.3 Study limitations

The sample size for this study, especially Phase Two, was small. Although a small sample is desirable for in-depth analysis, it may not be appropriate to generalise findings of such a study. This is the case with this study. However, it is possible to transfer these findings to institutions that have characteristics similar to the ones that have been studied here. Another challenge was time limitation. Student Response Systems such as Socrative and Participoll as well as the system that the researcher developed required more time to be studied. In addition, his SRS needs more refinement. Formative evaluation of the system should continue to perfect it.

7.4 Issues for further research

This study represents a case study of four secondary schools and one university. It is proposed that further studies should be conducted to include more universities, both public and private, in order to understand technology integration better. The use of electronic voting system using clickers, and student response systems such as Socrative and Participoll and their impact on students' attainment in large classes should be studied further. Social media, especially WhatsApp is becoming more and more popular with students and teachers in Malawi. There is need for further studies on how social can be harnessed to enhance student engagement in the learning process.

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Appendices

Appendix A – Ethics documents

University of Glasgow | College of Social Sciences

Consent Form

Title of Project: Integrating e-Learning technologies into conventional teaching and learning in the school and higher education system with scarce resources: A case study of Mzuzu University

Name of Researcher: Paxton Andrew Zozie

1. I confirm that I have read and understand the Plain Language Statement for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.

3. I understand that my interview will be audio-taped. The copies of transcripts will be returned to me for verification. I also understand that I will be referred to by an ID in any publications arising from the research.

4. I agree / do not agree (delete as applicable) to take part in the above study.

Name of Participant	**Date**	**Signature**
Researcher	**Date**	**Signature**

CSS July 2014

University of Glasgow | College of Social Sciences

Ethics Committee for Non-Clinical Research Involving Human Subjects

Staff Research Ethics Application ☒ ***Postgraduate Student Research Ethics Application*** ☐

Application Details

Application Number: 400140017

Applicant's Name Paxton Andrew Mwafwiyanji Zozie

Project Title Integrating e-Learning technologies into conventional teaching and learning in the school and higher education system with scarce resources: A case study of Mzuzu University

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Application Status **Approved**

Start Date of Approval *(d.m.yr)* 01/12/2014

(blank if Changes Required/ Rejected)

End Date of Approval of Research Project *(d.m.yr)* 30/12/2016

Only if the applicant has been given **approval** can they proceed with their data collection with effect from the date of approval.

Recommendations **(where Changes are Required)**

- ***Where changes are required all applicants must respond*** in the relevant boxes to the recommendations of the Committee and upload this as the **Resubmission Document** online to explain the changes you have made to the application. All resubmitted application documents should then be uploaded.
- ***If application is Rejected*** *a full new application must be submitted via the online system. Where recommendations are provided, they should be responded to and this document uploaded as part of the new application. A new reference number will be generated.*

(Shaded areas will expand as text is added)

MAJOR RECOMMENDATION OF THE COMMITTEE	APPLICANT RESPONSE TO MAJOR RECOMMENDATIONS

MINOR RECOMMENDATION OF THE COMMITTEE	APPLICANT RESPONSE TO MINOR RECOMMENDATIONS

University of Glasgow
College of Social Sciences
Florentine House, 53 Hillhead Street, Glasgow G12 8QF
The University of Glasgow, charity number SC004401

Tel: 0141-330-3007 or 1990
E-mail: socsci-ethics@glasgow.ac.uk

REVIEWER COMMENTS (OTHER THAN SPECIFIC RECOMMENDATIONS)	APPLICANT RESPONSE TO REVIEWER COMMENTS
Typo in consent forms both note 'for lecturers' i presume one should note 'for Students'	

Please retain this notification for future reference. If you have any queries please do not hesitate to contact the College Ethics Administration, email address: socsci-ethics@glasgow.ac.uk

End of Notification.

University of Glasgow
College of Social Sciences
Florentine House, 53 Hillhead Street. Glasgow G12 8QF
The University of Glasgow, charity number SC004401

Tel: 0141-330-3007 or 1990
E-mail: socsci-ethics@glasgow.ac.uk

University of Glasgow | College of Social Sciences

Plain Language Statement

1. Study title and Researcher Details

Project title: Integrating e-Learning technologies into conventional teaching and learning in the school and higher education system with scarce resources: A case study of Mzuzu University.

Investigator: Paxton Andrew Zozie. Contact numbers: Office: +2651930794; mobile: +265999077786

Supervisor: Prof. Victor Lally. Contact number: +44(0)1413303036

Degree: Education, PhD

2. Invitation paragraph

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

3. What is the purpose of the study?

Education institutions in Malawi have major weaknesses in the areas of infrastructure, level of staff training and finance. The number of students admitted in these institutions is increasing every year but teaching and laboratory infrastructure is not expanding. This limited infrasture has negative impact on the ability of these institutions to cost effectively deliver courses. Classrooms and laboratories are small. This makes it necessary to conduct the same lecture or laboratory session several times in small classrooms and laboratories respectively when it would be more cost effective to conduct the lecture laboratory session once in large lecture theatre or laboratory. This makes timetabling of classes extremely difficult.

E-learning has the potential of being an alternative mode of offering traditional face-to-face instruction teaching and learning. Secondary schools and tertiary educational institutions in Malawi stand to benefit greatly if e-learning was to be introduced as an alternative means of teaching and learning.

The aim of the research is to study how to sustainably integrate various e-Learning technologies into traditional teaching and learning in secondary schools and tertiary education institutions in Malawi. The study will be conducted at Mzuzu University, Luwinga Secondary School and Nkhorongo Community Day Secondary School.

