E-PEDAGOGY: TOWARDS THE MODEL FOR TECHNOLOGY- BASED EDUCATION FOR SECONDARY SCHOOLS IN TANZANIA

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Approval of the Thesis

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Abstract

E-PEDAGOGY: A MODEL FOR TECHNOLOGY BASED EDUCATION FOR SECONDARY SCHOOLS IN TANZANIA

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Technology has become an enabler for transforming teaching and learning practices. However, consideration of contemporary educational issues should go hand in hand with technology integration. This study investigated the translation and transferability of contemporary learning theories and approaches to instruction as a guide for the effective use of technology in teaching and learning. Both primary and secondary data were collected through interviews, observation checklists and a desk review. The purposive sampling technique was used to select participants and documents. The sample included ten (10) educational institutions from which 22 instructors, 25 students and 4 education officers were recruited. The documents included institution policies and scholarly articles. Descriptive statistics were used to analyze nominal data collected from structured interviews while contents analysis was used to analyze secondary data.

The findings revealed that technological media and tools such as discussion forums, emails, Google Docs, and social media applications are used to support technological pedagogical practices that are group work based, such as brainstorming and role-playing and involve the use of case studies. The study also revealed that digital resources and tools such as the internet, video conferencing, mobile technology, artificial reality, virtual reality, artificial intelligence, games, digital libraries, social media, wikis, MOOCs and learning management systems are used to

facilitate engagement, collaboration, creativity and innovation to improve problem solving and communication skills.

Furthermore, the learner-centered approach and the authentic and transformation models were found to be appropriate approaches and models in digital learning. Besides this, the study found that insufficient technological resources, lack of competence among instructors, destructive use of technology by students and lack of technical experts to support technology use were among the limitations of the technological pedagogical application. Other barriers include the unavailability of relevant policies to guide technology application, instructors and parents' beliefs and attitudes and the lack of appropriate governance structure for technology integration. Based on these findings, it is suggested that regular training be conducted on technological pedagogical knowledge for teachers; adopting an approach to minimizing the cost of technological resources; orienting and enforcing ethical practices when using technology; and establishing mentorship programs for awareness creation among instructors, students and parents.

Declaration

I declare that this thesis has been composed solely by me and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by reference or acknowledgment, the work presented is entirely my own.

Copyright

Dedication

This dissertation is dedicated to my lovely husband Casmil and my four wonderful children Jovin, Jeffrey, Joshua and Jillian.

Acknowledgement

I would like to thank God almighty for his blessings that made this licentiate research successful. I am very much grateful to my supervisor, Dr. Tanya Marie Hathaway for his constructive suggestions, guidance and valuable time devoted throughout this research work. My thanks are extended to Ms. Regina Monyemangene for her valuable discussions during the early stages of the licentiate and for facilitating data collection. My special thanks go also to Ms. Luly Bulili, Said Kinduli, Pius Martine, Rahim Abdallah, Robert Msangi and Mary Mbise for their assistance during the data collection exercise.

My last vote of thanks goes to my husband and family without whose support I would never have reached this far.

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AI : Artificial Intelligence

AR : Augmented Reality

List of Acronyms

CAD	:	computer-aided drawing and design
CBT	:	computer-based training
CMS	:	Content Management System
EASNIE	:	European Agency for Special Needs and Inclusive Education
EMIS	:	Education Management Information System
EMIS	:	Education Management Information System
ESPR	:	Education Sector Performance Report
ETP	:	Education and Training Policy
HTML	:	Hypertext Markup Language
IaaS	:	Infrastructure as a Service
IBT	:	Internet Based Training
ICT	:	Information and Communication Technology
ITS	:	Intelligent Tutoring Systems
LMS	:	Learning Management System
LPU	:	Lovely Professional University
MIT	:	Massachusetts Institute of Technology
MoEVT	:	Ministry of Education and Vocational Training
MOOCS	:	Massive Open Online Courses
NACTE	:	National Council for Technical Education
NGO	:	Non-Governmental Organizations
OER	:	Open Education Resources
PCK	:	Pedagogical Content Knowledge
PDF	:	Portable Document Format
PReM	:	Primary Records Manager
PReM	:	Primary Records Manager
REAF	:	Research Application Form
SaaS	:	Software as a Service
SIS	:	School Information System
SMS	:	Short Message Service
TCU	:	Tanzania Commission for Universities

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TMIS : Teacher Management Information System

TPACK : Technological, Pedagogical and Content Knowledge TV

: Television

UREC : University Research Ethics Committee US

: United States

VR : Virtual Reality

VSG : Victoria State Government

WBT : Web Based Training

Wi-Fi : Wireless Fidelity

Chapter 1: Introduction

1.1 Background

Chazan (2022) refers to education as the conscious effort to equip individuals with knowledge and skills that will enable them to perform some tasks in a given society; it is an exposure to enable individuals to obtain an understanding of some practices in a certain skill set. Another definition by Al-Shuaibi (2014) and Ayua (2017) refers to education as a process of imparting knowledge, skills and understanding to the learner. It involves the development of reflective thinking and abilities for individuals to enable them to manage their existence. The assumption is that knowledge is acquired by the learner through various mechanisms that are made available by institutions offering education (Usman, 2016).

Technology advancement has revolutionized every possible field including the education field. According to Bush and Mott (2009), the global education system has undergone significant transformation resulting from technological advancement. A number of studies and discussions were conducted around the world to examine the impact of technology on the process of teaching and learning. From research, different suggestions were presented regarding this topic; however, it was found that technology integration in the education process is unavoidable (Skenderi & Skenderi, 2017). According to Raja and Nagasubramani (2018), individual minds tend to work faster when supported by technological tools. The process of delivering knowledge by instructors and the acquisition of knowledge by students has been made easy with the application of technology (Raja & Nagasubramani, 2018). Teachers are the main stakeholders in the education process; initially, teachers were the primary source of information or provider of education and students were the receivers (Ananga & Biney, 2017). Due to increased information access and opportunities, as a result of technological advancement, the teacher's role has shifted to guiding,

managing and facilitating the learning process (Mahini et al., 2012). Besides this, technology has

impacted the education process by promoting active learning, collaboration, engagement, creativity, integration and evaluation (Raja & Nagasubramani, 2018); it has provided more opportunities for both teachers and students in adapting learning and teaching to individual needs (Skenderi & Skenderi, 2017). Furthermore, Harris et al. (2016) and Grimus (2020) state that the integration of technology into the classroom has nurtured the use of more student-centered learning strategies as it fosters more interactions and collaborations among students.

Despite the educational value offered by technology, some researchers argue that technology has not been used to its full advantage. Davies and West (2013) stated that the effort of integrating technology in schools was chiefly focused on expanding technology access for the purpose of increasing the extent of its use. For this reason, many teachers focused on what technology could do, instead of how technology could be used to achieve the intended learning outcomes (Watson, 2001). Indeed, increasing access to technology does not always imply an improvement in the learning process unless it is considered along with other necessary elements involved in the teaching and learning process. In this respect, critical analysis of the substantive educational theory surrounding technology integration in schools and consideration of research findings to promote teaching, are the important elements to reflect on prior to technology integration in the classroom (Okojie et al., 2006). Technology is an enabler for transforming teaching practices, given a set of enabling conditions hence integrating technology in schools demands for consideration of contemporary educational issues. Novoa-Echaurren and Canales-Tapia (2018) suggested that different interrelated facets, such as teaching approaches, content and context of instruction are important components to consider when integrating technology in the classroom. Further, technology integration in schools implies changes in education systems, policies and leadership (Grimus, 2020). This influences the need for a new approach to pedagogic planning and evaluation to facilitate the educative possibilities in technology-based educational settings.

In this regards, this study is conducted to obtain preliminary information and suggestions for pedagogical model for technology-based education. It involves putting together the theoretical framework, empirical evidence and research findings for the purpose of contributing towards the development the appropriate pedagogical model that is effective in improving the education process in the technology rich environment.

1.2 Tanzania Education System

According to Machumu et al. (2018), Tanzania has a total number of 4,753 Secondary schools of which 3,692 are public, and 1,061 are private. The current formal education and training system was adopted since 1990 and constitutes of two years of pre-Primary (3 – 5 years), seven years of Primary education (5 -12 years), four years of Ordinary Level Secondary Education (12 – 16 years), two years of Advanced Secondary Education (16 – 18 years) and at least three years of Tertiary Education (Mashala, 2019; Tshabangu & Msafiri, 2013). However, the development of the Education and Training Policy (ETP), in 2014, initiated significant changes to the education system which included the introduction of 11 years of free education spanning the pre-Primary, Primary and Secondary Education phases. The policy also endorsed the use of a single textbook for each subject in all schools (Education and Training Policy, 2014).

The focus of pre-Primary and Primary Education was to provide basic knowledge, an entry point for Secondary School Education. At this level, the language of instruction is Swahili especially for public schools while most private schools use English as their language of instruction. Secondary Education is the bridge towards professional development through Tertiary Education (Mashala, 2019); its final examination leads to academic certification which defines the qualification for admission into Tertiary Education.

1.3 Technology Integration in Tanzania Secondary Schools

Tanzania Education Sector Development Plan (2018) shows a rapid expansion of the education sector at all levels. Technology has brought a new learning experience to both instructors and learners. It is used to change the way people learn; it enable access to contents, information storage, management and dissemination as well as to facilitate communications (Selemani et al., 2021). Today, technology has aided plenty of resources that can enhance the teaching skills and ability (Tsakpornu, 2016); it support immediate information including online libraries and open courseware. Technologies has created posibilities to impart knowledge at a high pace, at anytime to individual in different locations; this includes support information access to marginalized individuals including those with special needs. Through technology, students can create a set of skills to help them in their career development. Technology application has also provided educators with ability to reach more students in a more efficiency as it provides wider range of learning styles and options (Ganisherovna, 2020). Tsakpornu (2016) pointed out that technology can facilitate group learning; learners can unite and collaborate online to do the desired tasks though internet and other web systems. Collaborations between students and instructors as well as with peers was enhanced through technology application. Beside this, technology is useful in supporting education administration; it can definitely help educators to monitor individual performance development and helps to innovative lesson planning (Ganisherovna, 2020). According to Henriksen et al. (2016), creativity and innovation are becoming increasingly important in the 21st century hence effective infusion of creativity and innovation through technology must be considered at all level of the education process. Beside this, technology often brings new possibilities for learners to be creative and innovative hence it serves as a pedestal to creativity and innovation (Henriksen et al., 2016). It can be used to transform ideas into useful solution to problems in a real world (Oiku & Ogunrinde, 2022). With the

aforementioned, developing countries like Tanzania needs to transform their education practices at all level in order to embrace the application of technology to enhance the quality of education.

In the past ten years, the country has been struggling to integrate technology in the education; several universities have made substantial investment in technology in-line with the government goal of improving quality of education. However, when it comes to secondary schools relatively limited achievement was recorded. The government, as well as other education stakeholders, has made considerable efforts to ensure necessary technology infrastructure, education information systems and e-contents are available among Secondary Schools (Raphael & Mtebe, 2017; Ngeze, 2017; Barakabitze, 2017). The purpose of developing e-contents was to supplement the "chalk and talk" method of teaching. A number of policies including Policy for Basic Education for 2007, Education and Training Policy of 2014, National ICT Policy of 2016, the National Five-Year Development Plan 2016/17-2020/21 and Tanzania Development Vision 2025 just to mention few were introduced to promote effective use of technology among education institutions in Tanzania (Selemani et al., 2021). These developed policies suggested use of the number of digital tools such as radio, television, computers, mobile phones and the internet to facilitate the teaching and learning process (Kihoza et al., 2016). Other initiatives includes National Programme on ICT for Secondary School Teachers, the e-Schools Project, Tanzania Beyond Tomorrow, ICT4E Project and African Digital Schools Initiative programme with the aim to transform 40 Tanzania secondary schools into digital schools (Selemani et al., 2021; Ngeze, 2017). The main targets for all these initiatives was to increase access to technological infrastructure and build technology capacity among instructors and learners in order to maximize the use technologies in facilitating the teaching and learning process.

However, despite the government efforts to integrate technology in the education process some success and unsuccessful stories about these initiatives has been recorded in researches. Remarkable numbers of secondary schools are still lacking technological devices; a study by Majige Selemani, Vitalis Ndume and Dalton Kisanga recorded students computer ratio to range from 20:1 to 110:1 (Selamani et al. (2017), which imply inadequate number of computers to serve effectively learning needs with technology. Ngeze (2017) pointed out that technology could enrich student-learning experience only if the necessary technological infrastructures are in place and instructors are well capacitated in terms of technology application and pedagogical skills. However, lack of instructors training programmes and technical support was recorded as among the major reason for ineffective use of technology in the education process in Tanzania (Kira, 2015; Ngeze, 2021). Teachers and students knowledge on utilization of technological tools is still at low level as a result the available technological facilities are underutilized (Selemani et al., 2021). Beside this, instructors attitude is another major barrier to technology among education institutions in Tanzania. Some instructors beliefs that application of technology to develop online contents will lead to job insecurity since the materials will continue to stay for long period without the needs for review (Oroma & Mduma, 2013). Lacks of guidelines for technology use was also recorded as another challenge towards integration of technology in the teaching and learning process in Tanzania; there is no baseline to follow; this leaves instructors to decide on how, when and to what extent to use technology which led into to ambiguity (Oroma & Mduma, 2013).

Recognizing the potential of technology in facilitating the education process education institutions mostly being universities have been restructuring their curriculum as well as their teaching approaches to enable them meet the demands for learners who are unable to attend in-campus training (Selemani et al., 2021). However, the greater emphasis was placed on the

development of technology infrastructure and less on technological pedagogy (Ndibalema, 2014). According to Skenderi and Skenderi (2017), technology and education are closely related, and they must be used together including connecting teachers to the process. The most important factor for the effective integration of technology is the "teachers' competence and ability to shape instructional technology activities to meet students' needs" (Skenderi & Skendery, 2017 p.2). Kihoza et al. (2016) pointed out that little effort was made towards supporting instructors' technology professional development. In this regard, Lashayo et al. (2018) and Ndume et al. (2008) observed that most Tanzania instructors had developed a negative perception of technology use; the main reason being a lack of competence, facilities and appropriate training. Besides this, there was no comprehensive instruction model to guide technology integration in education. Given this fact, researchers have called for the consideration of an operational model that will help instructors to effectively make the transition into sophisticated technology use in the education process (Zinger et al., 2017; Ndibalema, 2014).

1.4 Statement of the Problem

To facilitate knowledge acquisition among learners, educators must consider improving teaching methods, contents and instruction strategies (Kapur, 2020). Applying different methods and practices for instruction can determine the effectiveness of the learning process (Barber & Mourshed, 2007). To achieve the learning outcome and improve academic performance instructors should focus on a set of approaches, methods and practices referred to as pedagogy (Kapur, 2020). Effective learning requires instructors to combine the teaching methods, teaching contents and instruction strategies in a manner that would contribute to prominent knowledge gain. However, understanding the diverse needs of learners and their context can lead to an effective pedagogy (Persaud, 2019). According to Handrianto et al. (2021), effective pedagogy refers to classroom management that impacts students; it involves the instructor's ability to apply

different teaching practices that engender students to actively participate in classroom activities thus improving their learning. At its most sophisticated, pedagogy creates positive relationships between tutors, students and their learning environments which enhances the well-being of both learners and instructors (Sala-Oviedo et al., 2010).

Technology advancement has profoundly changed the education process; it has increased access to education and introduced different media that support the communication of knowledge (Ammad-ud-din, et al., 2014). It has facilitated the development of highly engaging tasks, and the use of multiple mediums and methods which promote student activeness (Tsai, 2009). With technology, the learning environment has become more dynamic and, as a result, learners have more control of the learning process which affords an optimal learning experience centered on improved student attitudes, motivations and self-efficacy (Väljataga & Laanpere, 2010; Taipjutorus et al., 2012). The application and integration of technology in facilitating the instruction delivery process has created a paradigm shift in teaching practices across the globe (Kweka & Ndibalema, 2018). The greatest challenge has been the maintenance of teaching effectiveness when introducing technology in the classroom. This is because the use of technology in education is more than just applying technological tools, it requires the application of pedagogical principles that are specific to the use of technology in the teaching process; hence lack of connection between instructional technology and pedagogical principles is a challenge facing education today (Islam, 2015; Lashayo et al., 2018; Ndume et al., 2008). According to Okojie et al. (2006) and Price (2015), in some cases institutions have been using technology as a driver of the teaching and learning process instead of being an instructional component. Some instructors are not fully confident and knowledgeable to use technological tools effectively as a pedagogical tool which impedes their effectiveness (Ali, 2019).

According to Okojie et al. (2006), integrating technology in the classroom has less impact on students' learning unless it is considered as a means of instruction. They assert that technology integration should be considered along with the principles of instruction including clear learning objectives, evidence-based instruction methods, appropriate evaluation and assessment mechanisms. Similarly, Isci and Demir (2015, as cited by Zinger et al., 2017, p. 578) argued that learning outcomes will not be attained if educational principles and pedagogy are ignored. Hence education success will be realized only if the adopted technology matches with existing pedagogic principles (Rogers & Finlayson, 2004). Whilst Tanzania has made a significant technology investment in schools, neither a policy framework nor competencies exist to support the application of technology to pedagogy (Kihoza et al., 2016; Malekani, 2018). Therefore, there is an identified need for a pedagogical model to guide technology integration among Tanzanian schools/institutions (Mehanna, 2004; Sharma, 2018).

1.5 Purpose of the Study

The main purpose of this qualitative study was to establish a pedagogical model for technology-based teaching among Secondary Schools in Tanzania. Technology-based teaching refers to the use of digital tools to supplement the classroom instruction process (Ghavifekr and Rosdy (2015); it involves application of technological tools such as computer, internet and other advanced media to facilitate the education process. In order to develop such a model, the study considered contemporary learning theories and approaches to instruction with a view to translating them into a guide for the effective use of technology in teaching. It also involved examining the pedagogical approaches and practices available in literature as well as those which are currently in use in order to identify critical pedagogical features which would afford meaningful technology-based learning.

Technology integration in education process contributes a lot to the pedagogical aspects which leads to effecting teaching learning (Ghavifekr & Rosdy, 2015).Application of modern tools provides opportunities for students to apply what they have learned; enables students to share their experiences; provides room for learner reflection; and access to up-to-date subject matter (Nicholas, 2012). Underlying the concept of effective teaching is the ability of teachers to meet students learning goals hence improving their achievements (Thomas et al., 2009; Ayua, 2017). Effective teaching practices involve careful orchestration of different pedagogical approaches to achieve the intended learning goal (Allan et al., 2009). Hence, the outcome of this study will enable educators to facilitate effective integration of technology in the education process.