Specifically, the study intends to:

- investigate if learning institutions can use locally available resources to change existing paper-based instructional materials for electronic delivery;
- find out electronic medium/media that can be used to sustainably integrate digital technology in secondary and higher education institutions in Malawi;
- identify challenges that resource challenged institutions meet when integrating digital technology and;
- find out the effect of the repurposed instructional materials and digital technologies on faculty's teaching and students' learning.

The study is expected to be carried out from 5th May 2014 to 30th September 2015

4. Why have I been chosen?

You have been chosen to participate in this study because you have expertise in one of the subjects which either has high enrolment of students or which students find difficult to master. We hope that your expertise will help us design quality e-learning materials from your teaching experience. Your students will also be asked to participate in the study to formatively evaluate the e-learning materials will develop. A total 200 participants will take part in this study.

5. Do I have to take part?

It is up to you to decide whether or not to take part. If you decide to take, part you are still free to withdraw at any time and without giving reason.

6. What will happen to me if I take part?

You will either be interviewed for about 45 minutes or asked to fill in a questionnaire which should take about 45 minutes. The questions are about your experiences in using various digital technologies for educational purposes. The interview will be recorded and notes will be made about the interview. You will only be asked to sit for one interview. The interview will take place at the institution where you teach. After the interview, the researcher will type a transcript of the interview. After transcription you will be invited to read the transcript and make comments.

If you will be given questionnaires, you will be given one week to fill in the questionnaire after which the researcher will come to collect them.

7. Will my taking part in this study be kept confidential?

Every effort will be made to hide your identity in any written work resulting from this study. All information which is collected about you during the course of the research will be kept strictly confidential. You will be identified by an ID number and any information about you will have your name and address removed so that you cannot be recognised from it. All data will be destroyed when the study is over.

8. What will happen to the results of the research study?

The results of this study are likely to be published by end of December 2016. Dissemination of the findings of the study will take the form of verbal presentation to all during public lecture. There will also be presentations to representative participants such as the management of Mzuzu University, head teachers of Luwinga and Nkhorongo Secondary schools and the Ministry of Education, Science and Technology. Articles of this study will also be published in e-journals. A copy of published results will be sent to University of Glasgow and Mzuzu University. The participants in this study will not be identified in any report or publication.

9. Who is organising and funding the research? (If relevant)

The research is funded by Malawi Government through the Higher Education Science and Technology (HEST) project.

10. Who has reviewed the study?

This project has been reviewed by the College of Social Sciences Research Ethics Committee at the University of Glasgow.

11. Contact for Further Information

If you have any questions or concerns or wish to know more about this study, please contact my supervisor Prof. Victor Lally, at the University of Glasgow on Victor.Lally@glasgow.ac.uk

If you have concerns regarding the conduct of the research project you can contact the College of Social Sciences Ethics Officer by contacting, College of Social Sciences Ethics Officer,
http://www.gla.ac.uk/colleges/socialsciences/info/students/ethics/committee

Appendix B - Data collection tools

University of Glasgow | College of Social Sciences

Baseline Survey Instrument for students

Integrating e-learning technologies into conventional teaching and learning in the school and higher education system with scarce resources: A case study of Mzuzu University

Questionnaire
Instructions: The objective of this survey is to identify ways to sustainably integrate e-Learning technologies into traditional teaching and learning in secondary schools and tertiary education in Malawi.

PLEASE DO NOT IDENTIFY YOURSELF ON THIS SURVEY. ALL YOUR RESPONSES WILL REMAIN CONFIDENTIAL.

I thank you for participating in this survey.

PART ONE: Demographic Information
Please supply the following information regarding your experiences and background. Please tick whichever applies to you.

1. **Gender:**

☐ Male ☐ Female

2. **Age bracket:**

☐ 20 to 29 ☐ 30 to 39 ☐ 40 to 49 ☐ 50 to 59 ☐

☐ 60 to 69 ☐ 70 or above

3. **Faculty:**

☐ Education ☐ Information Science and Communications

☐ Nursing and Midwifery

4. **What is your present level of experience in the use of electronic technology for the learning? Please check only one response.**

☐ Non-user ☐ Novice ☐ Average ☐ Expert ☐

PART TWO: Access to electronic media

5. Please indicate electronic media that you have access to by ticking in the box next to the appropriate electronic medium of communication. (*Please tick all that apply to you.)*

Moodle ☐
Internet ☐
Facebook ☐
Twitter ☐
YouTube ☐
Standalone computer ☐
Computer on LAN ☐
Tablet ☐
iPod ☐
iPad ☐
Ordinary cellphone ☐
Smartphone ☐
Multimedia projector ☐
DVD player ☐
Memory sticks ☐
Blank CDs ☐
Blank DVDs ☐
Other, specify:

____

____

____

6. If your institution organised a workshop to train students how to access instructional materials on the internet, podcasts, Facebook and YouTube, would you be willing to attend?

Yes ☐ No ☐

Please give reason(s) for your answer.

____

____

____

7. Would you be willing to use class sessions recorded and distributed on CDs, DVDs, the University's website, cellphones or memory sticks?

Yes ☐ No ☐

Please give reason(s) for your answer.

____

____

____

____

8. Assume that your lecturer/teacher had a video recording of one of his/her lectures and he/she wanted you to see it, which medium/media would be practical for you to view the video taking into account the resources that are available to you. (*Please tick all that apply to you.)*

Moodle ☐
University's website ☐
Facebook ☐
YouTube ☐
Your computer ☐
University's Computer ☐
Your Tablet ☐
Your iPod ☐
Your iPad ☐
Your cellphone ☐
DVD player ☐

Other, specify:

____

____

____

9. Do you use e-learning instructional materials like videos or audio files to supplement what you learn in class?

Yes ☐ No ☐

If yes, where do you get the supplementary electronic instructional materials from?