1.6 Research Aim

The overarching aim of this study was to construct a valid pedagogical model that utilizes the perceived affordances of technology for the purpose of enhancing teaching and learning among Secondary Schools in Tanzania. Technology affords the opportunity to restructure learning in new and dynamic ways which generates the need to combine data from both the theoretical evidence-base for technology supported teaching with the existing practice-informed and evidence-based approaches (Boyle & Cook, 2004). The study focused on establishing the connection between technology and contemporary learning theories to provide a theoretical framework for a technology-based teaching model. Connecting technology with educational theories helps to meet the students' needs and preferences for learning through digital technologies (Mcknight et al., 2016). Considering technology integration along with contemporary education theories is considered to be a worthwhile as it enables educators to comprehend the potential of having pertinent technological tools, educational apps and learning platforms which increases achievement of the current education need (Ali, 2020).

1.7 Research Objectives

The main objective of this study was to establish a pedagogical model to guide teaching and learning in this digital era. The study explored available teaching approaches; appropriate pedagogical practices and challenges faced by schools when applying technology for teaching and evinced a model that provided guidance for effective technology integration among Secondary Schools in Tanzania.

The following were the specific study objectives:

a. To critically analyze pedagogical tools and practices available in literature that are relevant for technology-based learning.
b. To examine the current teaching approaches applied in Tanzanian Secondary Schools in relation to the application of technology in teaching.
c. To examine the pedagogical challenges experienced by teachers and students when integrating technology in classroom.
d. To design a theoretically informed and evidence-based pedagogical model to guide the technology integration for teaching among Secondary Schools in Tanzania.

1.8 Nature of the Study

This research was exploratory in nature; the focus was to investigate the pedagogical approaches that are relevant to technology-based education. In this respect, an enquiry approach and qualitative content analysis were used by the researcher to gain insight to the phenomenon (Cropley, 2016). Teachers employed in Secondary Schools; Employees from Public and Non-public Educational Institutions; and Current Students in Secondary Schools were the main research participants. Both primary and secondary data were collected; primary data was collected through structured and semi-structured interviews and observation while secondary

data were collected from education policies and scholarly articles through desk review method. Multiple data collection methods were used in a triangulated approach. This approach strengthened the credibility of the study results; helped to confirm the findings; and determined the completeness of data (Shanks & Bekmamedova, 2018; Heale & Forbes, 2013; Chako, 2017. Multiple data collection methods enabled the researcher to capture different data pertaining to different dimensions of the same phenomenon.

Multiple cases presenting as selected education institutions were considered to enable the researcher to explore in-depth the multiple perspectives of participant groups (Sammut-Bonnici & McGee, 2015; Rebolj, 2013). According to Brink (2018), information collected from structured interview are reliable because the participants produces the same answers regardless of the characteristics of the researcher. Structured interviews increased objectivity, limited potential errors hence improving accuracy of the results (Rashidi et al., 2014). A semi-structured interview approach provided flexibility to the respondents and allowed the responsiveness to emerging themes (Jackson et al., 2007). It allows participants to dicuss the topic in more details and includes prompt questions to look for more information or to elaborate the points; it gave the participants opportunity to provide their views freely (Kakilla, 2021). Secondary data were collated through various documentation and recordings to complement interview and observation data. The use of verified secondary data increased the pace of the research undertaking and improved the quality of the findings (Martins et al., 2018; Ajayi, 2017). Documents provided information to supplement data obtained from interview; insights obtained from documents provided valuable additions of the knowledge base (Bowen, 2009; Cardno, 2018). A content data analysis approach was used to analyze the collected qualitative data. The flexibility of this approach provided an opportunity to understand issues widely; determine relationships between concepts and compare the concepts with data which were gathered using different methods in

different situations (Herzog, 2019; Braun & Clarke, 2012; Alhojailan, 2012). Data were compiled in a single data set and reduced through summarization and categorization to identify and link the patterns and themes in the data (Alhojailan, 2012; Kawiluch, 2004).

1.9 Significance of the Study

The advancement of technology has an influence in every aspect of human life; it has altered common practices in most work environments (Albiom & Tondeur, 2018). In the education sector, technology has provided new opportunities for both teachers and students to help them meet their teaching and learning needs (Ratheeswari, 2018). According to Raja and Nagasubramani (2018), technology integration in education has significantly impacted the teaching and learning process. Technology has led to faster, more efficient, effective and interactive classroom experiences (Jamil & Shah, 2011; Raja & Nagasubramani, 2018); it has facilitated active learning and engagement (Roy, 2019). However, integrating technology in the classroom demands a new approach to teaching; it has shifted practice from a teacher-centered model towards a learner-canted and more shared learning experience (Lowyck, 2014; Sieber & Andrew, 2003). Thus, it influences changes in the teaching methodology (Hamiti & Reka, 2012). According to Kasmo et al. (2012) and Miglinoa and Walkerb (2010), technology has generated a wide range of teaching techniques, tools and practices.

To exploit these new innovations, it is necessary to reconstruct the education system. However, Merillo and Domingo (2019) urged that technology integration in education has impacted not only teaching effectiveness but also pedagogical design. Hence, it is necessary for instructors to develop sophisticated pedagogical knowledge in order to improve teaching effectiveness (Auerbach & Andrews, 2018; Tsafe, 2013; Nicu, 2017). Ghavifekr and Rosdy (2015) urged that technology integration in education can contribute significantly to the pedagogical component

hence it requires an understanding and ability to select pedagogies that are suited for technology application (Okojie et al., 2006).

This study exploited and analyzed pedagogical tools and teaching practices to generate a pedagogical model that caters for individual learner needs through technology-based teaching. Implementing this model will encourage teachers to think critically as they enact teaching with technology (Mezirow, 1990, as cited Okojie et al., 2006 p. 68). The model will require teachers to consider contemporary learning theories as a foundation of their learning designs and to guide the selection and use of relevant instructional technologies. According to Ngoma (2010), technology can accelerate knowledge creation which leads to sustainable development. It is expected that this model will provide a new vision to promote country wide economic development and, hence, increased ability to respond to challenges which arise from change.

Furthermore, according to Sharma et al. (2014) and Azam et al. (2010), effective use of technology in education significantly contributes to the mass education of society in developing countries including Tanzania. Therefore, the model developed will enable achievement of the desired education outcome for the intended individuals; this includes students' attainment of basic skills, life skills, and personal and interpersonal skills (Prajapati et al., 2016; Deba et al., 2014). It will help teachers to approach the curriculum and strategize ways in which learners can develop an understanding in the most efficient way.

As highlighted, Tanzania lacks a policy framework to support technology integration in education; teachers' ability to use technology for instructional purposes as well as their capacity to explore the use of technology beyond the basic application, is limited (Okojie et al., 2006). Implementation of this model is predicted to maximize Tanzanian teachers' pedagogical

knowledge and competencies and hence enable teachers to make better decisions when selecting and forming teaching approaches that can be effectively operationalized. Also, the model will support the development of a useful heuristic for teachers to examine relevant technologies which are compatible with their teaching plans and learning outcomes (Goswami, 2014). Furthermore, it aims to inspire policy makers and education practitioners to engage the model when developing education policies and strategies to guide technology integration in the classroom specific to Secondary Schools. It will serve as a guide for the Tanzanian Ministry of Education and Vocational Training (MoEVT) to revise the technology integration practices in Secondary Schools and adopt pedagogical approaches that are relevant to technology use in order to improve teaching effectiveness (Chalich, 2015).

1.10 Research Questions

The focus of this qualitative study is developing a synthesis of theoretical and pedagogical evidence underlying a technology-based teaching model, for use among Secondary Schools in Tanzania. Its main concern is to elicit teachers' and students' individual experiences regarding pedagogical tools and teaching practices which are effective in a technology-rich environment and blend this with relevant educational theory to develop a robust theoretically informed and evidence-based model to guide technology integration in the education process. The study is not entailed to investigate any relationship between variables rather its purpose is to explore knowledge that can further be tested quantitatively as part of further research (Kabir, 2016). In this regard, the study was not designed for hypothesis testing rather it attempted to find answers to the following questions.

Q1. What are the pedagogical tools and practices documented in the literature that are relevant for technology-based learning?

Q1. What technology-mediated teaching approaches are used in Tanzanian Secondary School?

Two sub-questions are identified:

- How do the identified teaching approaches relate to pedagogical practices of teaching and learning?
- How do the teaching approaches influence the pedagogical practices of teaching and learning?

Q2. What are the pedagogical barriers (as experienced by both teachers and students) hindering technology integration in the classroom?

Q3. How can the pedagogical barriers be eliminated in the technology-based teaching environment?

Chapter 2: Literature Review

2.1 Theoretical and Conceptual Framework

2.1.1 Field Industry Description

Research studies must be supported by a theoretical framework to help specify the key variables that influence the phenomenon under investigation (Adom et al., 2018; Akayoğlu, 2019). In this study key issues were explored through a multi-theoretical framework to model multiple facets of education practices in order to recommend pedagogical practices which are relevant to technology-based education (Li & Wang, 2012). According to Sudhanaet al. (2019), integrating multiple theories in research increases explanatory power; hence, it helps to attain improved insight intoa phenomenon. The existence of similarities and interactions of constructs between theories makes the basis for integrating multiple theories in research.

2.1.2 Multi-Theoretical Framework for Learning

Benetti (2009), Mouza (2018) and Thomas (2017) refer to theory as a set of logical principles or relationships about the subject which seeks to describe a phenomenon and provide predictive utility in a systematic way. Learning theories are used to improve the learning design and teaching practice. In this study, multiple theories of learning are drawn together to help describe how the knowledge is conceptualized during the learning process (Carwile, 2007; Picciano, 2017; Rasmussen, 2017). Siemens (2005) pointed out that learning must be supported by underlying theories which describe the relevant learning principles and processes to reflect the social environments and learners' needs which are being investigated.

In accordance with the problem analysis and study objectives, the study was underlain by the Grand Theories of Behaviorism, Constructivism, Cognitivism, and Humanism and the contemporary theory, Connectivism. These theories differ in how they predict the learning

process and aspects (Filipatali, 2013). However, the best theoretical perspective can determine the effective teaching; instructors must combine learning theories, teaching approaches and technologies to design and deliver effective learning. Specific for this study, if any one of the five theories is abandoned or isolated, it will lead to incomplete learning outcomes (Guey et al., 2010).

Behaviorist theory foregrounds measures to stimulate responses; on the other hand, cognitive theory places emphasis on the mental activity of learners (Capacho, 2018; Filipatali, 2013). Cognitivism acknowledges the importance of reinforcement although it stresses the correctness of responses (Mergel, 1998). While in the behaviorist and cognitive approaches evaluation is based on meeting specific objectives in the constructivist approach evaluation is subjective. Humanist theory is largely based upon constructivism; this is because the learner's freedom promotes knowledge construction (Akhigbe, 2019). Connectivism is viewed as an updated version of constructivism and is applied to the current scenario of the use of technology in education, as it focuses on the ability of learners to construct knowledge across a network of connections (Herlo, 2017; Mattar, 2018). Figure 2.1 represents the theoretical framework for this study; it describes how each theory is articulated in relation to each other through the use of tools and practices to form a relevant pedagogy for technology-based learning.

2.1.2.1 Behaviorist Approach

The main contributors of behaviorist theory were Pavlov, Watson and Skinner. Skinner's concern was focused on human behavior and his environment (Amutan, 2014); he pointed out that a measurable learning outcome is only possible if a learner's behavior is changed (Skinner, 1971). Behaviorist approaches demand instruction that promotes learners with appropriate stimuli which provide opportunities to demonstrate the learner's desired behavior in order to

prove that learning has taken place (Kelly, 2012; Keramida, 2015). According to Mödritscher (2006), in the behaviorist approach the learning outcome should be clearly explained to allow learners to focus on the expectations in order to determine their learning progress.

Regardless of the environment, human behavior forms part of actions and reactions (Keramida, 2015); therefore, some elements of behaviorism are still crucial in the modern teaching. In this regard, it is essential to consider behaviorist principles when designing pedagogy for technology-based education. According to Siau et al. (2006), embedding technology into instruction stimulates learners' responses; it supports immediate feedback thus, reinforcing learners' behaviors. Technologies such as interactive web-based tools can promote development of more cohesive activities which can impact learner's behavior and promote academic achievement (Faryadi, 2007). Technology can also enable instructors to design assessment tasks in a variety of ways. Amua-Sekyi (2016) pointed out that assessment is an integral part of the education process; it affects how instruction are given and consequently, how students learn. Rewarding students for doing better can make student to strive for better work. In this regard, designing activities such as test and quizzes can positively or negatively reinforce individual stimuli which increase or maintain individual behavior. For example, in a grading system, good marks can positively reinforce learners while poor marks can negatively reinforce learners. Negative reinforcement is essential for promoting learners to express more effort in order to improve their performance. Positive reinforcement encourages learners hence give more attention while working on classroom assignments thus help their progression.

2.1.2.2 Constructivist Approach

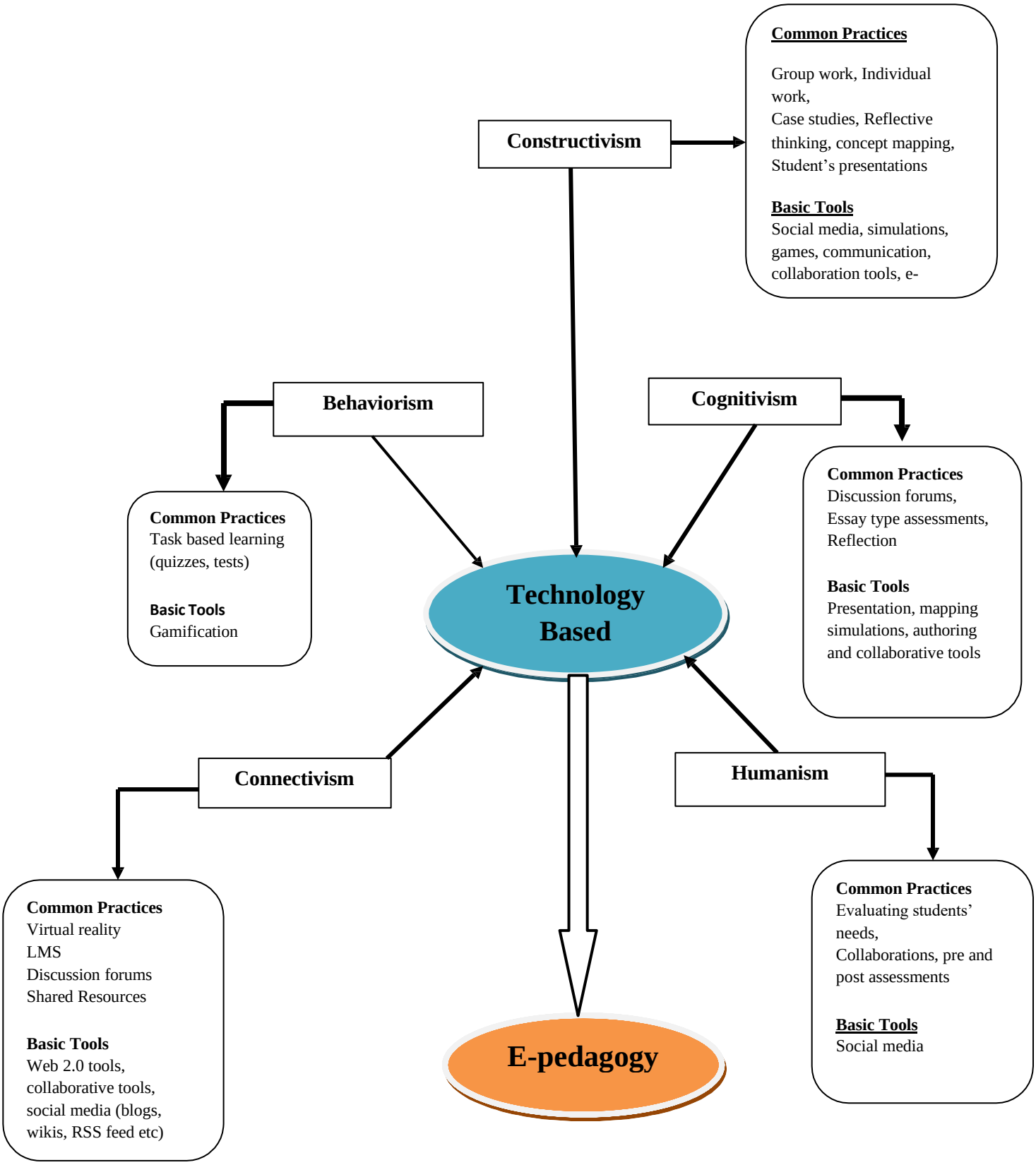
Jean Piaget, a founder of the constructivist approach, defined knowledge as something that is actively constructed by the mind and not received from a source (Hruby & Roegiers, 2012); his

theory and constructivist perspective is based on fundamental constructivism, which focuses on integrating individual cognitive processes with social interaction (Bozkurt, 2017). In this respect, the social aspect of learner interaction helps the growth of the individual aspect of knowledge creation.

Constructivist principles are ideal for application to technology-based education which demands for the creation of learning activities that allow learners to actively participate in learning which increases their ability to contextualize subject content. According to Mödritscher (2006), using modern technological tools promotes students' activeness through the creation of high-level activities that helps learners to interpret learning content and promote learners' collaborations. Application of technological tools such as simulation, collaboration and games can support learners to work in groups, make presentation and concept mapping as well as reflections which enhance construction of meaning. Beside this, using technology as constructivist tool can aid students to present their ideas and articulate their prior knowledge, experience and competence hence make new meaning. In this regard, technology has a potential to interpret information from prior knowledge, accessing new information or obtaining additional information necessary for comprehending the existing knowledge (Isik, 2018). It can encourage knowledge construction by creating activities that are socially situated.

Figure 2.1

A multi-theoretical framework for e-pedagogy



2.1.2.3 Cognitive Approach

Lev Vygotsky is among the founders of the socio-cultural theory of cognitive development; Vygotsky (1978) emphasized the role of social interaction in the development of cognition; Vygotsky believed that community plays a central role in the process of creating meaning. In the cognitive approach, social learning precedes individual development (Dagar & Yadav, 2016; Adams, 2006; Bozkurt, 2017). According to Filipatali (2013) and Kim (2001), learners construct knowledge through social interactions and utilize cognitive tools to impose meaning. The most popular theory for cognitive development was created by Swiss psychologist Jean Piaget. He was a constructivist who believes that learning is caused by a combination of both assimilation and accommodation processes (Kurt, 2021). According to Piaget (1977), instructors must make special efforts to provide opportunities to explore a variety of experiences in order to assimilate new information with previous knowledge (Piaget, 1971). Piaget asserted that learning development requires the changing or modifying of the structure of previous knowledge to accommodate incoming and new information. However, knowledge growth and development must balance in order to create new reasoning patterns (Babaee & Khoshhal, 2017; Lefa, 2014).

The emergence of digital technologies has increased the possibility to apply cognitive principles in the technology-mediated learning environment. It enhances the learning experience and makes learning easy and enjoyable (Ratniece, 2018). Greitzer et al., (2003), Swann (2013) and Ratniece (2018) suggested that tutors must design the learning content that relates to the learner's experience when applying cognitive approaches. Contents should be organized from simple to complex concepts; problem centered and interactive to encourage active construction of concepts to help build memories and deepen understanding (Greitzer et al., 2003; Swann, 2013; Ratniece, 2018). According to Wysocki (2007), cognitive practices should include a practical form of enquiry; this is essential in promoting critical thinking.

Beside this, activities such as essay type presentations and discussion forums are the main channels to support information exchange among the learners; learners can generate knowledge within the forums from different perspectives (Galikyan et al., 2021). When students interact, they present cognitive engagement as they make a mental effort to engage with the learning resources. According to Kew and Tasir (2021), technology application has facilitated higher level of cognitive engagement which leads to higher thinking capacity among learners.

2.1.2.4 Humanist Approach

Abraham Maslow is one of the pioneers of the humanist approach; Maslow (1943) proposed a hierarchy of human needs in motivating behavior; he believed that humans achieve their full potential when their human needs are fulfilled. According to Maslow (1962), the development of a person as a whole; balancing intellectual and emotional components; and intentionality and values of people actions are the important principles of the humanism approach. Maslow views learning as a personal act to fulfill learners' potential; he examines how the learning process can cause lifelong personal growth and development (Maslow, 1962).

The humanist approach promotes students' involvement in the learning process hence its principles are still valid and can add value to technology-based education (Javadi & Tahmasbi, 2020). Firdaus and Mariyat (2017) pointed out that modern technological tools promote creativity, planning, self-awareness, decision making and responsibility. They enhance creative characteristics, openness, flexibility, personalization and comfort which are important elements in humanism. Applying modern technology improves the teacher's ability to reinforce learner activeness and enables tutors to design activities that are linked to learners' lives and experiences; these activities attempt to engage the learners effectively through excitement, emotion, or even fun (Bykov & Leshchenko, 2016; Javadi & Tahamsbi, 2020). Beside this,

technology can shape pre and post evaluation and assessment for learners; this enables individuals to learn as they satisfy the self-actualization needs (Sanmugarevathi & Iyer, 2020). According to Singh and Malika (2021), appropriate use of social media sites such as Facebook, YouTube, or Flickr, for supporting learning is an effective approach to promote human dignity which enhances learner's academic performance; it encourages discussion of topics hence contributes to the knowledge gain (Morah & Duru, 2018). Technological tools provide freedom and autonomy to learners which help to improve knowledge gain among learners through fulfillment of other needs.

2.1.2.5 Connectivist Approach

Connectivism is the learning theory developed by George Siemens and Steven Downs. According to Siemens (2005), knowledge does not only reside in the mind of a learner it is distributed across a network; this means knowledge resides in the diversity of opinions and it involves connecting information sources which are beyond the individual levels. The central tenant of connectivist theory is its emphasis on the learner obtaining the current, accurate and up to date knowledge (Siemens, 2005; Kop & Hill, 2008).

Technology plays an important part in distribution of knowledge across information networks and can facilitate information storage in a variety of digital formats (Banihashem & Aliabadi, 2017; Kop & Hill, 2008). Learners are responsible for locating information, determining its sources and sharing the information through available connections. Mattar (2018), Herlo (2017) and Bell (2019) argued that connectivism theory addresses the learning that occurs outside the learners and considers the learning process which is manipulated by technology hence its best fit with technology-based learning. Furthermore, emerging technology such as web 2.0, artificial intelligence, video conferencing, social media and RSS have facilitated collaboration and

communication practices in the education process which enabled acquisition of knowledge within and across the networks.

2.1.3 Conclusion

This theoretical framework design has gathered a wide range of education principles from the five selected theoretical approaches. The contribution and implications of each selected theory to learning design was identified. However, each theory has its relevance as well as limitations; in this study the limitations of one theory were addressed by another theory. According to Ahlbrand (2017), behaviorism and cognitivism theories are better approaches for beginners while constructivism is appropriate as the learner moves to more advanced levels; in this case, the status of learners is an important aspect to consider when applying these theories. In this study, humanism approaches were used to supplement the behaviorist approach by emphasizing the personal worth of the individual (McLeod, 2020). Connectivism approaches encourage the use diverse opinions when constructing knowledge; addressing issues of knowledge transfer and management (Utecht & Keller, 2019; Siemens, 2005). These theoretical principles were considered to be relevant in developing this pedagogical model.

Table 2.1

Comparison of the Learning Theories

Theory	Contribution/Implication	Strengths	Limitations
Behaviorism	- Creating favorable environment can affect particular individual/learner and advocate acquisition of knowledge. - Learning occurs when there are factors that reinforce behavior either positively or negatively.	- It is easy to determine the environmental conditions that can best suit the learning and reinforce environment that are effective for particular individual - Educators can easily identify instruction strategies that are most useful in building certain responses that reinforce acquisition of higher-level skills.	- Best suits traditional way of teaching whereby instructors' belief in the concept of rewards and punishments - It does not promote critical thinking - Learning occurs only when there is an incentive
Constructivism	- Learning should be designed in such a way that it gives learners possibility for engagement in real world situation. Tools to enhance communication and access to real-world must be integrated. - Creation of learning environment	- Different from behaviorism and cognitivism, constructivism considers both learners and environment as critical factors for knowledge creation. - Constructivism emphasizes critical thinking for learners	- Different from behaviorism, constructivism theory focuses more on individual learners, not paying sufficient attention to environment (Gojkov, 2011).

	that is student-centered, collaborative, supportive and authentic task based.		
Cognitivism	- It focuses on efficient processing strategies different from behavior which focus on environment design. - Creation of environment that influences problem solving skills and promote development of mental skills.	- Focus on the use of human memory for storing and use of knowledge - Emphasize critical thinking hence it is appropriate in explaining complex forms of learning. - Promote, reasoning and problem-solving skills	- Different from constructivism whereby meaning is created from within individual experience and competence, cognitivism consider knowledge to be created from external environment
Humanism	- Emphasizing consideration of humanism care to create favorable learning environment. - Creating harmonizes relationship between instructors and learners can promote student active learning.	- It considers human potential for growth - Promote learner-centered approach thus encourage students to develop self interest in learning.	- The focus of humanism is individual development the approach is less competitive.
Connectivism	- Educators must consider diverse opinions that do not only reside on	- Complex learning can occur from diverse learning sources (Banihashem &	- Some contents might be irrelevant; there is a possibility for learners to

	individual's mind but also the knowledge that resides in a distributed manner across a network (Herlo, 2016). - Learners must be trained to identify relevant network for information gathering	Aliabadi, 2017). - Learners can acquire skills required in this era such as teamwork, communication, personal management skills etc. - Provide flexible learning time; learners can connect with others to find solution to particular issues at any time	access insufficient resources.

2.2 Learning Concept and Teaching Techniques

This section reviews a range of sources which discuss the concept of learning and teaching approaches which are inclusive of strategies and intentions portrayed through technical aspects of practice; it starts by exploring the meaning of learning and how people learn. Four learning delivery modes known as (1) face-to-face, (2) blended learning and (3) Online/distance learning are described; the benefits and drawbacks of each delivery mode are discussed. Further, two approaches to teaching which are teacher-centered and student-centered are discussed followed up by a discussion on learning strategies specific cognitive and metacognitive learning strategies in the last part of this section.

2.2.1 Understanding the Concept of Learning

The concept of learning is very important in human life as it affect human development; intellectual skills, decision of making right or wrongs as well as other concepts such as justice or sense are developed through learning. In this respect, learning is considered as a broad team; it involves acquiring new knowledge or experience that leads to a change of understanding. It is a process by which individual gain a variety of competencies, skills and attitude/behavior either in formal or informal way. In 1976, two Swedish theorists Saljo and Marto (1976) defined learning as the process of creating personal meaning and applying that meaning to the real world. Learning is a never-ending process as it starts from birth and continues throughout an individual's lifetime (Dharmaraj, 2015); learning started before establishment of schools, and it will continue outside the school setting. It involves the permanent change of behavior as a result of individual understanding, experience or conceptualization of the world around them (Behlol & Hukam, 2010). However, availability of other human basic needs such as food, security, self- respect, self-esteem and intellectual curiosity cannot be ignored for learning to occur. In addition

to this, instruction activities which are based on learners perceived needs is vital for the learning process (Behlol & Hukam, 2010).

Ference Marton and Roger Säljöfirst articulated the concept of student approaches to learning which explains the relationship between the learning process and students' level of understanding of the reading materials (Saljo & Marton, 1976). They described two approaches to learning which could be related to differences in the processing of information, surface level processing and deep level processing (McLoone & Oluwadun, 2014). In surface level processing, the student is concerned with the memorization of text and not necessarily understanding the concept while in the deep level processing the student is an active participant in attempting to understand the line of reasoning and arguments given by author (McLoone & Oluwadun, 2014). Marton's (1997) study reveals a hierarchy of conceptions of learning and six categories; these are (1) increasing in knowledge; (2) memorization and production of new ideas;
(3) application of knowledge; (4) understanding of hidden meaning; (5) approaching things differently; and (6) developing individual change. Beside this, teaching is not complete without learning hence before engaging in learning it is vital for teachers to understand the concept of learning and its relationship to understanding i.e. to understand its meaning and how the learning occurs (Sequeira, 2012). Further, learning is not limited to the formal education context; it occurs in our everyday life whenever there is an adaptation of new environment that results into modification of individual knowledge and understanding, or behavior.

Definitions of learning vary substantially across disciplines, driven largely by different approaches used to assess its occurrence. It is based on particular metaphors, such as 'acquisition' and 'participation' (Sfard, 2014). Dharmaraj (2015) defined learning as an act of gaining knowledge, experience, values and skills that help individuals to recognize new ways of

doing things; it is an increase in knowledge, through experience or ability to attain goals. Qvortrup (2016, p.189) viewed learning as "a process of gradually becoming part of a new disciplinary community which involves a gradual enculturation into the disciplinary discourse and thereby imply identity changes". This concept was originally developed by Lave and Wenger in 1991 who defined learning as a property of a kind of community; it is an inherent and social aspect of individual participation in a community of practice (Lave & Wenger, 1998). Sequeira (2012) has defined learning as a process of developing knowledge of a particular topic or skills using a variety of methods from listening, watching, questioning, reading or doing. Similarly, Houwer et al. (2013) and Malemed (2019) have defined learning as a relatively permanent transformation of individual behavior resulting from experience gained. Dharmaraj (2015) pointed out that the changes resulted from learning are permanent and can be intentionally brought about when attending a course, reading a book or discussing a topic or unintentionally without planning depending on a practice and experience in a given situation or environment. In this respect, it is correct to say that learning is the process of acquiring new understanding which occurs though constantly interaction with environment; the interaction influences the changes in skills, increase in knowledge, habits, attitudes, interests and other personality characteristics (Saljo & Marton, 1976).

Learning can help build individual capacity which contributes to the development of the society; it helps the society to transmit culture and transfer knowledge from one generation to another. Learning prepares individuals for life experience; it polishes individual mind, reinforce thought and enhance individual behavior. Through learning individual can distinguish bad and good hence leads successful and meaningful life (Bano, 2015). In this regard, it is necessary for each society to understand the objective of learning in order to attain complete individual transformation, improve life quality hence achieve growth in knowledge-based society.

2.2.2 Learning Delivery Modes

A reasonable time is needed to gain a deeper understanding of subject content, and to sustain and control the acquired knowledge in order to make sense of its application to new situations and be able to solve problems (Kapur, 2020). Kolari et al. (2008) pointed out that in order for optimal learning, adequate time and effort to study are required to achieve the intended learning outcome; individuals need days, months or even years to acquire a certain skill. However, effective delivery of learning can promote students' achievements. Learning delivery comprises of the means and resources used to structure the learning experience; it involves strategies through which knowledge, skills, attitude, ideas, beliefs and values are delivered to learners by instructor to ease the learning process (Ukor, 2018). There is a continuum of forms of delivering learning; these include face-to-face to fully technology driven distance learning, and in between a blended approach. In the following sections, each form of learning delivery is evaluated based on how it can potentially influence student learning (Baragash & Al-Samarraie, 2018).

2.2.2.1 Face-to-Face Mode of Delivery

In the face-to-face mode an instructor delivers the subject content to a group of students in a classroom environment (Alsaaty et al., 2016). It is a form of learning where instruction is delivered in person to a group of students in a set place at a set time; it combines different ways of learning through activities including writing notes, peer discussion, group work and direct instruction from the teacher (Baragash & Al-Samarraie, 2018). Face-to-face learning has been the primary teaching context for many years where learners and instructor interact in person at specific location in a given time (Ortega-Maldonado et al., 2017). In the face-to-face mode learners can ask questions while being taught and the instructor can confirm that learners have understood the concepts before moving to the next section (Alsaaty et al.,2016).

Face-to-face mode of delivery is a long-established approach to engendering learning which has been used in many schools for many years due to its potential benefits. According to Banna (2014), social interaction is essential for any aspect of being human; an in-person environment creates more opportunities to learn (Vygotsky, 1978). In the face-to-face classroom, teachers are allowed to commit their time for a specific duration, define the structure of the course, students are taught in a single physical location, and the instructor can respond immediately to questions (Graham, 2019). With this approach only the instructor can transmit knowledge to students; students have very little input to the instruction process (Kemp & Grieve, 2014). In this approach, instructors feel more comfortable and confident when using the face-to-face mode of learning delivery. Physical proximity between students means they can gain new ideas from their teacher and are able to seek clarifications in the areas that they do not understand (Kemp & Grieve, 2014). According to Banna (2014), behaviour and body language has a power to generate rich data and memorable experiences; this includes voluntary and involuntary human actions, language and tone which make the entire process to be seen and felt. In face-to-face learning, delivery mode responses, relations, and interactions are common in an in-person environment; therefore, individual experiences can add value and positively contribute to the teaching and learning process. Bejerano (2008) and Liu and Long (2014) argued that formal lectures and presentations delivered in the face-to-face learning delivery mode enables students to relate directly with their teachers hence increase their confidence level.

Despite the many advantages that face-to-face delivery possesses, there are some associated drawbacks. Students are required to schedule their time to match with their school timetable; their physical presence in class contributes to their performance progress (Hendricks, 2018). In addition to this, learners are always dependent of their instructors in every study related matter, which provides less thinking space for students; this suppresses student's creativity and

innovations (Liu & Long, 2014). According to Hawi and Sudira (2019) and Liu and Long (2014), in the face-to-face mode resources are limited to those identified by the teacher in the class; other potential resources available outside the classroom are not given priority. Hugely expensive fees are associated with campus-based teaching (Rosen et al., 2007); hence it requires higher investment in learners to attain a qualification. Due to the shortcomings associated with this mode of learning delivery, educators proposed a new way of teaching delivery known as blended learning in order to correlate with present technological development (Lalima & Dangwal, 2017; Jackman, 2018). This new learning delivery mode enhances and complements the face-to-face mode of learning delivery through communication tools, learning resources and assessment tools which lead to the reduction of time students need to accomplish activities (Baragash & Al-Samarraie, 2018).

2.2.2.2 Flipped or Blended Learning

The proliferation of instructional pedagogies has created changes to the traditional face-to-face learning environment; the development of digital technology has influenced the paradigm shift in education delivery (Jackman, 2018; Caner, 2012). According to Jackman (2018), blended learning has become the major trend in contemporary education. Both Eastman (2015) and Baragash and Al-Samarraie (2018), explain that blended learning delivery integrates different teaching strategies; it combines face-to-face methods and digital learning tools to create a learning environment that promote students' motivations and encourages self-learning. It combines the face-to-face elements, such as classroom lectures, laboratory sessions with online based elements such as narrated presentations, video or online discussion boards. Similarly, Bryan and Volchenkova (2016) defined blended learning as a delivery mode that is facilitated by a mix of varieties of learning delivery modes; it combines in-person learning strategies at one end and technological tools on the other. The combination of different pedagogical approaches

produces optimal learning outcomes (Caner, 2012). Another scholar, Beaver (2014) defined the blended form of delivery as a form of education delivery which utilizes technological tools to facilitate student self-learning and a supervised physical classroom environment on campus in order to provide an integrated learning experience and enhance student performance. Blended learning uses technology to combine on-campus and off-campus learning practices. The best technology-based methods are combined with the techniques used for classroom instructions to improve students' performance (Hawi & Sudira, 2019).

This delivery form promotes student autonomy to access learning resources and provides an environment for student interactions which promotes critical thinking and unleashes individual student experiences (Baragash & Al-Samarraie, 2018). For example, a teacher may teach students in class and use the LMS to facilitate out of class learning. In this approach of combining the traditional approach and digital technologies learners are given the instruction they need, and at the time they need (Nazarova, 2019; Hill, 2018).

Flipped classroom is one form of blended learning which has shifted the classroom from passive to active learning. This delivery mode replaces in-class teaching with homework assigned to students as reinforcement; this facilitates student's individual learning and helps develop problem-solving skills (Urfa, 2018). It allows students to watch online lectures, collaborate in online discussions, or carry out research at home and take notes of what they do not understand and discuss with teachers during in-class sessions (Ozdamli & Asiksoy, 2016). This delivery mode has transferred the teacher's responsibilities to students.

With blended delivery, students gain advantage of digital tools without losing the social interaction element and human touch (Lalima & Dangwal, 2017); interaction between students

and instructors is also enhanced through the application of modern technological tools such as online discussion forums, video conferencing tools, games, and using mobile technologies to engage with students (Hunt, 2012; Oye et al., 2012). The blended mode of delivery aids the face-to-face delivery mode which results in high levels of student achievement (Szadziewska & Kujawski, 2017); the method is considered to be superior to traditional face-to-face delivery mode because it has a potential to accommodate different learning strategies to effectively reach students individually and create student inclusion which enhances the quality of learning and improves students' level of understanding (Lalima & Dangwal, 2017; Bryan & Volchenkova, 2016; Hawi & Sudira, 2019). It exploits the benefits of face-to-face mode of delivery and technology-based learning (Chen & Lu, 2013); the combination of face-to-face and technology-based learning helps schools and institutions to meet the learning goal, as well as to support teachers and students to achieve their learning outcome.