____

____

____

End of survey

Thank you for taking your time to respond to questions in this survey

University of Glasgow | College of Social Sciences

Baseline survey for lecturers

Integrating e-learning technologies into conventional teaching and learning in the school and higher education system with scarce resources: A case study of Mzuzu University

Questionnaire
Instructions: The objective of this survey is to identify ways to sustainably integrate E-Learning technologies into traditional teaching and learning in secondary schools and tertiary education in Malawi.

PLEASE DO NOT IDENTIFY YOURSELF ON THIS SURVEY. ALL YOUR RESPONSES WILL REMAIN CONFIDENTIAL.

I thank you for participating in this survey.

PART ONE: Demographic Information
Please supply the following information regarding your experiences and background. Please tick whichever applies to you.

1. **Gender:**

☐ Male ☐ Female

2. **Age bracket:**

☐ 20 to 29 ☐ 30 to 39 ☐ 40 to 49 ☐ 50 to 59 ☐

☐ 60 to 69 ☐ 70 or above

3. **Faculty:**

☐ Education ☐ Information Science and Communications

☐ Nursing and Midwifery

4. **What is your present level of experience in the use of electronic technology for the learning? Please check only one response.**

☐ Non-user ☐ Novice ☐ Average ☐ Expert

PART TWO: An inventory of resources for repurposing existing paper-based instructional materials for electronic delivery

5. Please indicate the resources that you have in your department by circling the appropriate option in the table below.

Resource	*(Please circle one)*	
1. Scanner	Available	Not available
2. Voice recorder	Available	Not available
3. Video camera	Available	Not available
4. Video editing software	Available	Not available
5. Digital camera	Available	Not available
6. Personnel with video editing skills	Available	Not available
7. Voice recorder	Available	Not available
8. Computer	Available	Not available
9. Website editing software	Available	Not available
10. People with website design skills	Available	Not available
11. Text to Speech software	Available	Not available
12. Speech to text software	Available	Not available
13. Audio editing software	Available	Not available
14. Personnel with audio editing skills	Available	Not available
15. Microphone	Available	Not available
16. PDF convertor	Available	Not available
17. Lecture materials in print format	Available	Not available
18. Time to convert your lecture materials to electronic format	Available	Not available

PART THREE: Status of skills for repurposing existing paper-based instructional materials for electronic delivery.

6. Please select by circling the response option that best represents your level of skills in using the technologies listed in the table below.

Response key:
(1 = None; 2 = Low; 3 = Average; 4 = Above average; 5 = High)

		(Please circle one)
1.	Scanning documents	1 2 3 4 5
2.	Recording lecture using a voice recorder	1 2 3 4 5
3.	Editing speech using voice editing software	1 2 3 4 5
4.	Recording video using a video camera	1 2 3 4 5

5.	Editing videos using video editing software	1	2	3	4	5
6.	Taking photographs using a digital camera	1	2	3	4	5
7.	Editing photographs using graphic editing software	1	2	3	4	5
8.	Converting documents into PDF format	1	2	3	4	5
9.	Finding instructional materials on the Internet	1	2	3	4	5
10.	Designing web pages	1	2	3	4	5
11.	Designing blogs	1	2	3	4	5
12.	Uploading instructional materials on the Web	1	2	3	4	5
13.	Using Text to Speech software	1	2	3	4	5
14.	Using Speech Recognition software	1	2	3	4	5

7. If your institution organised a workshop to train lecturers/teachers to change existing instructional materials that are presently in print format to electronic formats like web pages, PowerPoint slides, audio or video, would you attend?

☐ Yes ☐ No

Please give reason(s) for your answer.

____

____

____

8. Would you be willing to convert your lecture notes that are in print format to electronic formats like web pages, PowerPoint slides, audio or video, if you were asked to do so?

Yes ☐ No ☐

Please give reason(s) for your answer.

____

____

____

9. Would you be willing to have your class sessions recorded and distribute the edited audio or video files to students using CDs, DVDs, the Web, smartphones or memory sticks?

☐ Yes ☐ No

Please give reason(s) for your answer.

____

____

____

10. Are there written policies at this institution that encourage lecturers/teachers and students to use technology?

☐ Yes ☐ No ☐ Not sure ☐

PART FOUR: Access to electronic media

11. Please indicate electronic media that you have access to by ticking in the box next to the appropriate electronic medium of communication. (*Please tick all that apply to you.)*

Moodle ☐
Internet ☐
Facebook ☐
Twitter ☐
YouTube ☐
Standalone computer ☐
Computer on LAN ☐
Tablet ☐
iPod ☐
iPad ☐
Ordinary cellphone ☐
Smartphone ☐
Multimedia projector ☐
DVD player ☐
Memory sticks ☐
Blank CDs ☐
Blank DVDs ☐

Other, specify:

____

____

____

12. Have you designed any e-learning instructional materials before for use by your students?

Yes ☐ No ☐

If yes, did you use video, audio, PDF or other?
Specify:

____

____

13. If you have designed e-learning instructional materials before for your students, which medium/media did you use to distribute them?
Specify:

____

____

____

End of questionnaire

Thank you very much for taking time to answer the questionnaire.

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Post Implementation Survey Instrument for students

Integrating E-Learning Technologies into Conventional Teaching and Learning in the School and Higher Education System with Scarce Resources: A Case study of Mzuzu University

Questionnaire

Instructions: The objective of this survey is to identify ways to sustainably integrate E-Learning technologies into traditional teaching and learning in secondary schools and tertiary education in Malawi.