Besides many advantages, blended delivery mode of learning has potent disadvantages especially with regards to the technical aspects; this delivery mode strongly depends on technical resources or tools for delivery of blended courses. It requires a robust Information and Communication Technology (ICT) infrastructure and tools which are reliable and up to date as well as competent ICT skills of both students and teachers (Liu & Long, 2014; Chen & Lu, 2013; Hunt, 2016). The instructor workload is increased especially at the early stage of blended learning; also, balancing between online and face-to-face time is another challenge (Hunt, 2016; Priscila, 2020). Further, many students are still struggling with time management and self-discipline, making them less than ideal candidates for courses that are flexible and include online instruction (Chen & Lu, 2013).

2.2.2.3Online/Distance Learning

Online learning is a type of learning which is designed to reach and engage the learners on individual basis at any time or location over the internet (Adebo, 2018). It is a form of distance education enabled by technological devices used by learners residing at different location with their own settings away from the main education source (Meşe & Sevilen, 2021). It involves the use of Internet and other important technologies, whether in full or in part, to produce learning content, facilitate course delivery and interaction between students and instructors (Arkorful & Abaidoo, 2014; Goyal, 2012). Online learning relates particularly to internet based flexible delivery of content and programs that focus on awarding a certain qualification to an individual. "It encompasses a range of technologies such as worldwide web, email, chat, news groups and texts, audio and video conferencing delivered over computer networks to impart education" (Dhull & Arora, 2019 p.32). Online learning offers the ability to share contents in different formats such as videos, text and audio. Other option includes conducting live online classes (webinars) and communicating with tutors via chatting tool and online forums. These can be managed using an online management system, which allows for course content to be delivered as well as to conduct online assessments. Online learning enables learners to learn at own pace, according to their own convenience and encompass a range of technologies such as the World Wide Web, email, chat, audio and video conferencing (Dhull & Arora, 2019)

On the other hand, distance learning is an older term which refers to the interaction between learners and instructors at a distance (Santiago et al., 2022); this can utilize combination of technological correspondence such as video conferencing, online discussions and emails or any other means to deliver the education contents (Adebo, 2018). The history of distance education spans almost two centuries and this time period represents significant changes on how learning occurs and is communicated (Moore et al., 2010). Initially, postal services were used to facilitate

distance education services, but later on, education institutions started to rely on media such as radio and television to broadcast the education contents to more public beyond traditional contents in a print form (Abdrahim, 2018). Emergence of computers and internet introduces the new option for instruction delivery of distance education. Later on, modern technologies such as audio conferencing and videoconferencing technologies have now become the media for supporting distance learning (Abdrahim, 2018). With technology development a newer or improved version of distance education known as "online learning" was established. Online learning can be of two forms that is fully online course – most of its teaching and learning activities are carried out online or partially online course – integrates some traditional elements of teaching and learning with online elements (Dhull & Arora, 2019).

The changing nature of both student body and available technologies has influenced the changes in the teaching and learning approaches and practices. The online learning environments began to emerge, with possibilities for learners to gain access to education contents from available technological resources (Dhull & Arora, 2019; Abdrahim, 2018). Today, education institutions are rapidly adopting online learning mode an alternate or complementary mode of education delivery, and indeed transformed the higher education. This form of education system has greatly impacted higher education across the globe. There are many reasons that account for the increasing growth of online courses and programs as follows:

I. Student Seeking Flexibility

Online enrolments are being driven by the growing number of students who are seeking flexible formats for courses, certificates, and degree programs to support career placement, advancement, and transition as well as to pursue advanced studies (Betts, 2017). A report issued by Global Market Insights in September 2017 found that the online learning market, already estimated to be

worth 150 billion US Dollars in 2016 and will grow at a rate of over 5% annually between 2017 to 2024 (Etherington, 2017). This implies that many students prefer a kind of learning which involves mostly online components as a result of continued decline of face-to-face learning environment. At the same time, many state institutions are unable to accommodate all those who want to take classes on campus, escalating the demand for online learning (Snyder, 2013).

II. Career Motivation

The majority of today students are enrolled with their career motivation in mind, so they also have ability to choose their learning approaches. Online courses are very attractive to individuals who are working because individuals can acquire certain qualifications without leaving their job or family (Meşe & Sevilen, 2021). Adult learners who are willing to upgrade their career are much interested in enrolling at institutions that offer fully online courses (Sarbabidya & Shikdar, 2018). This is particularly significant factor for growing of online programs at community colleges.

III. Learner Characteristics

Learner characteristics such as gender, work experience, computer experience and previous experience to online learning are other motivational variables that influence the online learning (Houlden & Veletsianos, 2019). Online education affords greater flexibility; "it addresses the needs for individuals who are location bound due to workforce, family or other responsibilities, needs, wishes and desires" for example individuals with disabilities (Houlden & Veletsianos, 2019 p. 3). This mode of delivery can favour students who wish to study in other country different from their home country hence learning options are not affected by geographical location (Dhull & Arora, 2019). Online learning offers equal opportunities; learners cannot be discriminated based on their gender, sex, race or physical disability because learners are situated

in different locations (Houlden & Veletsianos, 2019). The most obvious advantage of online learning is to ease access to education at student convenience (Wakahiu, 2015); hence, this mode of learning has served to overcome serve to overcome many of the barriers that have made traditional education difficult or impossible for women (Adu-Marfo & Biney, 2017). Given the challenges ahead of women in their family roles (productive and reproductive) online learning offers more opportunities for them to acquire different levels of education while continuing serving these roles. According to Msoffe (2016), establishment on online learning allows the marginalized groups like women and people with disability to access education while at a distance. It enables them to take advantage of learning anytime, and anywhere to implement positive changes in their lives.

IV. Environmental Challenges

Typical distance learners are regular students, but also adults, physically challenged people, and working/business people who are looking for ways to enhance their skills alongside their busy schedule (Houlden & Veletsianos, 2019). Majority of individuals prefer to maintain their professional and familial relationship hence they would like to learn while living closer to their family members and while maintaining their established projects. Online learning has become an alternative mode of learning during the COVID – 19 outbreaks (Yu, 2022; Meşe & Sevilen, 2021); this is due to its advantage of not being constrained by time, geographical location or other environmental factors. Even after COVID-19 pandemic the focus for many education institutions has been to establish online courses (Meşe & Sevilen, 2021).

Fundamentally, online learning is categorized into asynchronous and synchronous (Sentiago et al., 2022; Hrastinski, 2008). In the asynchronous mode, students' learning is scheduled with time; it does not require real time interaction with the teacher while synchronous learning

involves live interaction between students and teachers via modern technological tools (Arkorful & Abaidoo, 2014; Goyal, 2012). In the synchronous online learning mode, the learning resources are delivered and received via mobile, video conference, internet-based conferencing or group chats, emails; this category does not necessarily require real time interaction between students and instructor (Hyder et al., 2007; Hrastinski, 2008). Asynchronous online learning uses technologies such as streaming audio, video, podcasts and discussion forums to deliver and receive learning contents in real time (Yakaraju, 2014; Hrastinski, 2008).

Unlike traditional face-to-face delivery mode, online learning makes learning simpler, easier, and more effective. It accommodates everyone's needs (Arkorful & Abaidoo, 2014); online learning offers individualized instruction which the face-to-face delivery mode cannot. According to Chitra and Raj (2018) and Arkorful and Abaidoo (2014), with online learning it is easier to access information and offer flexibility with respect to time and place. It eliminates the need for the instructor to meet with students at the same place and time. However, there are several downsides in relying completely on technology to learn. According to Chitra and Raj (2018) and Olofintuyi and Kayode (2014), the common disadvantages of online learning are the fact that some participants may be technologically challenged which can constrain them from participating in full; some materials might be incompatible with other systems which can make them inaccessible (Chitra & Raj, 2018). In this respect, there is a real need to build capacity for teachers and students in this new paradigm. According to Kemp and Grieve (2014), relying on the digital environment can minimize personal relationships and inclusion of essential human attributes in the learning process; this can create an uncomfortable communication environment between peers and teachers when practicing online learning. In this case Graham (2019) suggested that in implementing e-learning, instructors must establish learning activities that

facilitates a sense of community; this includes integrating tools to support group work and other collaborative activities.

Plagiarism is also another common practice in online learning; students may be tempted into piracy and plagiarism, they can copy and paste materials direct from a website without acknowledging the author of the content or share their work with their fellows (Lilian & Chukwuere, 2020; Jareb et al., 2018). Ali et al. (2012) and Jareb (2018) suggested that efforts should be taken to instill the realization and understanding amongst the students on plagiarism and how can be avoided; plagiarism detection technologies, academic integrity policies, awareness training and punishment for students who violate policies are vital when implementing e-learning (McCord, 2008).

2.2.3 Teaching Approaches

Over the past twenty years, teaching and learning has changed significantly (Adcock, 2008; Roy 2019; Budhwar, 2017). Technology has provided new tools which provide students with opportunity to interact with each other as well as encouraging collaboration (Budhwar, 2017). In this respect, educators must change the way they teach, and the way students learn in order to improve education service delivery and meet demands for education (Tamhankar et al., 2019). This change promotes a change in focus from teacher to student centered approaches (Schreurs & Dumbraveanu, 2014). The two concepts are discussed hereunder:

2.2.3.1 Teacher-centered Approach

Teachers are the key players in the education process; they are information providers and evaluators of the education process (Emaliana, 2017). Traditional education is routed in the behaviorist approach where different techniques are used to bring students' behavior under

stimulus control (Garrett, 2008; Skinner, 1971). Teachers have been the main source of information in the traditional education context and students are the receivers of the information (Varadarajan & Rao, 2009). According to Trigwell et al. (1999), teacher-centered instruction is also known as a teacher-focused approach. In this approach, the teacher controls the instruction process by delivering the lecture to a group of students sitting in the same physical location at the same time and they learn the same thing (Serin, 2018; An & Mindrila, 2020). The teacher decides the course content, method of teaching, and the type of assessment to employ (Scheurs & Dumbraveanu, 2014; Ahmed & Ain, 2013). The main focus of this instructional strategy is to make students perform well in tests and exams and does not consider student's individual needs (Emaliana, 2017); it can also be used where the resources are limited to allow students to become an integral part of the classroom management (Garrett, 2008). Also, in this approach the learning resources are determined by the teacher, and they are the only person to respond to student's questions based on their own experience as well as to monitor student's progress. According to Muganga and Ssenkusu (2019), in this approach, the teacher's experiences are given priority and not the student's experiences; students are passive receivers of knowledge from teachers. In order to maintain control over students, teachers use instructional methods which pull the students' focus to the teacher's side; these include classroom presentations, handouts, guided discussions, assessment such as class assignments, quizzes and examinations to assess student ability to answer the questions in-line with the contents which were delivered by a teacher during the classroom sessions (Muganga & Ssenkusu, 2019; Garrett, 2008).

The teacher-centered approach is routed in behaviorism and positivist theories of learning; according to Skinner (1971), providing reinforcement could shape individual behavior. In this approach various techniques are used to bring student's behavior under stimulus control when education is teacher-centered (Mpho, 2018); it is positivist because it is assumed that knowledge

stems from human experience (Buchanan, 1998). According to Ahmed and Ain (2013) and Emaliana (2017), this approach is suitable for large classes as it can allow class activities to be accomplished within a short time hence reduces teacher's workload.

The teacher-centered approach is dominated by the use of textbooks; it limits the student's ability to become creative, innovative, problem solver and their ability to make own decision (Serin, 2018). Students miss the opportunity to share their discoveries with their peers, develop collaborations and critical thinking skills. Since teachers are the only knowledge provider, students have less opportunity to think aloud and interact (Emaliana, 2017). Muganga and Ssenkusu (2019) pointed out that educators should place more focus on student-centered learning; this will help to recognize individual learner differences, align the education with the societal needs and enable students to acquire appropriate skills needed in the current job market. Emaliana (2017) and Serin (2018) suggested that both approaches can be used in some stages to enhance both effective teaching and learning at different levels.

2.2.3.2 Student-centered Approach

In face-to-face delivery teachers are actively involved in teaching while learners are passive recipients of the knowledge being presented. Ignoring the student's role in the teaching process is a major drawback in the traditional system of education (Jony, 2016); consideration of students' roles improves the sustainability of education services. Agommuoh (2016) pointed out that the role of a teacher is not only to deliver content but also to create room for students' participation in the education process. Researchers have proven that students tend to learn better when given opportunity to practice what they learn and when they are engaged in the learning process (Jony, 2016). In this regard, traditional education does not fit with the current demands

of digital age hence there is a need for a new teaching environment that is stimulating, challenging and dynamic (An & Reigeluth, 2012; Agommuoh, 2016).

According to Agommuoh (2016), the student-centered approach is a teaching strategy whereby students are given opportunity to participate in the learning process. It demonstrates a range of teaching elements, including interactive discussion, collaborative work, and prompting feedback; student's responsibility is beyond taking notes, listening to instructor's presentations, memorizing content and passing exams rather it is to participate in shaping curriculum and develop their skills (Yeh & Swinehart, 2017). According to Piaget (1971), learning is a transformative process, learners make sense of what they know and progressively develop a new knowledge that is compatible with previous understanding. In this approach, students change from being recipients of subject content from instructors to becoming active participants in the process of creating their skills and knowledge by choosing their learning materials, method of learning, and ways of assessing their learning (Saxena, 2013; Jony, 2016; Schreus & Dumbraveanu, 2014). The student-centered approach considers individual students' differences and their diverse needs hence it is also humanist in nature. This instructional strategy also considers the fact that learners make sense of information differently (An & Mindrila, 2020). It provides opportunity for students to build collaboration and communication skills which are essential and valuable skills in life.

Integration of technology in the classroom has influenced this new instruction strategy by providing educators with essential tools to create learner-centered environments (Saxena, 2013). With technology, instructors are able to create learning experiences which helps to optimize their time, efforts and resources; the instructor's main role remains to focus on guiding and coaching students to attain their knowledge. Technology platforms are used to share students' work and

engage in public conversations; this is application of connectives principle by George Siemens (Utecht & Keller, 2009). However, educators must choose the relevant technology to support each learning objective as well as to building capacity for teachers to help create learning contents that satisfies the current demands of learners within the student-centered context (An & Reigeluth, 2012; An & Mindrila, 2020; Saxena, 2013; An & Mindrila, 2020).

2.2.4 Learning Strategies

Learning strategies are referred as steps taken by learners to undergo the learning process (Shi, 2017); it involves actions taken by learners to solve a specific problem during their learning process (Mariani, 2002). Choosing appropriate learning strategies can enable learners to control their learning and increase their confidence level and motivation towards their learning. Learning strategies differ from teaching strategies as they belong to the learners however, instructor's needs to develop tasks that prompt the use of the strategies (Mariani, 2002). In most cases instructors are the main source of the learning strategies, they design the strategies and dispense to students when it is appropriate. In this regard, according to Shi (2017), instructors should be encouraged to design appropriate learning strategies for students and should orient learners the appropriate use of the strategies (Dinsmore & Fryer, 2019).

There is a wide variety of learning strategies available in the education process; however, students may opt to choose a strategy based on instructional variables such as learner's differences, instruction methods, course schedules, learning technologies, assessment mode, and qualification level (Simsek & Balaban, 2010). Saks and Leijen (2018) classified learning strategies into cognitive and metacognitive learning strategies. The following section presents a discussion on cognitive and metacognitive learning strategies.

2.2.4.1 Cognitive Learning Strategies

The word "cognitive" was derived from "cognition" which means ability to think comprehends and solve problems. Cognitive learning strategies refers to the type of learning strategies that promote individual ability to process information more deeply, transfer and apply information to new situations; this may result into an improved learning (Winn, et al., 2019). Application of cognitive learning strategies improves learner's comprehension when attempting learning tasks; it allows learner to use their brain more effectively. According to Man (2021), enhancing cognitive ability of learners can maximizes the ability of their brain to acquire and process information; this can foster a more conducive learning process. With cognitive strategies learners can better grasp difficult or complex topics (Man, 2021). In addition to this, cognitive strategies encourage learner to reflect on the learning contents so as to obtain better knowledge and understanding on how the knowledge can be applied in the current and future situations. Problem-solving, reflections, visualization and adaptive learning are some of the examples of practices that fall under cognitive learning strategies (Campenhout, 2020; Man, 2021).

2.2.4.2 Metacognitive Strategies

Sometime is difficult to identify between cognitive and metacognitive strategies; Rahimi and Katal (2012) and Jaleel and Premachandran (2016) pointed out that cognitive strategies focus on mental processes such as memory, learning, problem-solving, attention and decision making while metacognitive strategies focus on individual's higher order thinking, where a person has actively control over his cognition process. Cognitive strategies allow learners to engage their mental process in order to create meaning from the world around them, metacognition go beyond this as it deals with the active control of the cognitive process (Jaleel & Premachandran, 2016). Metacognitive refers to the process of monitoring and control of cognitive strategies. Susantini et al. (2021 p.3) has also defined metacognitive strategies as "a set of knowledge that includes

awareness of one's own abilities, strategies about how to learn, and choosing effective strategies according to certain learning conditions". Basically, metacognitive strategies include connecting new knowledge with old one; choosing effective strategies according to the certain learning condition; and planning the learning goal and monitor and evaluate the effectiveness of the selected thinking strategy (Rahimi & Katal, 2012; Susantini et al., 2021).

Metacognitive strategies are important as they help learners to think about their own thinking; this provides students with abilities to monitor and evaluate their progress towards achievement of their learning goal. Students can develop deeper awareness of their learning process and gain control over their learning; this leads to ability for learners to manage their motivations, capacity for self-regulation and to become more independent (Susantini et al., 2021).

2.3 Integrating Technology in Education

This section describes the meaning of technology and how the integration of technology in education has transformed the education system. The section starts by discussing the concept of education technology and its historical development including the affordances of technology in education. Next the potential role of technology integration in education was discussed. Lastly the benefits and challenges of integrating technology in the education process are presented.

2.3.1 The Concept of Educational Technology

The education system is undergoing a profound rapid change; this change is the result of the development of technology and its potential to transform the learning process (Escueta et al., 2017). Delgado (2015) pointed out that the digital revolution has changed the way people communicate to exchange information; this has also changed the way teachers interact with students to deliver content and the process of instructional design and delivery. Today,

governments, institutions, communities and schools consider technology as central to education operations (Escueta et al., 2017). Educators are seeking new and effective ways to design learning; consequently, educational institutions have paid greater attention to selecting and using the relevant technologies to enhance the education system.

The phrase "education technology" comprises of two words which are "education" and "technology". In order to understand the meaning of "education technology" it is important first to understand the meaning of "education" and "technology". Naziev (2017) refers to education as a process of transmission of experience from the previous generation to the next generation. This involves providing individuals with the understanding of what is happening around the world so as to put their potential to the best use in order to produce fruitful results. Lovely Professional University [LPU] (2013) defined education as a means to provide new experience to learners in order to make them adjust according to the environment and to develop their inherent abilities so as to contribute to their family or society. In contrast, technology has been defined as "a manner of accomplishing tasks especially using technical processes, methods, or knowledge" (Isman, 2012, p. 207). It is a systematic use of scientific tools and principles to produce objects or techniques that can enrich human productivity; the application of these tools and principles affords solutions to problems and helps to attain specific goals (Carrol, 2017; LPU, 2013). Similarly, Brückner (2015) and Kurt (2017) defined education technology as the process of facilitating learning practices through appropriate use of technological tools and resources. From the definition of the two terms, we can simply define education technology as an integration of scientific application tools and principles for management and administration of education system. It involves the use of combination of computer hardware, application software's and internet to maximize the learning experiences (Goswami, 2014). Educational technology places emphasis on communication and approaches to teaching and learning using modern scientific

tools; it utilizes modern technology to improve education through identifying individual needs; adapting technology in the teaching and learning process; and evaluating students' performance (Salavati, 2016).

2.3.2 Educational Technology Milestones

The education system has passed through a number of delivery stages from oral communication to audio visual and network resources populating the classroom (Del-Campo et al., 2012). The development of each stage was a result of the effort to improve the education services by educators and policy makers who have been working to identify the existing gaps in curriculum; teacher's pedagogical knowledge; student's needs; and classroom environment (Tomei, 2010). However, according to Koh and Lim (2008), a good education system is the one which is open and inclusive and aims at improving learner's characters. However, the main duty for educators is not only to recommend ways to fill the gap using the emergence of modern technological tools but also to adopt technology which can create an open education ecosystem that can improve learners' experiences. Before describing the history of education technology, it is good to understand the changes that have occurred in the education system.

2.3.2.1 Phases of Education Transformation

Global changes in social and economic development raises the need for new skills; this leads to the development of an education system as a way to leverage and contribute to the growing needs of individual's critical skills (Aslan et al., 2015). The earliest forms of formal education were implemented through oral communications; students listen to teachers and comprehend the information through listening and meditations (Kapur, 2018). This was followed by the introduction of written documents (Clayton, 2019); at this stage analytics, critical thinking and reasoning was emphasized than oral communication. In the 15th century, Johannes Gutenberg

invented the printing press which brought about changes in the education system by creating the possibility of faster and simultaneous transfer of written information to many people (Matković, 2002; Koh & Lim, 2008). The development of reliable railway networks, roads and postal systems resulted in the emergence of the formal correspondence education (Bozkurt, 2019; Anderson & Simpson, 2012). The concept of distance learning emerged at this period (Koh & Lim, 2008); initially, distance learning relied on the postal services and other transport systems but later, Open Universities transformed the printing contents through the integration of learning activities developed through print media (Bozkurt, 2019). The emergence of radios and television enhanced communication and interaction hence it became the central means of delivering learning contents to large audiences (Anderson & Simpson, 2012; Bozkurt, 2019).

In the early 90's, the virtual learning environments began to truly thrive; the capacity offered by technology made interaction become the central focus (Bozkurt, 2019). People were able to gain access to a wealth of online information through the Internet. Video and audio teleconferencing was used extensively to extend communication and shift focus to social construction of knowledge (Anderson & Simpson, 2012). The use of e-books is now overtaking the use of normal textbooks; electronic devices such as mobile phones, tablets and laptops are used to handle hundreds of electronic resources for delivering reading materials in a form of text, audio and video. Media sites such as Twitter, Facebook, and Instagram are used to organize group work which helps students to build their peer community (Krach, 2017). Interactive whiteboards have replaced the chalkboard and schools are investing in augmented and virtual reality (Zimmerman, 2018). Further, the use of new teaching and learning formats such as LMS, video assisted tools, gamification tools, and big data to improve education through making new discoveries about learning, smart classrooms equipped with a specialized software including

smart boards, assistive listening devices and audio/visual capabilities; and learning analytics is taking education into a new shape (Bui, 2020; Zimmerman, 2018)

2.3.2.2 Development of Educational Technology

In the normal practice, human beings are always striving to discover new things (Briggs, 2014); as soon as they discover new ideas, they share the idea with others in order to move to the next achievement. According to Raja and Nagasubramani (2018), Garcia-Huidobro et al. (2017) and Means (2010), the changing nature of both the student body and availability of modern technologies has compelled educators to change their teaching approaches in order to prepare students to meet the demands of the 21st century job market. The development of education technology was fueled by knowledge economy, the need for new skills, and revolution of ICT (Koh & Lim, 2008).

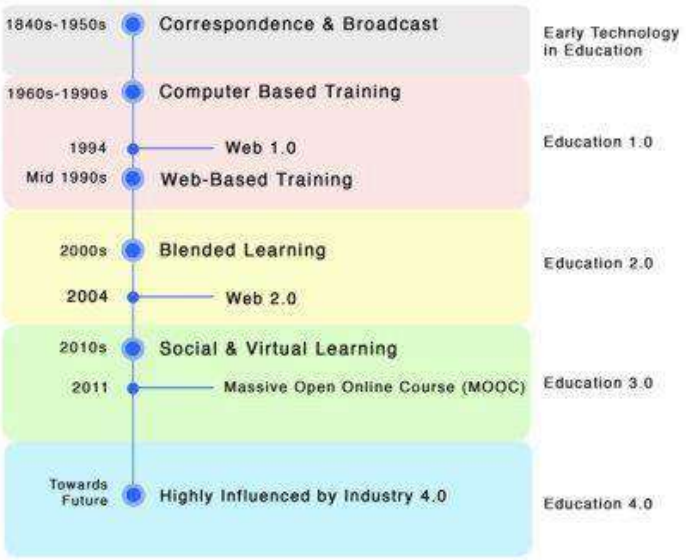
The development of education technology became visible in the US training of soldiers; training films were used as a teaching tool as well as other mediated materials (Goswami, 2014). The use of aids like charts, maps, symbols and models were later introduced followed by the electronic revolution with the introduction of sophisticated software and hardware (Bozkurt, 2019). Projectors, radio and televisions as well as other sophisticated equipment for effective presentation of instructional content were also used to support the education process (Koh & Lim, 2008; Bozkurt, 2019). Computer-based training with multimedia started to emerge in the 1980's to 1990's; in this period educators believed that students could learn better through animations, listening to audios or watching video clips (Leinonen, 2005). In the mid 1990's, the internet became the main communication medium; this brought a tremendous impact in education technology (Koh & Lim, 2008); digitization of textual contents to digital form including audio and video were shared using computer assistant instruction. The explosion of

internet services resulted into digital revolution; the internet facilitated the development of a new approach to learning known as e-learning which consisted of collaborative learning, multimedia technology, social networking and other learner's supportive services.

In the 2000's, the learning was much influenced by the use of advanced technologies including machine learning, programmed instructions and advanced multimedia technologies. Leaving other factors such as unequal access to technology between schools, today technology has been highly embraced and is being used to improve and facilitate learning everywhere (Waddell, 2015).

Figure 2.2

Education Technology Development



2.3.3 Affordances of Technology in Education

The concept of affordance was elaborated by James Gibson, an ecological psychologist in 1966. Gibson (1979) defined affordances as an action possibility available in the environment

independently of the individual's ability to perceive; it combines the characteristics of both environment and action and provides the link between them (Xiangming & Song, 2018). Donald Norman gave an alternative view of affordances; Norman (1988, p.9) referred affordances as "the perceived and actual properties of the thing, primarily those fundamental properties that determine just how things possibly be used". Norman's definition was revised in 2013 to refer the relationship between a physical object and how the object could possibly be used by a person (Harwood & Hafezieh, 2017). Affordances are focused on the relationship between people and objects and their creative interaction with environment rather than any compliant response to any designed features of that environment (Conole & Dyke, 2004). In this respect, affordances can thereby refer to the "relationship between objects in that holds between an object in the environment and any individual who is acting on the object" (Valanides, 2018, p.116). Technology affordances can be defined as the relationship between the modern technological infrastructure and individuals who use such technologies (Conole & Dyke, 2004). It refers to an array of potential uses of technology in different situations (Bobsin et al., 2019); it involves unpacking different technological attributes so as to determine their suitability for achieving the learning outcomes.

Tools can afford different actions; today learners are surrounded by a multitude of modern technological tools; these tools are used not only to support learning but also other social, political and economic activities. Integration of these tools in the education system emphasizes that educators, researchers and policy makers need to develop technology-enhanced curricula so that all learners irrespective of their cognitive differences can improve their learning and develop relevant skills needed in the 21st century (Valanides, 2018). According to Boyle and Cook (2004), technology affords the opportunity to restructure learning in new and dynamic ways; this has created the needs to look at the theoretical basis for technology use to support teaching.

Technology affords a range of opportunities that can transform the education process and offer improved possibilities for learning. However, technology affordances should focus on the fundamental interactions between the technology and users (Xiangming & Song, 2018); it should be advocated in both functional and relational approaches.

The greatest technological affordance is accessibility – technology affords the possibility of communication interaction which increases access to learning contents in a new way (Day & Lloyd, 2007; Boyle & Cook, 2004). With technology, education can be accessed by all regardless of their physical status (Talebiana, 2014). Web services such as wikis, social networking sites, blogs and podcasts are few examples of technological tools which support networks of people and facilitate connections between individuals (learners); facilitate collaboration between learners; support content creation; and modification (Lee & McLoughlin, 2014; Xiangming & Song 2018; Talebiana, 2014). These affordances stimulate the development of learner's engagement and participatory culture; also, members feel socially connected with each other (Al-Maawali, 2020). Another affordance is based on how technology can be used to enable students to navigate through myriad of varying information sources and enable them to make decisions and solve their problems (Boyle & Cook, 2004). This involvesdesign tools that can support the development of activities which are productive for learning. However, technology integration in education can only be deemed valuable if learners are able to realize the intended affordances in the learning and the processes (Al-Maawali, 2020). Teachers needs to understand the affordances of technology and to perceiving the educational affordances of technology; henceit is necessary to include this topic during teacher training (Valanides, 2018). The ability to make the most of the affordances available due to technology can significantly promote higher levels of pupil engagement and increase the education outcome (Burchmore, 2018).

2.3.4 The Potential Role of Technology in Education

Technology has impacted different facets of life; several manual tasks have been automated, complex processes are being carried out in faster and more efficient ways (Raja & Nagasubramani, 2018). Integration of technology in education has brought into the classroom the endless possibilities which aid educational achievement (Stosic, 2015; Courville, 2011). The main role of incorporating technology in the teaching and learning process is to create a change in how teachers and students can acquire, access, analyze, present and share information (Waddell, 2015). Technology supports a number of education functions including content development; content sharing and delivery; communication between learners, teachers and parents; lecture presentation; academic research; as well as supporting administrative work and student application and registrations (Talebiana, 2014). It facilitates the acquisition and absorption of knowledge; this offers countries the possibility to increase opportunities for enhancing the education processes and, in response, to review their education policies (Mikre, 2011).

Another role of technology in the education system is to support a shift to a new paradigm, support a new pedagogy for education, and shift students' approaches to learning (Mikre, 2011; Prensky, 2008). Technology has removed physical barriers and allowed greater access to education resources (Courville, 2011; Raja & Nagasubramani, 2018). It offers students new and highly effective tools such as e-books, journals, past papers and revision guides to support their self-learning (Budhwar, 2017). The use of modern tools enables students to sort out relevant content; help analyze content to make sense of it; collaborate with peers; and to create and present contents. Technology innovation has become an important resource for educators and has enabled creation, distribution, sharing and use of this new knowledge (Budhwar, 2017; Goswami, 2014). It has provided a greater acquisition of knowledge (Mikre, 2011); learners can

use an array of media to access knowledge (Bhattacharjee & Deb, 2016). Apart from improved access levels and inclusive education, technology has also played a greater role in improving the cost for education (Jhurree, 2005; Bajracharya, 2017); with technology there is no need to maintain students in the same place and provide students with textbooks, workbooks and other resources, rather it introduces the use of multimedia contents for students to access the same learning content irrespective of where they are, and at their convenience (Budhwar, 2017). Also, there is no need for students to travel from their home places to seek for education (Florin et al., 2011); neither do governments need to build large campuses to accommodate students. This has reduced education costs dramatically.

Technology integration in education has created a simulating and individualized learning environment (Stosic, 2015; Mikre, 2011; Budhwar, 2017); if well implemented learners can reap the pedagogical benefits of technology through the implementation of constructivist principles whereby student interaction increases the possibilities for learners to construct their own knowledge from what they already know (Piaget, 1980). Further, application of technology in education has expanded the availability of resources; the use of the internet has helped students to search for resources and not to rely only on teacher's classroom facts (Bingimlas, 2009). According to Saba (2009), the modern workplace requires critical skills including the ability to collaborate with others; problem solving skills; interpersonal skills; creativity and innovation skills. Technology has a potential to equip students with these high-level cognitive skills.

2.3.5 Benefits and Challenges of Integrating Technology in Education

Technology can offer both challenges and opportunities; these challenges and opportunities can help to estimate the value of adopting technology in education (Cloete, 2017). Understanding the benefits and challenges of integrating technology in the classroom may assist teachers in

embracing the benefits and developing solutions to the associated barriers; this will create a possibility for excellent application of technology in the teaching and learning process.

2.3.5.1 Benefits of Technology Integration in Education

Technology is regarded as a new dimension in the field of education. It can provide effective teaching and learning methods (Kapur, 2018). In the technology environment, teachers use teaching methods in an adequate manner which enables students to increase their level of understanding. Application of technology in the education field has helped to improve individual participation in the learning process (Stosic, 2015). It has the potential to promote student-directed learning of which students take part in the learning process (Agommuoh, 2016). When students learn how to use and take command of technology, students develop the ability to enhance their understanding of the subject matter (Kapur, 2018). Applying technology increases a student's ability to overcome challenges associated with adopted technological tools which enables them to work independently with minimal assistance. Student creativity and innovation is enhanced through technology application in the classroom. Students may use existing technological tools to enrich their work with pictures, images, tables, and charts, graphs which will make their assignments more creative and presentable (Kapur, 2018). Further, technology improves the decision-making skills of learners especially with regard to how they can organize their work and select appropriate tools. Learners have option to select content which fits their learning needs and interests (Florin et al., 2011).

According to LPU (2013), education technology provides principles that enable the restriction of learning content into forms which motivate students and increase their interest. According to Jhuree (2005), technology integration in education increases student's motivation. This is because students are given opportunity to engage with their learning. Using relevant tools will

foster students' interest, make instruction easier and more challenging (Bingimlas, 2009; Jhrree, 2005). Also, application of modern technological tools has created more powerful and engaging learning environments (Resta & Laferriere, 2007). Technology increases the opportunity for connection between teachers, students and even parents; this has facilitated student's absorption of critical soft skills - building teamwork, developing leadership skills, the ability to network and development of critical thinking skills which will likely better prepare them for the job market (Hayes, 2017). Student's collaborations can also benefit teachers as it helps them identify student's needs. However, to make this process more effective teachers must be open to gaining knowledge from their students (Cloete, 2017).

2.3.5.1 Challenges Associated with Integration of Technology in Education

Although technology is considered to be beneficial, the integration of technology in education is facing a number of barriers. Effective use of technology by students can only happen when they have access to appropriate technologies. According to Johnson (2015), global access to education is still a major problem; technology is the only way to overcome this challenge. However, access to technology is still a major challenge facing technology adaption in education (Johnson et al., 2016). One of the challenge for technology integration in education is inadequate technological facilities or inappropriateness of technology adopted in the classroom. According to Atabek (2019; Patel, 2021), sufficient technological facilities and appropriate infrastructure is vital for successfully technology integration in education. However, a strong network infrastructure requires fast, high-quality WiFi either in school or home environment (Patel, 2021). Both instructors and learners must be provided with important technological gadgets such as laptops, computers, projectors, gadgets and other objects that are always used in the learning process to make the process of teaching and learning successfully. Education institutions must maximize the use of accessible, available and affordable technologies around their communities (Kanwar

et al., 2018). Technology such as radio, TV, phone, and free internet-based solutions can also be adopted. In addition to this, educators should also ensure that they choose technology that can only fit for purpose (Muñoz-Najar et al., 2021). For example institutions may opt to use cloud services to provides affordable, innovative and collaborative learning environment (Kiryakova, 2017). In addition to this, Davies (2014) proposes to use intelligent tutoring systems to enhance teacher's ability to teach and assess students using modern technology.

Another challenge which was recorded is inadequate internet connection; this may limit instructors and learners from accessing the education contents (Mellati & Khademi, 2018). Khanzode and Sarode (2017) pointed out that many education institutions does not have realiable internet services. In addition to this, due to digital divide not everyone can have access to technology; however, Cloete (2017) pointed out that without advanced technology, some education institutions will be excluded from global development. In order to overcome this barrier, each school must develop a comprehensive plan and continued review for technology integration (Kelly, 2015). Muñoz-Najar et al. (2021), suggested that government may team up with private sectors such as telecommunication companies to facilitate access to remote learning.

Internet is the main technological resource for faciliataing teaching and learning process; however, internet is inevitably exposed to constant security threats, risks, and attacks; unfortnatelly many education institutions have integrated technology into their teaching and learning process without considering the security aspect of technology (Chen & He, 2013). This initiative has caused many security risks such as loss of confidentiality, exposure of critical information, cyber-bulling practices and hacking to sensitive information (Khanzode & Sarode, 2017). In this respect, educators needs to consider underlying factors that may cause information insecurity in technology-based education and implement measures to mitigate the security risks

associated to technology use. Measures such as use of authentication codes when entering the learning system, installation of security softwares - malwares and antiviruses as well as creation of security awareness among learners is vital (Salimovna et al., 2019). Kelly (2015) pointed out that policies on appropriate use of technology should be developed and put into practice in order to ensure safety and privacy of individuals.