PLEASE DO NOT IDENTIFY YOURSELF ON THIS SURVEY. ALL YOUR RESPONSES WILL REMAIN CONFIDENTIAL.

I thank you for participating in this survey.

PART ONE: Demographic Information

Please supply the following information regarding your experiences and background. Please tick whichever applies to you.

1. **Gender:**

☐ Male ☐ Female

2. **Age bracket:**

☐ 20 to 29 ☐ 30 to 39 ☐ 40 to 49 ☐ 50 to 59

☐ 60 to 69 ☐ 70 or above

3. **Faculty:**

☐ Education ☐ Information Science and Communications

☐ Nursing and Midwifery

4. **What is your present level of experience in the use of electronic technology for the learning? Please check only one response.**

☐ Non-user ☐ Novice ☐ Average ☐ Expert ☐

PART TWO: Access to electronic media

5. Did you access the electronic information that your lecturer provided in form of website, mp3 and mp4?

Yes ☐ No ☐

If your answer to the question above is No, please explain.

____

____

____

6. If your answer Question 5 above is yes, indicate the electronic medium/media that you used to access the electronic information by ticking in the box next to the appropriate electronic medium of communication. (*Please tick all that apply to you.)*

Moodle
University's website ☐
Facebook ☐
YouTube ☐
Your computer ☐
University's Computer ☐
Your Tablet ☐
Your iPod ☐
Your iPad ☐
Your cellphone ☐
DVD player ☐
Other, specify:

____

____

____

7. Which medium/media would you recommend your lecturer to use in future when distributing electronic instructional materials to students?

____

____

Give reasons for your answer:

____

____

PART THREE:

A. The following questions solicit your opinion on how you would evaluate the mp3 instructional materials on Communication Skills that you were asked to access as part of your lessons this semester.

8. Please select by circling the option that best represents your opinion on the mp3 instructional materials on Communication Skills 1 Module.

Response key
(1 = Strongly agree; 2 = Agree; 3 = Undecided; 4 = Disagree; 5 = Strongly Disagree)

		(Please circle one)
1.	It was easy to follow the mp3 audio on communication skills.	1 2 3 4 5
2.	The accent of the presenter of the mp3 communication skills lectures was easy to understand.	1 2 3 4 5
3.	The print module on communication skills should be given to the students alone without the mp3 files.	1 2 3 4 5
4.	The print module on communication skills should be given to the students with the mp3 files.	1 2 3 4 5
5.	The mp3 files on communication skills should be given to the students alone without print module.	1 2 3 4 5
6.	I found the mp3 files on communication skills very helpful.	1 2 3 4 5
7.	I could do without the mp3 files. They were a waste of time.	1 2 3 4 5

9. Did you find any problems with the mp3 Communication Skills audio files?

Yes ☐ No ☐

If the answer to the question above is yes, please explain.

____

____

____

____

10. Please make any suggestions on how we could improve the mp3 Communication Skills audio files.

____

____

B. The following questions solicit your opinion on how you would evaluate the mp4 presentations on Communication Skills 2 that you were asked to access as part of your lessons this semester.

11. Please select by circling the option that best represents your opinion on the mp4 instructional materials on Communication Skills 2 Module.

Response key
(1 = Strongly agree; 2 = Agree; 3 = Undecided; 4 = Disagree; 5 = Strongly Disagree)

		(Please circle one)
1.	It was easy to follow the mp4 videos on communication skills.	1 2 3 4 5
2.	The accent of the presenter of the mp4 communication skills lectures was easy to understand.	1 2 3 4 5
3.	The print module on communication skills should be given to the students alone without the mp4 files.	1 2 3 4 5
4.	Both the print module on communication skills and the mp4 videos should be given to the students.	1 2 3 4 5
5.	The mp4 video files on communication skills should be given to the students alone without print module.	1 2 3 4 5
6.	I found the mp4 video files on communication skills very helpful.	1 2 3 4 5
7.	I could do without the mp4 video files. They were a waste of time.	1 2 3 4 5

12. Did you find any problems with the mp4 video files that we gave you?

Yes ☐ No ☐

If the answer to the question above is yes, please explain.

____

13. Please make any suggestions on how we could improve the mp4 video files.

C. The following questions solicit your opinion on how you would evaluate the C Programming website that you were asked to access as part of your lessons this semester.

14. Please select by circling the option that best represents your opinion on the C Programming website.

Response key
(1 = Strongly agree; 2 = Agree; 3 = Undecided; 4 = Disagree; 5 = Strongly Disagree)

		(Please circle one)
1.	I found the exercises on the website very helpful.	1 2 3 4 5
2.	I attempted to do the exercises first before looking at the solution.	1 2 3 4 5
3.	I looked at the solutions first before attempting the exercises	1 2 3 4 5
4.	I would prefer if the website did not have solutions to the exercises.	1 2 3 4 5
5.	I did not find time to use the website at all.	1 2 3 4 5
6.	I used the website for revision	1 2 3 4 5
7.	I used the website to prepare for classes ahead of time.	1 2 3 4 5
8.	The website did not help me at all. I found it a waste of time.	1 2 3 4 5

15. Did you find any problems with the website that we asked you access?

Yes ☐ No ☐

If the answer to the question above is yes, please explain.

16. Please make any suggestions on how we could improve website on C Programming.

17. Did the use the mp3 audio files, mp4 video files or website have any effect on your studies?

Yes ☐ No ☐

Please explain your answer.