Beside this, Cloete (2017) suggested that, both instructors and learners must possess relevant skills to utilize the available technologies in order to benefit from it. Inadequate professional development and training on the technology use is another challenge hindering successfully application of technology in the education process. This includes lack of self-perceived competency, knowledge, and self-confidence to integrate technology into the curriculum (Goswami, 2014); teachers may fail to use a specific technological application tool hence inability to resolve issues resulting from failure to use the application (Yemothy, 2015). To address these barriers schools should seek to identify and provide training to teachers to develop their pedagogical knowledge of technology, professional development in using technological resources, and methods of assessing using technology (Johnson et al., 2016; Yemothy, 2015). Instructors must also be supported to acquire and use the technical and pedagogical competencies relevant to the chosen technologies (Muñoz-Najar et al., 2021).

Teachers support and beliefs towards technology integration can greatly influence their adoption of this new practice; positive attitudes can influence the acceptance of adapting technology in education (Buabeng-Andoh, 2012) while negative attitudes pertain to the difficulties in bringing technologies in the classroom (Kelly, 2015; Bingimlas, 2009). Some instructors have demonstrated a resistance to change and unwillingness to adopt education technology (Patel, 2021); some view learning a new teaching tool as a risky because they are not well trained.

Athough it is very difficult to overcome resistance to change, educators can work together with instructors to support them in adopting new technologies. Educators should invest time and money to create awareness and train teachers to apply technology effectively as well as to conduct research on how to implement technology in a pedagogically sound manner (Cloete, 2017). This will help teachers to recognize themselves as pedagogical leaders, share what works for them and encourage each other, which will lead to their professional development (Kelly, 2015).

Support services are also vital when integrating technology in the classroom teaching and learning process (Kelly, 2015). Lack of technical support is another common barrier in integration of technology in education process (Bingimlas, 2009); this can prevent teachers from successful integration of technology in education. Schools must ensure the availability of technicians to help handle the technical problems which arise during the teaching and learning process with technology.

On the other hand, technology investing in schools requires consideration of number of key elements; this include infrastructure, storage systems, hardware devices, and application softwares and skills. The biggest challenge of implementing all these requirements is limited budget (Patel, 2021); in most cases the budget set for schools is not sufficient for sufficient technology investment. Again, implementing and maintaining technology is highly costful; hardware can become out of date after a certain period, software licenses are expensive as well as high cost of internet services (Khanzode & Sarode, 2017). It has been very hard to overcome this challenge because the required cost to adopt and maintain technological tools and services is tremendous increasing. Institutions needs to plan on how they can get additional funds to mplement and sustain technology in the classroom so as to maximize the use of technology in the

education process. However, application of cloud services can help minimize cost for technology investment; it offers a number of education tools and provide opportunities for working offline which minimizes institution budget for procuring hardware and software applications (Kiryakova, 2017).

Parents are the key stakeholders for critical success of education (Osorio et al., 2021); they play a great role in supporting their children in using education technological tools. Parental engagement can create powerful connection for children learning and great predictors of their achievement (Osorio et al., 2021). According to Maxwell et al. (2021), parental support toward children use of educational technological tools and processes is vital for successfully use of technology in the classroom. However, the parents always do not have the same education experience with technology hence they may be less supportive to their children to acquire or use technology to support their education. In some cases parents have fear that their children may get distructed if allowed to access technology; some parents consider technology through a lens of 'damage' and 'risk' before seeing the educational benefits offered by technology (Hollingworth et al., 2011). In order to overcome this challenge educators must develop inclusive programme with parents when integrating technology in education so as to create awareness about the positive aspects of technology and its benefits (Maxwell et al., 2021; Osorio et al., 2021). Beside this, teachers may provide recommendation through specific websites or written documents to parents and share testimonial on how technology has bosted students performance; this may lead to change parents attitudes on how they perceive technology (Osorio et al., 2021; Hollingworth et al., 2011).

Furthemore, integration of technology in education has both positive and negative effects; while technology is priceless in supporting the education process, Fox (2018), pointed out that there is

an increase in technology misuse in the learning environment. Today, student use technology not only for academic and social networking purpose but they spend more time to see pornography and other unethical contents (Apriani, 2020). The main reason for this is lack of supervision and guidance from their instructors and parents. In order to overcome this challenge educators must take into account students age and cognitive development when integrating technology in the classroom (Maxwell et al., 2021). Instructors and parents must also consider amount of time students spend in interacting with technology to ensure it is used for specific purpose only; educators must also consider creating awareness programmes about ethical issues related to copyright law, patent rights and other ethical concerns (Fox, 2018).

According to Atabek (2019), for successfully, efficient and productive education services, the barriers to technology adoption in schools should be countered with practical solutions; effective procedures should be adopted when implementing education technology.

2.4 Emerging Technologies for Education

Technology has greatly impacted the contemporary learning experience; it has created myriad opportunities to exploit modern technologies in the field of education. Application of advanced technology can facilitate greater numbers of students to participate in a course either though synchronous or asynchronous instruction (Sivakumar & Govindarajan, 2019); this has proven to drive academic success and is linked to improvements in learner retention rates (Muljana & Luo, 2019). Technology has enabled teaching to occur in different education modes, both formal and informal. According to Halaweh (2013), technology is still emerging; it is now becoming a must to use technology in every aspect of life. From an education perspective, emerging technology refers to the tools, concepts and innovations which are emerging to serve the education purpose (Veletsianos, 2010).

This section reviews the emerging technologies for education; the section discusses the five innovative education technologies emergent over the last 20 years. These innovations are (1) Learning Management Systems; (2) Mobile Learning; (3) Video Conferencing; (4) Games and Gamifications; and (5) Education Technology-based on Artificial Intelligence (AI).

2.4.1 Learning Management Systems

Learning Management Systems, also referred as e-learning or virtual learning, refers to web-based platforms to provide an interactive learning content in an online environment (Lopes, 2014); LMS are used to automate the administration, organization, delivery, and reporting of education management services (Turnbull et al., 2019). Similarly, de-Oliveira (2016) defines LMS as the virtual environment that is built to transform face to face delivery mode to the use of technology to deliver learning. Many people confuse between Learning Management System and Content Management System (CMS). Although the two acronyms are similar, each present different meaning. LMS comes with many interactive features for delivering consistent training which is different from CMS which is used to display training contents in a central location for learners to view in a passive way (Zoe, 2020).

Ahmed and Mesonovich (2019, p.583) pointed out that "LMS combine a range of courses or subject management and pedagogical tools to provide a means of designing, building and delivering online learning environment". It facilitates the effective delivery of content; training and other development programmes (Chaubey & Bhattacharaya, 2015). LMS also facilitates interaction between instructors, learners and administrators to use and access resources beyond the limitation of time and distance, either synchronously or asynchronously (Chauvey & Bhattacharaya, 2015; Mohamed et al., 2018). Further, LMS provides tools for supporting

multimedia content; interactions such as discussion forums, charting; assessment such as assignments, online quizzes and examinations. It provides learning analytic tools that allow schools to monitor learning activities and to monitor individual and group progress; this helps to ensure each tool and LMS-based activity contribute to effective learning (Anderson, 2016).

The emergence of Learning Management Systems has enabled today's learning generation to satisfy their education needs without the need to meet in the single location (Iqbal & Qureshi, 2011). Many of the processes associated with learning were automated to enable the online delivery of subject content, resources and activities as well as to promote handling of the associated administrative tasks (Turnbull et al., 2019; Chaubey & Bhattacharaya, 2015). LMS has become a critical tool for nearly all education institutions and schools (Chaubey & Bhattacharaya, 2015). Hence, it is important for institutions and schools to understand the growth of LMS in order to improve their ability to choose the most appropriate LMS and the best pedagogical innovations for technology-enabled learning. According to Stone and Zheng (2014), the development of LMS is a result of the decentralized organizational structures, increased demands for education and training, pressure to minimize education costs while increasing returns for education investment. However, LMS have their roots in the distance education (Turnbull et al., 2019); they were first introduced in the 1990's and were accelerated by the development of multimedia and internet (De-Oliveira, 2016). The arrival of Open Source LMS such as Moodle further enhanced the LMS usage; today the latest cloud-based platforms are taking LMS to the next level. There are several best known LMS systems; some are commercial such as Blackboard, WebCT and Desire2Learn; and others open source LMS such as Moodle, Atutor, KEWL and several others (Cavus et al., 2006; Turbull et al., 2019). Moodle is argued to be the most popular LMS used today with almost "100,000 registered users in 225 countries" (Turnbull et al., 2019, p. 3).

According to Stone and Zheng (2014), current education trends include the emergence of modern technology and the growing needs of learners which has influenced at a greater level, the transformation of education systems including the need to use LMS to facilitate the teaching and learning (Stone & Zheng, 2014). With technology development instructors are becoming more flexible, personal open, social, analytic and mobile. According to Chauvey and Bhattacharaya (2015), a good LMS must have features which promote a learner-focused pedagogical perspective; allow flexible learning environments; provide access to massive learning resources; and must offer significant cost savings (Chauvey & Bhattacharaya, 2015; Stone & Zheng, 2014). It should also provide curriculum contents – totality of what should be taught; learner's assessment – measuring effectiveness of teaching; learner's engagement - provide interactive features to both instructors and learners; and should consist of special tools for content design and management (Kulshrestha & Kant, 2013; Turnbull et al., 2019). Beside this, high quality LMS must guarantee individual security and privacy; be responsive possess ability to be accessed using mobile computing devices; and support social connectivity (Turnbull et al., 2019). De-Oliveira (2016) pointed out that in order to effectively apply LMS, special techniques for designing a course should be applied; new forms of instruction must be developed; and special means of communication through electronic devices which are relevant for LMS must also be considered. In this reason, institutions need to establish new organizational and administrative arrangements to respond to the changing needs and keep pace with new technologies.

In addition to this, institutions are advised to evaluate their LMS choice in order to explore their effectiveness and creation of positive impact (De-Oliveira et al., 2016). Better choice of LMS can produce a very positive impact; this is attributed to the fact that it can accommodate student's needs and can promote student's responsibility for their learning which can lead to the

improved academic outcomes (Turnbull et al., 2019). Notably, Adzharuddin and Ling (2013) pointed out that although many interactive features are available in LMS some instructors are not effectively using these features hence the LMS adopted should be more adaptive and customizable.

2.4.2 Mobile Learning

There is increasing engagement with wireless devices across the world; this was made possible by the proliferation of mobile devices and increased availability of wireless network access. The development of wireless fidelity (WiFi) technology has been a critical resource in increasing the education access through mobile devices (Carley, 2015; West, 2015; Omar et al., 2018). WiFi is a wireless networking technology which allows devices such computers and mobile devices equipped with wireless network card to access internet while roaming in different workstations (Al-Alawi, 2006). Mobile technology has transformed the way learners interact with different technological devices thus extending traditional notions of learning to a new phenomenon outside the formal education location (Çakmak, 2019). According to Çakmak (2019) and Traxler (2005), mobile learning is a type of education provision via mobile devices technology which can be accessed instantly and at any place. It is the ability to provide or obtain study contents through portable devices such as laptops, tablets and mobile phones (Mehta, 2016). Mobile learning was derived from LMS (Ozuorcun & Tabak, 2012); it more private, situational, unstructured and informal in its presentation (Ozuorcun & Tabak, 2012; Mehta, 2016); learners can access LMS through mobile devices.

The emergence of mobile learning was a result of the revolution of mobile computing which facilitated person-to-person communication (Bidin & Ziden, 2013). Following Piaget's (1929) concept of stages of cognitive development, knowledge acquisition develops through interaction

with the environment; students should construct their knowledge from critical thinking in order to solve problems authentic to their environment (Crompton, 2013). According to Helen (2013), this pedagogical shift causes the technological dilemma; it was not possible to easily shift desktop computers from one place to another hence mobility became the desired attributes in the technology based-learning model. The development of mobile learning was also emphasized by the shrinking of computers to become smaller, more efficient and easier to use as well as development of WiFi technology (McQuiggan et al., 2015; Al-Alawi, 2006). Mobile learning emerged in the mid of 1990's and was characterized by a focus on devices, in particular mobile phones, tablets and laptops, which could be used for education. Specifically, learning outside the formal education setting which provides opportunity for learner's mobility (Nakapan, 2014). By the 2000s mobile learning provided new affordances to learners and was reflected by educators and government (Crompton, 2013). Today, there is an increasingly awareness among students and instructors about the potential of using these devices for self-directed learning.

The main characteristics of mobile learning include learners' mobility and learning virtually anywhere at any time via mobile devices (Bidin & Ziden, 2013). Mobile learning is portable and personalized; students can use these devices to collaborate with peers and access digital content for their personal and education use. Mobile learning offers some additional value-added aspects; it is adaptive to constantly changing learning context (Çakmak, 2019). Criollo et al. (2018) argue that many people utilize mobile phones throughout the day; this makes education more accessible to individuals and groups including vulnerable groups, especially those living in remote areas and those with disabilities. Mobile learning can truly personalize learning (Alomary et al., (2016); learners can have the option to choose the type of learning content they are interested in, thus making the learning experience more student-focused. It facilitates continued and life-long learning (Mehta, 2016); individuals can access education throughout their lifetime

regardless of their status. However, mobile devices lack functionalities to support effective learning; they have small screens which can limit the quantity and type of information to access; limited storage capacity; can easily be lost; and needs regular charging which is a major challenge in places where power is unreliable (Criollo et al., 2018; Mehta, 2016). Another challenge is the availability of WiFi technology in school and other important places; Chirwa (2018), pointed out that the major challenge facing education access in Tanzania is inadequate computers, lack of ICT literacy skills and unreliable internet connectivity including wireless access point.

With technology advancement new forms of mobile technology such as advanced tablets, smart phones and laptops with many additional capabilities and web functionalities were developed (Helen, 2013). Nonetheless, learners who live in places with insufficient network coverage can experience challenges in accessing the learning content (Criollo et al., 2018). Since mobile learning has become an emerging learning trend connection between home and schools is very essential (Alomary et al., 2016; Vereen, 2020); it is no longer an option but necessary in supporting learning in this modern technological era (Criollo et al., 2018).

2.4.3 Video Conferencing

Video conferencing technology refers to live communication between people in different locations through electronic means to enable simultaneous interactive communications (Rop & Bett, 2012). It is a real time transmission and reception of audio and video data in a network which provides the easiest, dynamic way of communication between members who are at a distance (Kristóf, 2020). Similarly, Fatani (2020) has defined video conferencing as a two-way communication model for interactive real time voice, video, and data sharing between instructor and learners which enables content sharing and messaging. Participants involved in video

conferencing can see facial expression and body language; these are very essential element for effective communication.

According to Gladović et al. (2020) and Aoki (2012), the first generation of distance education pedagogy was characterized by correspondence based on printed materials; the second generation was characterized by both printed and broadcasted correspondence through radio and television; and the third generation was characterized by communication through media such as the internet and video conferencing which facilitated the interactions between learners and teachers. Today, there is a high increase in web conferencing tools; educators have seen the promise of video conferencing as an instructional tool (Upshaw, 2019). One of the major reasons for the development is the response to the COVID-19 outbreak and pandemic which enforced schools to see the benefits of offering more coursework online and remote student learning (Khatib, 2020). However, according to Kristóf (2020), Krutka and Carano (2016), even before the outbreak of COVID-19, videos were used in classroom to engage students; in this respect, these practices are expected to continue even after the end of the COVID-19 pandemic.

Video conferencing has become an essential component of education; it has given teachers new ways of presenting content, working with students and has stimulated the development of teaching strategies which are consistent with emerging technologies (Paderanga, 2014). This type of teaching has pushed teaching beyond textbooks and connects students with the world they live in (Gladović et al., 2020). Application of video conferencing technology in education has improved the communication and presentation skills of students (Paderanga, 2014). It has facilitated sharing of resources between teachers; provided access to national and international experts in different skills; reduced environmental impacts – cost and time for travel, stress and traveling fatigue; and can provide the ability to record and save conference sessions for future

reference (Rop & Bett, 2012). Video conferencing technology increases social presence; promotes learner-centered opportunities; facilitates student interactions; allows real time assessment; and facilitates sharing of responsibility between instructors and learners as they analytically think about how to approach a problem (Fatani, 2020). However, implementing video conferencing in the education requires not only technology but adaptation of effective teaching methods and contents to support the highly interactive teaching environment (Krutka & Carano, 2016).

Video conferencing can be very effective when connectivity is supported to locations anywhere in the world. Development of broadband provides additional capacity for these resources (Akpan-Obong & Alozie, 2012). However, connectivity that spans with secured systems is not possible in most of the developing countries including Tanzania (Word Trade Organization, 2017). A digital divide between rural and urban areas persists; rural areas have a generally less developed in terms of internet connectivity which might exclude them from accessing these resources (Janc & Siłka, 2017). Some video conferencing tools are designed to limit certain numbers of individuals to be accommodated at a time (Fitzgibbon, 2003); in this respect it cannot work for larger classes. Also, setting up video conferencing facilities requires huge investment and technical capabilities (Fields, 2019). In order to tackle these challenges educators can choose from a range of available cloud based and cost-effective video conferencing technologies to enhance their communication efforts. Schools may opt to use video conferencing technology such as Skype, Zoom, GoToMeeting, Google Hangouts and Microsoft Teams (Kristóf, 2020); these tools are easy, efficient and cost effective. Also, countries need to develop strategies for technical assistance in the preparation and deployment of video conferencing technology for inclusive education. Further, in order to make video conferencing function effectively, it is

important to combine it with other significant educational services and it must be customized to best motivate and meet students' needs (Trajkovik & Caporali, 2009).

2.4.4 Games and Gamification

Educators have been using different teaching methods and approaches to promote students' active participation and engagement in their own learning (Furdu et al., 2017); this is achieved through modification of learner's behavior (Chapman & Rich, 2017). The use of game-based techniques to engage and promote desired learner behaviors has successfully brought specific educational objectives into educational practice (Papadakis, 2018; Arnold, 2014). Gamification refers to utilizing video game design and game elements in the learning environment. Cahyani (2016) and Dicheva et al. (2015) defined gamification as the adoption of game elements to improve learners' experience and engagements in a non-game context. Gamification has created engagement which is necessary for any learning experience (Alomari et al., 2019); it increases the connection with a subject, an experience or an idea which in turn motivates students towards mastery goals (Lopes, 2014; Gressick & Langston, 2017). Initially, game elements were applied in the traditional education model to engage learners at the social, emotional, and cognitive level (Chapman & Rich, 2017; Papadakis, 2018). However, technology integration in education has expanded opportunities to use technology enabled games (Gressick & Langston, 2017); mobile technology development has widened the opportunities for games which allow learner engagement at any time and place (Arnold, 2014).