18. Would you recommend that your lecturers continue designing more electronic instructional materials?

End of questionnaire

Thank you for taking your time to respond to questions in this questionnaire

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Interview protocol for Faculty members

My name is Paxton Zozie. I am doing research on integration of e-learning technologies in teaching and learning. The main aim of my research is to investigate how institutions can sustainably integrate various e-Learning technologies into traditional teaching and learning in secondary schools and tertiary education in Malawi.

I intend to conduct my study at Mzuzu University, Luwinga Secondary School and Nkhorongo Community Day Secondary School. Specifically, the study intends to investigate if learning institutions can use locally available resources to repurpose existing paper-based instructional materials for electronic delivery; find out electronic medium/media that can be used to sustainably integrate digital technology in secondary and higher education institutions in Malawi; identify challenges that resource challenged institutions meet when integrating digital technology and; find out the effect of the repurposed instructional materials and digital technologies on faculty's teaching and students' learning.

Discuss issues of confidentiality and anonymity.

- Obtain signature on informed consent form.
- Ask for permission to audiotape the interview.
- Proceed with the rest of the interview

1. How long have you been teaching at this University/Secondary school?
2. What courses do you teach?
3. What is your present level of experience in the use of electronic technology for the learning?

The following questions deal with access to electronic media

4. Have you designed any of instructional materials for electronic or online delivery? If not, please explain. If yes;
   (a) What technology or technologies did you use to design your instructional?
   (b) What electronic medium/media did you use to distribute the electronic instructional materials?
   (c) Why did you choose this medium or these media?
5. Which medium/media would you recommend for lecturers to use in future when distributing electronic content to students? Give reasons for your answer.

The following questions deal with challenges you faced when changing print-based instructional materials to electronic format.

6. If you have designed instructional materials for electronic or online delivery, did you meet any challenges when designing the electronic materials? If yes, what were these challenges? How did you manage the challenges?
7. What would you suggest the institution should do to minimise these challenges?

The following questions deal with effect of the repurposed materials on the teaching and learning process.

8. Did the repurposed e-learning instructional materials have any effect on your teaching? If yes, what were these effects?
9. Did the repurposed e-learning instructional materials have any effect on the students' learning? If yes, what were these effects?
10. Was there any significant difference in academic attainment of your students after you started using the repurposed electronic instructional materials?
11. If yes, was the academic attainment higher or lower than before?
12. How do you explain the difference in your students' academic attainment?
13. Would you recommend the use of repurposed e-learning instructional materials to management other members of teaching staff? Please explain.
14. Suggest ways the institution could sustainably integrate digital technologies into teaching and learning.
15. Do you have any additional comments regarding integrating technology in education in Malawi?

Thank you for taking your time to respond to questions in this interview

Appendix C - Free Software for Educators

Office and Design

FreeMind	FreeMind is a mind mapping application. A mind map is a diagram used to represent words, ideas, tasks, or other items linked to and arranged radially around a central keyword or idea
GanttProject	With GanttProject you can break down your project into a tree of tasks and assign human resources that have to work on each task.
Lyx	LyX is an advanced open source document processor. It is called a "document processor" because unlike standard word processors, LyX encourages an approach to writing based on the structure of your documents, not their appearance.
Open Office	Open Office is an office software suite for word processing, spreadsheets, presentations, graphics, databases and more.
Scribus	Scribus is a desktop publishing (DTP) application. It is known for its broad set of page layout features comparable to leading commercial applications.

Internet

Firefox	Firefox is a web browser that's winning praise from users and the media for making the web fun and easy again. It has security, speed and new features that will change the way you use the web.
HTTrack	HTTrack is an easy to use offline browser utility. It allows you to download websites from the internet to a local directory, building recursively all directories, and getting HTML, images, and other files from the server to your computer.
JoomlaPC!	JoomlaPC! provides Windows users with a complete Joomla! 1.5 solution without the need for hosting space online.
Kompozer	KompoZer is a complete web authoring system that combines web file management and easy to use WYSIWYG web page editing.
RSSOwl	RSS ("Really Simple Syndication" or "Rich Site Summary") is a document specification that gives users the power to collect and organise web-based news and information in a more efficient manner.
Thunderbird	Thunderbird is a rich email client with popular features like tags and message filters. In addition to talking to a variety of email servers.

Educational Tools

CourseLab	CourseLab is a powerful, yet easy to use, e-learning authoring tool that offers programming-free "What You See Is What You Get" (WYSIWYG) environments for creating high-quality interactive e-learning content which can be published on the internet, Learning Management Systems (LMS), CD-ROMS and other devices.
eXe	The Web is a revolutionary educational tool because it presents teachers and learners with a technology that simultaneously provides something to talk about (content) and the means to hold the conversation (interaction).
Hot Potatoes	The Hot Potatoes suite includes six applications, enabling you to create interactive multiple-choice, short-answer, jumbled-sentence, crossword, matching/ordering and gap-fill exercises for the World Wide Web.
Ren'Py	Ren'Py is a free and cross-platform engine that helps you make story-based games.
Wink	Wink is a tutorial and presentation creation software, primarily aimed at creating tutorials on how to use software (like a tutor for MS-Word/Excel etc.).

Graphics and Animation

Blender	Blender is a 3D graphics application. It can be used for modelling, texturing, rigging, water simulations, skinning, animating, rendering, particle and other simulations, non-linear editing, compositing, and creating interactive 3D applications.
Dia	Dia is roughly inspired by the commercial Windows program 'Visio', though more geared towards informal diagrams for casual use. It can be used to draw many different kinds of diagrams.
Gimp	GIMP is a free raster graphics editor used to process digital graphics and photographs. Typical uses include creating graphics and logos, resizing and cropping photos, altering colours, combining multiple images, removing unwanted image features, and converting between different image formats.
InkScape	Inkscape is a vector graphics editor. What sets Inkscape apart from other graphic software is its use of Scalable Vector Graphics (SVG).

Audio and Video

Audacity	Audacity is an easy to use audio editor and recorder.
LMMS	Linux Multimedia Studio is a free cross-platform alternative to commercial programs which allow you to produce music with your computer.
MuseScore	MuseScore is a music score writer for Linux and Microsoft Windows. MuseScore is a WYSIWYG editor, complete with support for score playback and import/export of MusicXML and standard MIDI files.
Songbird	Songbird is an open source customisable music player and web browser featuring automatic media import, smart playlists, media library, radio streaming and multi-language support.
VLC Media Player	VLC media player is a highly portable multimedia player for various audio and video formats (MPEG-1, MPEG-2, MPEG-4, DivX, mp3, ogg, ...) as well as DVDs, VCDs, and various streaming protocols.

Utilities

7-Zip	7-Zip is a file archiver designed originally for Microsoft Windows. 7-Zip operates primarily with the 7z archive format, as well as being able to read and write to several other archive formats. It enables you to bundle and compress multiple files into one.
ClamWin	ClamWin is a free antivirus program for Microsoft Windows. It comes with an easy installer and open source code.
DVD Flick	DVD Flick aims to be a simple but at the same time powerful DVD authoring tool. It can take a number of video files stored on your computer and turn them into a DVD that will play back on your DVD player, media centre or home cinema set.
InfraRecorder	InfraRecorder is a free CD/DVD burning solution for Microsoft Windows.
TheSage	TheSage's English dictionary and thesaurus is a professional software package that integrates a complete dictionary and multifaceted thesaurus of the English language into a single and powerful language reference system.

Compiled from http://www.unesco.org/bangkok

Appendix D – Detailed feedback from students on using WhatsApp

Detailed feedback from some students concerning how WhatsApp was used for a period of six months

Respondent	Feedback
R001	*WhatsApp is useful in the sense that we get first-hand information. However, many of the students do not have access to phones which have the application. Therefore, it is important for you to take your time to tell students the importance of this application and encourage them to get good phones. In addition, you should not rely much on WhatsApp. You should also enhance Facebook method because nowadays Facebook can be accessed even through phones without Internet connectivity.*
R002	*WhatsApp platform has been superb except for few people who have been abusing the group by using it for personal interests. I would suggest removing such people from the group if this persists in future. All in all, information is easily shared on this platform. A special announcement has to be made to the Whole Cohort 3 group to convince those who are not on WhatsApp to subscribe to this social medium for the sake of the course.*
R003	*WhatsApp has been successful in sending and receiving official messages from the Centre. As one of the students' representatives, we also use the WhatsApp group to disseminate information to fellow students, especially if we were informing our colleagues on wedding of our colleague. However, some of the students were abusing the platform by posting unnecessary comments. They used the WhatsApp group for personal communication. There is need to sensitise members on what issues to communicate through the official WhatsApp group.*

R004 *As you have asked about the group, I thought it could be good if members concentrated on academic issues rather than taking it as a platform for non-academic issues. Communications have been made simple. Therefore, it is good to inform those who abuse this group of removal. Those are my views. Thanks for creating the forum.*

R005 *Sir, my suggestions are as follows: Firstly, the group is just very good in the sense that many of us are able to access first-hand information on academic matters in as far as our course is concerned as per its name Distance education. So, we cannot run away from using this WhatsApp group. However, there are some members of the group who are good at bringing in issues which are not for academics. I find it to be of little use because they sometimes end up disturbing some of us in the group. Of course, I know that education is not all about thinking or doing something about education always but sometimes it becomes too much.*

R006 *I have found it useful myself. Much of useful information reaches me in time. The only problem with it is that some people use the account for their personal issues and not academic ones. They like extending their personal arguments. So, my suggestion is that you remove these members.*

R007 *"On the issue you have raised on the ODL page. I feel for it to improve there is need for advising not to make irrelevant comments on the page that is public but those that would help us all.*

R008 *WhatsApp has been very successful to me. For instance, I managed to access the results, the calendar and even sharing information with friends. However, students engage in personal conversations using group WhatsApp and this is unwelcome because most of the conversations are not academically oriented. Improvement would include sending information faster i.e. reminding about fees and any*

	other developments. This can assist us very much because we rely on this facility.
R009	*The WhatsApp group has been very helpful as I have been getting first-hand information, some of which has been the exam results, assignments, changes in the academic calendar and various information from the Centre. I have also found the group reliable because the information is direct from CODL staff. The only improvement necessary is addition of more new members and frequent updates on hot issues such as what lecturers of those courses we have not gotten assignments. Overall, on a scale of 1 to 10; I give this innovation a 9."*
R010	*All communications concerning assignments, fees balances and lectures information are useful apart from some of the unnecessary comments from the group members who always disturb with useless information.*
R011	*People use this platform to communicate personal matters which could be individually communicated. I suggest you should caution such individuals.*
R012	*The facility is very useful considering the fact that we get timely messages and responses. Again, despite some of us not being on WhatsApp, communication is easily relayed by others. The only drawback which needs to be looked into is unnecessary messages by group members which are personal; not affecting members. There is need for us to send messages which directly have an impact on the group members not just funny chats. It may become boring. There is need to however make sure that issues that affect the group should not be delayed. Personal messages should be sent to personal accounts not on the group WhatsApp.*