Digital games have become more important in creating social interaction and constructivist learning environments (Papadakis, 2018). Schools are creating engaging experiences which inspire students to approach education through games. Today, there are different types of games used in education; these include those which were developed specific for education purpose as

well as other commercial games especially those which are found to be suitable for education. The most typical games used include games points, levels, badges, and leader boards and others such as rewards, progress bar, challenges, feedback, and avatar (Rabah et al., 2018; Alomari et al., 2019).

Game-based learning provides effective ways to stimulate learning environments and promotes students' motivation, interest and enhances students' important skills such as problem-solving, collaboration, and communication skills (Papadakis, 2018; Rabah et al., 2018). Applying the gamification concept in education expands the opportunities for experiential, self-paced and lifelong learning (Arnold, 2014). It encourages the development of logical and critical thinking which promotes greater acquisition of knowledge (Papadakis, 2018; Lopes, 2014). Rewards systems are the integral components of games (Lopes, 2014). Despite the fact that rewards are expected to positively reinforce the student's behavior as well as encourage the player to persist even when they have failed, in some cases rewards can de-motivate learners and reduce learning and achievements (Gressick & Langston, 2017; Glover, 2013); learners can be discouraged when they score low points. In some cases, gamification can also encourage addictive behavior among learners; it may lead to learners focusing on getting points or other rewards instead of achieving the desired goal of knowledge generation (Andrade, 2016; Carreño, 2018).

The potential of these negative effects of gamification can be reduced by careful design of the gaming elements in the learning activities (Glover, 2013). Before adding a gamification approach to a learning design, it is important to firstly ensure that there is a suitable pedagogical framework and the activity level is appropriate; educators must also ensure that the concept does not conflict with the required outcome (Glover, 2013; Rabah et al., 2018). Educators may opt to adopt commercial games in the market for education purpose or develop new games which are

specific tailored for education. Games such as word search, crossword puzzle, jigsaw puzzle, hangman, word scramble, sliding puzzle, brain teaser, quiz games can be adopted and customized for education (Zirawaga et al., 2017). However, developing new games must consider clear learning objectives and the constructivist theory of learning (Papadakis, 2018). Kaufmann (2018) pointed out that despite the fact that there are number of apps for gamification; educator must choose apps that allow for the tasks to be suitable for the overall learning goal.

2.4.5 Education Technology based on Artificial Intelligence

The future of education is connected to the development of new technologies and computing capacities of the new intelligent machines. Artificial intelligence (AI) refers to the ability to create intelligent machines that work and react like human beings (Goksel & Bozkurt, 2019; Karsenti, 2019). Lu and Harris (2018) and Tuomi (2018) defined AI application as a computer system which is configured to perform tasks that are conventionally thought to require human intelligence. Artificial Intelligent has significantly impacted the profound nature of education services over the past ten years; it has brought about new possibilities and challenges into the education system (Popenici & Ker, 2017). The interest in AI became visible towards the end of 1980's (Tuomi, 2018); towards 2010, learning through algorithm became an important agenda (Goksel & Bozkurt, 2019). After 2010, new AI features such as deep learning, cross-border integration, human-computer cooperation and intelligent personal assistant started to emerge (Tuomi, 2018; Goksel & Bozkurt, 2019). Globally, there is massive investment in AI in the education system; great numbers of AI-based software applications systems were created to enhance teachers' and students' experience (Zhidkov, 2020; Mwiti, 2019). The future holds many possibilities; Tuomi (2018) point out that AI-based system will continue to expand and will rapidly change the economy and job market; this development demands for new education and education systems.

Application of AI in the education creates a wonderful educational experience to learners and instructors; it offers helpful automatic feedback to students and teachers which allow teachers to concentrate on other tasks (Karsenti, 2019). AI application affords the ability for teachers to analyze students' understanding and interest hence making them able to provide more personalized recommendations (Kuprenko, 2020); facilitated by the focus on individual student needs. AI provides new ways of interacting with subject content (Karsenti, 2019); for example, Google can adjust students' searches in accordance with their geographic location and language. Some of the common AI-based education technology functions include tutoring using Intelligent Tutoring Systems (ITS); personalized learning – useful for provision of individualized learning, can provide support even to special needs students through ITS or adapative tutors (Aldosari, 2020). AI tools can also be used for automatic assessment as well as to perform other automated tasks such as recording attendance, automatic test and question generation and automatic grading systems (Lu & Harris, 2018; Aldosari, 2020).

Despite the amazing progress in technological innovation, the human element in the teaching and learning process is still very essential; provision of greater independence in students may disadvantage learners who are un-disciplined (Lu & Harris, 2018). Implementing AI systems places increasing demands on teacher's professional abilities to translate the data received from AI systems. Beside this, successful implementation of these systems requires significant investments; this includes not only the availability of technology and internet access but also a significant number of professionals in the AI field; policy consideration for the integration and innovative use of digital technologies in education, as well as policy which can respond to the demands for data security and privacy from the community is needed (Tuomi, 2018; Lu & Harris, 2018). Aldosari (2020) suggested building in-depth awareness and skills to teachers on

practical usage of these systems in order to effectively use and acquire its associated benefits. Panigrahi and Joshi (2020) pointed out that AI based systems should also be contextualized, customized and available to wide and diverse audience.

2.5 Pedagogy and Pedagogical Models

The quality of an education system depends on the quality of the pedagogical approaches that instructors apply in the teaching and learning process (Husbands & Pearce, 2012; Barber & Mourshed, 2007). According to Rutton (2017), pedagogy is a discipline that combines education theory and practice, specifically the knowledge and skills of teaching. In this respect, effective teaching must be guided by the application of specialized pedagogical knowledge (Ermenc et al., 2015); evaluation of a teacher's capacity to teach should be emphasized by educators to ensure the availability of required competence (Hulman, 1986). This section discusses the meaning of pedagogy and pedagogical models in education. The models, principles and practices of pedagogy are discussed followed by the benefits and challenges of each model.

2.5.1 Understanding Pedagogy and Pedagogical Models

The core of learning lies in the way teachers and students interact to facilitate the learner's potential and self-actualization (Susanso et al., 2019; Ermenc et al., 2015). The education process is guided by instructional techniques and strategies that afford learning. However, teacher action in the classroom in relation to their teaching and learning process is underpinned by the ideas and values teachers possess about education as well as the education theories (Livingston, et al., 2017). Persaud (2019) and Kapur (2020) pointed out that pedagogy is concerned with the theory and practice of education; it involves understanding the context in which learning and teaching take place (Waring & Evans, 2014). According to Wright (2005), pedagogy involves different ways of conceptualizing teaching; it entails both instruction and management of the classroom.

Similarly, Waring and Evans (2014) and Livingston et al. (2017) refer to pedagogy as a concept that covers not only teaching methods but also embraces and informs education theory, learning styles, assessment and the connection between learners and instructors with respect to culture and techniques used for learning. Again, Henri and Pardo (2020) refer to pedagogy as the ability of a teacher to match theoretical foundations or concepts with teaching resources together with the intellectual capacity of learners in order to enable them to meet individual needs. On the other hand, Victoria State Government (VSG) (2020) defined pedagogical models as the theoretical constructs derived from learning theory that enable the implementation of specific instructional and learning strategies. They are specific instructional plans which connect several variables with the teacher's basic professional knowledge to enable knowledge transfer from instructors to learners (Susanso et al., 2019).

2.5.1.1 Importance of Pedagogy

Pedagogy is considered as a driver for bringing about improvement of students' academic performance through promoting student learning (Livingston et al., 2017; Kapur, 2020). It is regarded as an essential part of teaching and learning process (Kapur, 2020). However, there are different ways of measuring teaching. According to Husbands and Pearce (2012), effective pedagogy is the one that considers students' voice and their prior experience; consider long term learning outcome; focus on higher order thinking; inclusive; and it depends on teacher's beliefs, knowledge and understanding. A well-structured pedagogy enhances the teaching and learning process which reflects on students' performance (Susanso et al., 2019). Also, Persaud (2019) and Livingston et al. (2017) pointed out that quality teaching is essential element for education development; quality teaching is linked to teacher's competence in relation to their knowledge, beliefs and attitudes as demonstrated in academic and how such competence is used shape the academic performance (Wang et al., 2011). Educators believe that given the global changes

using the standardized teaching strategies as well as teacher's competence are essential for quality teaching (Henard & Leprince-Ringuet, 2008). However, to arrive at quality education a number of activities, policies, and approaches must be executed (Arendale, 2010); these activities, policies and approaches are referred to as best education practices.

2.5.1.2 Importance Pedagogical Content Knowledge for Teachers

According to Shulman (1986), pedagogical content knowledge (PCK) refers to the knowledge teachers' use to translate subject-matter in forms which are most efficacious to support students developing understanding in the context of facilitating learning. It illustrates teacher's ability to transform the subject matter of a scholarly discipline into an accessible form of communication with students. Shulman (1986) stated that the knowledge base of teaching is characterized by the ability of teachers to transform content knowledge into a pedagogy that can be adapted by students of different capacities and background. The key elements of PCK for teachers to master include content knowledge that is knowledge about particular subject matter; pedagogical knowledge that is knowledge related to understanding of the processes, practices or methods of teaching and learning and curriculum knowledge that is the lesson and the contents to be taught in a specific course (Ball et al., 2008; Shulman, 1986; Susanso et al., 2019).

Teachers are the key drivers for changes that influence the quality of education (VSG, 2020; Broom, 2015); hence it is very important for teachers at all levels of education to enact quality teaching methods; instructional strategies and contents in a manner that contributes to effective learning (Kapur, 2020). Teachers' pedagogical knowledge underlies their profession, assuring its meaning and its significance (Nicu, 2017). In any education setting it is a must to equip teachers with the knowledge of how to apply different pedagogical principles in their classroom. The provision of pedagogical knowledge will help instructors to align the curriculum, pedagogy and

assessment in local context as well to foster cultural diversity and implementation of new pedagogical approaches (Livingston et al., 2017). Biggs (1996) referred to this alignment as constructive alignment, whereby knowledge is constructed through learner's activities. The alignment aspect refers to what the teacher does to set up a learning environment relevant for creation of appropriate learning activities to achieving the intended learning outcome. The process starts by the defining the learning outcomes, choosing the learning activities that can lead to achieving the outcomes and finally, develop an assessment mechanism to examine if the student's level of understanding matches with the intended learning outcomes (Biggs, 2003).

2.5.2 Pedagogical Models, Principles and Practices

2.5.2.1 Pedagogical Models

According to Buitrago (2015), a model is a representation of an object, phenomenon or real-life situation. In the education field, a model is used to formulate guidelines for teaching in the classroom; it helps to visualize and organize instruction in different formats. Pedagogical models represent dimensions of the teaching and learning process (Buitrago, 2015); a model may be used to shape a curriculum or a course, to select instructional materials, or to guide a teacher's action and specify ways of teaching and learning that are intended to achieve certain learning outcome (Persaud, 2019). There are several kinds of pedagogical models; however, this section discusses three pedagogical models namely the didactic, authentic and transformative pedagogical models.

I. Didactic Pedagogical Models

The word 'didactic' refers to something that is designed or intended specifically for instruction (Gracia, 2014). Didactic pedagogy can be defined as the application of strategies to convey instructional materials to learners in a consistent and scientific approach (Abdullahi, 2019; Henri

& Pardo, 2020). It follows a teacher-centered approach whereby teachers provide instruction to students and students become passive listeners (Albaradie, 2018). Didactic pedagogy involves structured and informed teaching directed by specific learning objectives and the instruction delivery and it is largely dependent on the instructor knowledge and experience (Henri & Pardo, 2020; Albaradie, 2018). Although this type of pedagogical model is very old, it still prevails in many education institutions; it employs a face-to-face delivery method which allows direct interaction between instructors and learners. It enables skills, ideas and knowledge generation from the structurally organized contents (Abdullahi, 2019). This model is based on multiple theories of teaching, and in a wider sense, theory and the practical application of teaching and learning methods (Henri & Pardo, 2020)**.**

Teachers using the didactic pedagogical approach must have ability to translate a theory into practice hence this model demands for teacher's personal qualities; culture and teaching style; creativity and talent; and teaching professionalism (Tchoshanov, 2013). In order to effectively practice the didactic approach, educators must conduct analysis, design and construct teaching products for learning (Vizgirdaite & Juceviciene, 2014).This is because didactic model involves interaction among teachers, contents and learners (Mård & Hilli, 2020; Tchoshanov, 2013).

Benefits and Challenges of Didactic Pedagogy

Didactic model is very effective for students who cannot study independently and depends only on the teacher's instructions (Abdullahi, 2019). It is very efficient and economical; this is because delivering instruction systematically is a very useful method of transmitting knowledge to a large number of students in a short period of time (Albaradie, 2018). Also, didactic pedagogy allows students to be exposed to real language; this can help students to generate skills, ideas and knowledge from a content which is well formatted and organized (Muhammad,

2019; Gracia, 2014). Further, da-Gruz and Magalhães (2017) urged that combining teaching methodologies with physical experiments and internships comprise to the more practical dimensions which aid students understanding of the physical concepts (Sommerfeldt, 2013). This combination also enhances teaching as it makes learning content intuitive and vivid which stimulate learner's interest in learning hence improving education quality (Lai et al., 2017).

However, didactic pedagogy is no longer significant in the current education setting; this is because the development of technology has opened up doors for unlimited access of information from the Internet hence there has been a shift from teacher-focused to student-centered (Albaradie, 2018; Abdullahi, 2019).According to da-Gruz and Magalhães (2017), didactic pedagogy is based more on theoretical knowledge and practical experiences. Technology and globalization mean that up-to-date subject knowledge is easily accessible meaning that course materials may quickly become outdated (Gracia, 2014); in this respect, applying didactic pedagogy alone becomes insufficient. Furthermore, the use of didactic pedagogy may engender the learner's inability to see real-life connections between what they learn in school and what exist in real life (Mims, 2003).

II. Authentic Pedagogical Model

The word authentic means something which is "real" or "genuine" or "true" (Lehman et al., 2018; Vos, 2011). Newmann et al. (1995) laid the foundation of authentic pedagogies; authentic pedagogy fosters high levels of engagement and interaction hence it is constructivist in nature (Ahmad et al., 2015; Splitter, 2009; Newmann et al., 1995). According to Cydis (2015), authentic instruction is defined as the type of instruction in which students construct meaningful knowledge through reflection, discussion and perform tasks to solve problems in a real-world context. Similarly, Abdullahi (2019) refers to authentic pedagogy as a pedagogical approach that

allows students to think, discuss, discover, deliberate and logically construct relevant concepts to the study. The authentic pedagogy model brought about changes in the education system; it has fostered a pedagogical shift from teacher-centered to learner-centered approaches. The pedagogical shift has also promoted the development of critical thinking and problem-solving abilities among learners as well as promoting self-directed learning (Samson, 2015). The main focus of authentic pedagogy is to connect what is taught in class with real-world problems and projects (Trivedi et al., 2017); it offers students an opportunity to explore, discuss and construct meaningful concepts and relationship in real world context (Mims, 2003).

Technology integration in education can serve as an opportunity to integrate authentic instruction; the use of modern technological tools can promote learner's ability to create connections between new and existing knowledge, skills and experiences which are necessary in responding to changing needs of the community (Cydis, 2015). In this model, the teacher's role is changed to become facilitator and developer of conducive learning environment which will help to explore and unlock hidden potential of students (Muhammad, 2019; Ahmad et al., 2015). Authentic pedagogy is assessed based on how students construct meaningful knowledge from previous experience; adopt problem-based learning; obtain knowledge beyond school level; create connection between school and real-life experience; and inclusiveness (Ahmad et al., 2015; Trivedi et al., 2017). The focus of authentic pedagogy is knowledge construction; this knowledge must be the one needed to respond to the changing need of the community (Cydis, 2015; Trivedi et al., 2017).

Benefits and Challenges of Authentic Pedagogy

Authentic learning is considered to be a very effective learning approach which prepares students for the 21st century job market. It engages a learner's entire range of senses which enables learners to create meaningful and useful shared knowledge (Christmas, 2014). The main reason

is the fact that authentic pedagogy promotes constructivism and connectivism as background philosophies; it creates the ability to see connections between ideas, and concepts and emphasizes the construction of new and meaningful knowledge (Klímová, 2014). Students can learn to assimilate the knowledge that is unfamiliar to them and are forced and attracted to learn when it is relevant and applicable to their lives outside the school (Trivedi et al., 2017). Students are given an opportunity to collaborate and participate in different activities and perspectives which allow them to become critical thinkers hence increasing their engagement and dedication to their learning (Trivedi et al., 2017; Klímová, 2014). This provides opportunities for students to discover new ideas, concepts and theories (Albaradie, 2018); students become the source of knowledge by themselves. Further, authentic pedagogy attempts to change learner's attitudes from becoming dormant learners who are waiting to receive knowledge to becoming knowledge generators (Ahmad et al., 2015). According to Mims (2003), students feel the value of learning when they are able to transfer their learned knowledge and skills into their everyday life. In this case, authentic learning gives the opportunity to bring real life activities into the classroom.

There are cases whereby authentic pedagogy is not appropriate for learners; this is because not every student can create relevant concepts or ideas and even if a student discovers a new concept, he/she might not be able to present it accurately (Abdullahi, 2019). Also, Mahmudah (2013) pointed out that materials generated in authentic pedagogy normally go too far beyond the students' level or student's prior knowledge; this might discourage students learning due to its difficulties. In addition to this, materials used in authentic pedagogy are too long, dense/complex and can quickly become outdated (Lansford, 2014); this is because new concepts and ideas generated by learners can quickly replace the existing contents (Case, 2019). Further, authentic pedagogy mainly focuses on students rather than the teacher; however, some students, including those who are unprivileged, cannot identify concepts by themselves and they often need

guidance from teachers to understand new things hence applying this model may result into a possibility to exclude some students.