Appendix E - C Programming Interactive Exercises Source Code

Sample Source code for Questions 1 & 2

Student Response System (True/False Questions) - Students Interface

Source code for Index Page (index.php)

```
<!DOCTYLE html>
<html>
        <head>
                <title>Online Voting System</title><style type= "text/css">
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
img:hover {background:orange;}
input {margin:1px;}
</style>
        </head>
<body>
<center><h3>Student Response System: C Programming</h3>
<h4>Exercise 1</h4>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
</div><p><center>

<div class="container">
<A href="structure.php">Start Here</a>
<?php

?>
</div>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;"><center>
</div><p>

</body
</html>
```

Source code for Question 1 (structure.php)

```
<!DOCTYLE html>
<html>
        <head>
                <title>Online Voting System</title><style type= "text/css">
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
```

```
img:hover {background:orange;}
input {margin:1px;}
</style>
        </head>
<body>
<center><h3>Student Response System: C Programming</h3>
<h4>Exercise 1</h4>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
</div><p><center>
<center>
<p><img src="images/ex01q1.jpg"><p>
</center>
<div class="container">
<form action="structure.php" method="post" align="center">
        <center><input type="submit" name="a" value="TRUE"/>
        <input type="submit" name="b" value="FALSE"/>
        </center>
</form>
<?php

$con = mysqli_connect("localhost","root","","cprogex01");
if(isset($_POST['a'])){
        $res_a = "update structure set a=a+1";
        $exec_a = mysqli_query($con, $res_a);
        if($exec_a){
        echo "<h5 align='center'>Sorry! The correct answer is 'False'.</h5>";
        }
}
if(isset($_POST['b'])){
        $res_b = "update structure set b=b+1";
        $exec_b = mysqli_query($con, $res_b);
        if($exec_b){
        echo "<h5 align='center'>Correct!</h5>";
        }
}

?>
</div>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;"><center>
</div><p>
<center><a href="structure.php">Done</a> | <a
href="extension.php">Next</a></center>
</body
</html>
```

Source code for Question 2 (extension.php)

```
<!DOCTYLE html>
<html>
	<head>
		<title>Online Voting System</title><style type= "text/css">
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
img:hover {background:orange;}
input {margin:1px;}
</style>
	</head>
<body>
<center><h3>Student Response System: C Programming</h3>
<h4>Exercise 1</h4>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
</div><p><center>
<center>
<img src="images/ex01q2.jpg">
</center>
<div class="container">
<form action="extension.php" method="post" align="center">
	<center><input type="submit" name="a" value="TRUE"/>
	<input type="submit" name="b" value="FALSE"/>
	</center>
</form>
<?php
$con = mysqli_connect("localhost","root","","cprogex01");
if(isset($_POST['a'])){
	$res_a = "update extension set a=a+1";
	$exec_a = mysqli_query($con, $res_a);
	if($exec_a){
	echo "<h5 align='center'>Correct!</h5>";
	}
}
if(isset($_POST['b'])){
	$res_b = "update extension set b=b+1";
	$exec_b = mysqli_query($con, $res_b);
	if($exec_b){
	echo "<h5 align='center'>Sorry! The correct answer is 'True'.</h5>";
	}
}
?>
</div>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;"><center>
```

```
</div><p>
<center><a href="structure.php">Back</a> | <a href="extension.php">Done</a> |
<a href="sum.php">Next</a></center>
</body
</html>
```

Student Response System (True/False Questions) – Lecturer's Interface

Source code for Question 1 (index.php)

```
<!DOCTYLE html>
<html>
	<head>
		<title>Online Voting System</title><style type= "text/css">
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
img:hover {background:orange;}
input {margin:1px;}
</style>
	</head>
<body>

<center><h3>Student Response System: C Programming</h3>
Q1 | <a href="q2.php">Q2</a> | <a href="q3.php">Q3</a> | <a
href="q4.php">Q4</a> |
<a href="q5.php">Q5</a> | <a href="q6.php">Q6</a> | <a href="q7.php">Q7</a> |
<a href="q8.php">Q8</a> | <a href="q9.php">Q9</a> |
<a href="q10.php">Q10</a><p></center>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
</div><p><center>
<center><p><img src="images/ex01q1.jpg"><p>
</center>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;"><center>
</div><p>
<center><a href="structure.php">Dashboard</a></center>
</body
</html>
```

Source code for structure.php

```
<!DOCTYLE html>
<html>
	<head>
		<title>Online Voting System</title>
<style type= "text/css">
```

```
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
img:hover {background:orange;}
input {margin:1px;}

</style>
        </head>
<body>
<center><h3>Student Response System: C Programming</h3></center>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
</div><p><center>
<div class="container">

<?php
$con = mysqli_connect("localhost","root","","cprogex01");
if(isset($_POST['a'])){
        $res_a = "update structure set a=a+1";
        $exec_a = mysqli_query($con, $res_a);
        if($exec_a){
        echo "<h4 align='center'>Sorry! The correct answer is 'False'.</h4>";

        }

}
if(isset($_POST['b'])){
        $res_b = "update structure set b=b+1";
        $exec_b = mysqli_query($con, $res_b);
        if($exec_b){
        echo "<h4 align='center'>Correct!</h4>";

        }
}


if(isset($_GET['results'])){
        $get_resps = "select * from structure";

        $exec_resps = mysqli_query($con, $get_resps);
        $row_resps = mysqli_fetch_array($exec_resps);
        $a = $row_resps['a'];
        $b = $row_resps['b'];
        $count = $a+$b;

        echo "
        <div style='padding:10px; text-align:center;'>
                <center>
```

```
                <h4>Results:</h4>
                True   : $a    <br>
                False: $b <p>
                Total Responses: $count</b><p>
                The correct answer is: FALSE
                </center>
        </div>
        ";
}
?>

</div>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;"><center>
</div><p>

<center><a href="index.php">Back</a> | <a href='structure.php?results'>View
Results</a> | <a href="reset_structure.php">Reset Table</a>

</body
</html>
```

Source code for reset_structure.php

```
<!DOCTYLE html>
<html>
        <head>
                <title>Online Voting System</title><style type= "text/css">
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
img:hover {background:orange;}
input {margin:10px;}
</style>
        </head>
<body>
<center><h3>Reset structure Table</h3>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
   </div><center>

<div class="container">
<form action="reset_structure.php" method="post" align="center">
        <center>
        <input type="submit" name=" reset_a" value="RESET TRUE Table"/>
        <input type="submit" name=" reset_b" value="RESET FALSE Table"/>
        </center>
        <?php
$con = mysqli_connect("localhost","root","","cprogex01");
```

```
if(isset($_POST['reset_a'])){
        $res_reset_a = "update structure set a=a-a";
        $exec_reset_a = mysqli_query($con, $res_reset_a);
        if($exec_reset_a){
        echo "<align='center'>TRUE Table = 0</h4>";
        }
}
if(isset($_POST['reset_b'])){
        $res_reset_b = "update structure set b=b-b";
        $exec_reset_b = mysqli_query($con, $res_reset_b);
        if($exec_reset_b){
        echo "<align='center'>FALSE Table = 0</h4>";
        }

}
?>
        </div>
        <center><div style="background:green; color:white; text-align:center;
width:50%; padding:1px;">
   </div><p><center>
<a href ="structure.php">Back</a>
</body>
</form>
```

Source code for Question 2 (q2.php)

```
<!DOCTYLE html>
<html>
        <head>
                <title>Online Voting System</title><style type= "text/css">
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
img:hover {background:orange;}
input {margin:1px;}

</style>
        </head>
<body>
<center><h3>Student Response System: C Programming</h3>
<a href="index.php">Q1</a> | Q2 | <a href="q3.php">Q3</a> | <a
href="q4.php">Q4</a> |
<a href="q5.php">Q5</a> | <a href="q6.php">Q6</a> | <a href="q7.php">Q7</a> |
<a href="q8.php">Q8</a> | <a href="q9.php">Q9</a> |
<a href="q10.php">Q10</a><p></center>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
</div><p><center>
<center><img src="images/ex01q2.jpg">
```

```
<p>
</center>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;"><center>
</div><p>
<center><a href="extension.php">Dashboard</a></center>
</body
</html>
```

Source code for extension.php

```
<!DOCTYLE html>
<html>
        <head>
                <title>Online Voting System</title>
<style type= "text/css">
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
img:hover {background:orange;}
input {margin:1px;}

</style>
        </head>
<body>
<center><h3>Student Response System: C Programming</h3></center>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
</div><p><center>
<div class="container">

<?php
$con = mysqli_connect("localhost","root","","cprogex01");
if(isset($_POST['a'])){
        $res_a = "update extension set a=a+1";
        $exec_a = mysqli_query($con, $res_a);
        if($exec_a){
        echo "<h4 align='center'>Correct!</h4>";
         }

}
if(isset($_POST['b'])){
        $res_b = "update extension set b=b+1";
        $exec_b = mysqli_query($con, $res_b);
        if($exec_b){
        echo "<h4 align='center'>Sorry! The correct answer is 'True'.</h4>";
```

```
        }
}


if(isset($_GET['results'])){
        $get_resps = "select * from extension";

        $exec_resps = mysqli_query($con, $get_resps);
        $row_resps = mysqli_fetch_array($exec_resps);
        $a = $row_resps['a'];
        $b = $row_resps['b'];
        $count = $a+$b;

        echo "
        <div style='padding:10px; text-align:center;'>
                <center>
                <h4>Results:</h4>
                True   : $a    <br>
                False: $b <p>
                Total Responses: $count</b><p>
                The correct answer is: TRUE
                </center>
        </div>
        ";
}
?>

</div>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;"><center>
</div><p>

<center><a href="q2.php">Back</a> | <a href='extension.php?results'>View
Results</a> | <a href="reset_extension.php">Reset Table</a>

</body
</html>
```

Source code for reset_extension.php

```
<!DOCTYLE html>
<html>
        <head>
                <title>Online Voting System</title><style type= "text/css">
body {padding:0; margin:0; font-size:14px; font-family:geneva, arial, helvetica,
sans-serif;}
.container {width:800px; margin:0 auto; padding:10px;}
img:hover {background:orange;}
```

```
input {margin:10px;}
</style>
        </head>
<body>
<center><h3>Reset extension Table</h3>
<center><div style="background:green; color:white; text-align:center; width:50%;
padding:1px;">
   </div><center>

<div class="container">
<form action="reset_extension.php" method="post" align="center">
        <center>
        <input type="submit" name=" reset_a" value="RESET TRUE Table"/>
        <input type="submit" name=" reset_b" value="RESET FALSE Table"/>
        </center>
        <?php
$con = mysqli_connect("localhost","root","","cprogex01");
if(isset($_POST['reset_a'])){
        $res_reset_a = "update extension set a=a-a";
        $exec_reset_a = mysqli_query($con, $res_reset_a);
        if($exec_reset_a){
        echo "<align='center'>TRUE Table = 0</h4>";
        }
}
if(isset($_POST['reset_b'])){
        $res_reset_b = "update extension set b=b-b";
        $exec_reset_b = mysqli_query($con, $res_reset_b);
        if($exec_reset_b){
        echo "<align='center'>FALSE Table = 0</h4>";
        }

}
?>
        </div>
        <center><div style="background:green; color:white; text-align:center;
width:50%; padding:1px;">
   </div><p><center>
<a href ="extension.php">Back</a>
</body>
</form>
```