III. Transformative Pedagogical Model

The concept of transformation is linked to improvement aimed at bringing about change (Farren, 2019). Dorji et al., (2020) refers to transformative pedagogy as an art of teaching that fosters learner's collaboration and reinforces learner's critical thinking and creativity. It is a learning that induces effective change in learners; such profound shift comes about as a result of personal experience and reflection upon that experience (Marks, 2005). Transformative pedagogy thus provides a learning experience which shapes learners and helps to produce a significant impact, or paradigm shift, which affects the learner's subsequent experiences (Berner et al., 2013). To compliment this, the concept of transformative learning is a process of using *a priori* knowledge or experience to construct a new or revised concept of the meaning of one's experience for the purpose of guiding future action (Mezirow, 1978). Transformative learning as introduced by Jack Mezirow in 1978, leads to "a more functional frame of reference which is more inclusive, differentiating, permeable, critically reflective, and integrative of experience" (Mezirow, 1996, p. 163). The main challenge that educators face is how to foster transformative learning; Ukpokodu (2010) suggested that in order to overcome this challenge teachers must engage in transformative pedagogy (Ukpokodu, 2010). Thus, the main focus of transformative pedagogy is the ability of learners to interpret and reinterpret their experiences in order to make meaning of their learning (Taylor, 2008). According to Berner et al. (2013), transformative pedagogy is very important for sustainable education; this is because it enables students to understand themselves and their relationship with other human beings and the world which leads to the paradigm shift (Taylor, 2008). As Badara (2011) pointed out, education occurs by transforming habits of mind.

This model allows teachers to work with students to identify questions and develop a plan for answering questions on a particular topic (Khedkar & Nair, 2014). Teacher's expertise remains as an important resource; students are encouraged to explore multiple facts and concepts through interaction and collaboration among themselves and with instructors (Khedkar & Nair, 2014).

Benefits and Challenges of Transformative Pedagogy

Transformative pedagogy combines social constructivism and critical pedagogy (Lynch, 2019); it encourages students to critically examine their beliefs, values and experience to develop new ways of understanding (Dorji et al., 2020). Transformative pedagogical curricula focus mainly on problems and the generation of solutions by both teachers and students; it creates safe and inviting environments to continue improving the course which also positions students at the center of the learning (Meyers, 2008). It promotes student's interaction and collaborations; promotes teamwork culture and facilitates social and psychological growth of learner (Dorji et al., 2020). The main focus of transformative pedagogy is how the learning occurs rather than accumulation of knowledge; the aim is to develop student's capacity to adapt, innovate and create in order to create a change. This type of pedagogy provides room for learners to negotiate meaning with peers hence it enhances student's relationships; it is an efficient way to develop deeper understanding. In this respect, transformative pedagogy creates a very sustainable form of education; it helps expands student's awareness on how community forces create changes to people (Meyers, 2008).

However, Dorji et al. (2020) points out that using transformative pedagogy can make teaching become steadily slow; this is because developing strategies that inject real life into a curriculum is very challenging (Smith, 2017). Very few schools are able to integrate these components and attempt to analyze how the experiences can shape the world they live. This often creates tension

when trying to create a balance between the articulated learning objectives and outcomes shaped by the learner's experience (Smith, 2017). In this respect, this category of pedagogy makes students hard to focus so students may not truly learn.

2.5.2.2 Pedagogical Principles

An effective pedagogy must maintain teaching presence, put students at the centre, seek to maximize cognitive engagement and promote active learning, and should be inclusive to all (McAleavy & Gorgen, 2020; Husbands & Pearce, 2012). It should also utilize assessment for formative purposes with immediate constructive feedback loops (Husbands & Pearce, 2012). A good pedagogy must originate from well-developed educational theories; employ relevant principles and strategies for teaching and learning (Kapur, 2020). According to Livingston et al. (2017) and McAleavy and Gorgen (2020), the main principles of pedagogy include but are not limited to inclusiveness; supporting learners' motivation and engagement; involving innovative approaches; matching with curriculum; supporting both formative and summative assessments; and providing opportunity for classroom interaction.

In a best practice pedagogy, every learner must have equal access to education; spaces must be organized in such a way that it can accommodate every individual (Gudjonsdottir & Óskarsdóttir, 2016). These individuals include vulnerable and disadvantaged individuals such as women; individual with special needs; disabilities; social and ethnic groups. Spratt and Florian (2013) argued that in an inclusive pedagogy creation of environments which do not limit the expectations of both teacher and learner is vital. In addition to this, pedagogy must support learner's interest to continue to learn and create good experience to both teachers and learners (Anderson & Mccormick, 2005). Motivation is another necessary requirement for student engagement; student engagement contributes to the achievement of sound academic outcomes

(Saeed & Zyngier, 2012). However, integrating technology in education will provide more opportunities for student engagement through the use of different technological tools that help to develop stimulating activities and makes learning content more interesting (Parimala & Livingston, 2020).

Pedagogy must prepare learners to meet contemporary challenges; this involves the ability to promote multiple ways of teaching (Marc et al., 2018). Modern technology can assist creation of innovative learning strategies; emerging technological such as LMS, Mobile Learning, Artificial Intelligence tools, Gamifications and Video Conferencing tools spur an innovative mindset to students (Parimala & Livingston, 2020). Furthermore, pedagogy should facilitate students to apply their learning experience to their communities, and to their own personal experiences and situations (Persaud, 2019); to support this, teachers must develop challenging learning content and activities to promote students' cognitive development in order to lift their understanding of concept to the higher level. Anderson and Mccormick (2005) stated that a good pedagogy must match with existing curriculum; clear learning objectives; application of relevant content which are suitable from students' tasks; and alignment with assessment methods are important aspects.

Assessment is mostly considered as part of instruction; both formative and summative assessment plays their intrinsic role to promote student achieve high performance and increase quality of education (Black, 2013). Formative assessment refers to student's assessment during the course in order to monitor the progress, identify learning needs and adjust teaching where appropriate while summative assessment is used to measure students understanding at the end of course unit or topic (Black & Wiliam, 2018). According to Sert (2019), one of the pedagogical goals is to foster classroom interaction; this is the most important means to create students learning opportunities. Hence, a good pedagogy must provide opportunity for classroom

interaction. Nomlomo (2020) asserts that classroom interaction refers to ability to exchange roles and talks (conversations) between learners and teachers as well as between learners themselves. Learners are allowed to think, speak, and be listened to as they participate in a particular mode of inquiry; this provision stimulates student's involvement and fuels their motivation to see teacher's relevance to the topic (WaMaina, 2011).

2.5.2.3 Pedagogical Practices

Pedagogical practices are one of the most important stages in the professional training of students (Kravchenko et al., 2018). There are two categories of pedagogical practices applied in education namely participatory which involve practices such as group work, brainstorming, role playing and case studies and oppressive which involve practices such as bullying, racial and gender discriminations (Silva & Costa, 2016; Pittman, 2010). According to Tsegay et al. (2018), participatory pedagogical practices is an approach in which a teacher and students all together become responsible in the teaching and learning process. Instructors are no longer the only source of knowledge rather they engage students for mutual growth and development. Learners are placed to participate in all decisions related to the curriculum and how it will be delivered (Nyakrura & Mbalamula, 2017); the teacher's role is to be facilitator, motivator and a promoter of learning during the classroom interactions. This type of pedagogical practice is routed in the concept of constructivism whereby students gain the opportunity to interact and create meaningful knowledge through dialogue and reflection of concepts and eventually arrive at a common agreement (Omollo et al., 2017). However, positive instructor traits and skills; conducive classroom environmental factors; and classmates' perceptions are the major motivating factors for student's participation in the learning process (Mustapha et al., 2010; Abdullah et al., 2012). Participatory pedagogical practice enhances academic success; student's

voice; and competences which are crucial for learners to participate in the improvement of their learning (Simpson, 2018; Tsegay et al., 2018).

On the other hand, oppressive pedagogical practices refer to an approach which oppresses students' voices and dominates the teaching-learning process (Maekele et al., 2018). It hinders students' active participation in perceiving and sharing their knowledge. This pedagogical practice was described by Paulo Freire who was attempting to help fight back to regain the lost humanity and achieve full humanization (Freire, 1970). Since the practice oppresses students' voices and dominates the teaching-learning process, it encourages students to memorize content hence to repeat exactly when they have memorized (Maekele et al., 2018). Freire (1970) pointed out that when students are limited in active participation in their education process, rather their main role is to receive, file and store information. Mustapha and Rahman (2010) pointed out that this practice is driven mainly by teacher's attitudes; this happen when teachers became authoritarian and oppressive. As a result, students lose interest and become de-motivated which end up affecting their academic performance negatively. In this respect, educators must develop strategies to encourage student's activeness in order to overcome factors that hinder their active participations.

2.5.3 Technological Pedagogical Tools and Practices

2.5.3.1 Technological Pedagogical Tools

A study by Ndibalema (2020) and Aldosari (2020) highlighted a number of technological pedagogical tools; LMS is one of the the common technological pedagogical tool used for facilitating learning including collaborations among instructors and learners. Mesonovich (2019) and Mshangi (2013) pointed out that Learning Management System (LMS) is a useful pedagogical tool to facilitate interaction, enable course creation and delivery, provide charting

facilities among learners as well as with instructors, LMS facilitate discussion of the topic moderated by instructors, engagement and faciliates both formative and summative assessment. Massive Open Online Courses (MOOCS) is another pedagogical tool documented by Ndibalema (2020); this pedagogical tool is used for enriching learning contents. MOOCS fosters access to education and gives opportunity for learners to connect with global learners; it provide open access to education (Kumari & Naaz, 2020). Beside to this, electronic library was also considered as among the important pedagogical tools that provide learners access to learning resources beyond the normal books found in physical libraries; the resources include magazine journals, articles, papers, images, sound files, and videos (Aldosari, 2020; Brewer et al., 2017). Electronic libraries provide access to latest information from multiple collections in different formats at a very short time (Khan, 2021). Further to this, modern software and hardware are also important tools used for preparing learning resources and produce digital content (Ndibalema, 2020; Aldosari, 2020). According to Ndibalema (2020), other technological pedagogical tools such interactive animations, electronic games and simulations, learning systems for preparation of learning contents and AI tools for supporting individualized learning. Application of computers simulation programs can help students to easily understand difficult topics (Barakabitze et al., 2015). Simulation softwares provides learners with opportunity to practice what they have learned in a real-life situations; learners are allowed to experiment with the the real situation. It improves learners problem solving skills, promote teamwork, enhance decision making and critical skills capabilities (Campos et al., 2020). On the other hand, multimedia softwares can helps instructors to design interactive learning activities to stimulate the learning process; this make the education subject more interesting (Gunawardhana, 2016). Application of multimedia during contents development can enhance learners motivations (Mshangi, 2013).

Bidding & Ziden (2013), pointed that Mobile Learning is another important technological pedagogical tools that can provide mobility among learners and facilitates virtual learning anywhere at any time; it provide individual learning capabilities hence support continued life-long learning (Alomary et al., 2016; Mehta,2016). Beside this, a number of available video conferencing tools such are very useful, easy to use and cost effective pedagogical tools; these tools are very potential in enhancing teaching and learning process because it facilitates resource sharing including access to national and international experts (Kristóf, 2020). Zirawaga et al. (2017) also suggested that schools may opt to use commercial games to stimulate learning process; it makes learning process more palatable and encourage creative behavior and divergent thoughts. Furthermore, Barakabitze et al. (2015) and Mshangi (2013) highlighted the technologies such as radio and television to be among the important tools that can be used for accessing educational contents; it can be used to offer formal and informal education to learners who lack access to the internet or have low digital literacy. Though the availability audio-visual affects it helps learners to improve their listening skills as well as increasing learner's motivations (Potane, 2022).

Integrated databases have been used to record teacher's specialization, qualifications and experience; this helps to facilitate the process to distribute deploy and track professional development for technological pedagogy for teachers (Barakabitze et al., 2015). Technology can also be used to faciliate access to students with special needs; a number of assistive technologies are available such as text-to-speech (TTS) software, Talking spell-checker, text Magnification and hearing assistive technology tools (Viner et al., 2020). In addition to this, Viner et al. (2020) mentioned other assistive technology tools such as visual support systems, visual aids/technology and hands-on activities, assistive learning systems and math talk recognition softwares. In addition to this, social networking sites is among the technological development tools which has

become an indispensable means because of its capabilities to transform the education process; they are used to share classroom updates, share learners feedback, facilitate communication among students and instructors and collaborations (Alhumaid, 2020). Yoo & Kim (2013), pointed out that social media allows prolonged interaction among learners, instructors and parents. Technology such as Web 2.0 empowers instructors to instruct students; it enables collaborations among instructors, students and parents (Majid & Verma, 2018). It can be used to support communication and creation and sharing of wide range of digital artifacts. Tools such as Grammarly, Slide Share, Survey builder, blogs, Google Classroom are among web 2.0 technologies that if used in the teaching and learning process will motivate learners towards better learning environment (Majid & Verma, 2018). According to Perumal and Vinothkumar (2022), web 2.0 technologies are very useful in education as it helps to build and connect education communities hence increase engagement and touch. In addition to this, Conger at al. (2017) and Kioumarsi et al. (2018) pointed out that Wikis and wiki spaces are among the web 2.0 technologies that can enhance collaborations among learners thus enables knowledge creation. Wikis are powerful for project planning and documentation; these tools are useful in facilitating online learning groups discussions, support dissemination of information, thus enhancing the exchange of ideas and facilitating group interaction.

2.5.3.2 Technological Pedagogical Practices

Technology can aid a number of teaching practices; instructors can apply a range of software application for creation of teaching aid like visual graphics, charts, presentation and drawings (Kisanjara et al., 2014); visual graphics gives educators an opportunity to increase the quality of their teaching and to connect with learners in more interesting way. Teachers can transit text into a visual format which increased learner's cognitive capacity by providing clarity to complex concepts and create meaning (Duchak, 2014). For example, digital cameras offer aid to the

quick generation of visual images for teachers and students to utilize them in the classrooms; it helps to import graphics, photo and text presentations which is crucial in classroom for conceptual understanding and problem solving (Bakar et al., 2020). Visual graphics are used to facilitate communication about important concepts to help learners to build a deep understanding about the given concepts (Kumari, 1998). On the other hand, internet is the main source of education resources such as books, magazines, newspapers, audios and videos; teaches can plan lessons around the internet through creation of class activities, locating good resources for further reading, posting class schedules, assignments and events and for organizing online projects with interactive aspect. Kafyulilo (2010) highlighted a number of good practices by instructors when using technology as application one being the use of hands-on activities which provides learners with opportunity to share ideas with peers thus promote active learning. According to Musharrat (2020), application of hand-on approach can enable learners to easily remember the contents; this will enable them to transfer the skills in their real world. Hand-on activities can influence learners interest (Ekwueme et al., 2015); this is an important factor for increasing learners motivation.

Furthermore, Silva & Costa (2016) and Pittman (2010) suggested some pedagogical practices that are effective in ensuring students engagement such as group work, brainstorming, role-playing, case studies and demonstrations. In a student-centered approach, students are encouraged to take the active role in the learning process; brainstorming which is an open sharing activity usually conducted in small groups encourage actively participations among learners (Ammade,2018). It allows students to learn through sharing of thoughts, opinions and ideas as well as asking questions that evoke learners interest that is, it allows open-learning environment (Unin & Bearing, 2016; Khan & Ashraf, 2021); this practice encourage learners creativity, critical thinking, communication and problem solving skills (Khan & Ashraf, 2021).

Technology such as mobile technology, Wordle (a web-based game), mind mapping and different word clouds are some of the technological tools to facilitate brainstorming practices (Rashtchi, 2020). On the other hand, group work is the teaching practice that promote learning through socialization; learners learns together in groups which gives more opportunities for learners to contribute on the topic (Karim, 2015). Group work practice can enhance teamwork which increases ability for learners to contextualize the topic of study (Volkova et al.,2021). The main focus for the practice is to foster social learning, peer interaction, cognitive and communicative processes. Social and communication tools such as Google docs and social media sites such as facebook, instagram, twitter and whatsapp provides rich and complex communication environment that can facilitate group collaborations and enquiry learning (McKinney, 2016).

Role-playing promotes critical thinking, which is essential practice for learners intellectual development; the strategy helps to improve communication skills for learners through facilitating exchange of dialogue but also can modify learners behavior (Rashid & Qaisar, 2017). It involves designing contents which are learners-centered, that is, activities that permits every individual in the class to practice and express interactive abilities to showcase their various roles (Selvakumar et al., 2022). Technology such as voice recorders, video cameras and smart phones/tablets allow traditional face-to-face role-play exercises to be recorded and stored online; beside this, asynchronous technologies, such as online forums, discussion boards and social network allows role-play to take place over longer periods of time and in a more considered way (Glover, 2014). In addition to thia, case study is another pedagogical practice which involve problem based learning hence promotes analytical skills; it goes beyond knowledge generation to analysis, evaluation, and application of such knowledge (Bonney, 2015; Minniti et al., 2017). According to Bonney (2015 p. 21), “applying case studies practices can improve learners ability to

synthesize complex analytical questions about the real world issues associated with scientific topic". Further to this, demonstration strategy is a pedagogical events/practice with the purpose of illustrating a certain concepts; both learners and instructors gets opportunity to share their views and ideas hence learners feels the sense of belonging in their learning process (Pangaribuan et al., 2022). Demonstration practices increases learners cognitive and reasoning abilities. Visual aids including models, specimens, graphs, charts, videos are important tools for demonstration.

2.6 Technology and the Changing Nature of Learning

Today, technology plays an important role in everyday life; it has impacted different facets of life hence transforming the way we live (Mellati, 2018; Raja & Nagasubramani, 2018). Education is no exception, technology has created myriad changes in the education field, a range of new teaching and learning formats have been enabled through technology; these include application of mobile learning, artificial intelligence tools, video and audio teaching content, games and sophisticated simulations as well as enabling online collaborative learning (Cubukcuoglu, 2013; Dankbaar & Jong, 2014). Integration of technology with learning can be described as technology-based learning which refers to the type of learning which combines all approaches in which technology is used to support the learning or teaching process (Schweighofer & Ebner, 2015); Kirkwood & Price, 2016). Researchers have suggested substantial benefits when technology is integrated into the education field. According to Harris et al. (2016), technology has enhanced the communication between learners and instructors; it has allowed students to engage and learn in different ways (Cubukcuoglu, 2013). Students can constantly connect to content and are stimulated by the latest gadgets which have altered the education system (Eady & Lockyer, 2013). This theme describes how technology has changed the nature of learning; it starts by presenting the pedagogical aspects of technology-based

learning, followed by the pedagogical practices in the technology-based learning, and lastly discussing the implications for technology integration to pedagogy.

2.6.1 Pedagogical Aspects of Technology-based Learning

The potential of education lies in a diverse number of factors; these include characteristics of individual learners, level of intellect, personality and instructors' skills and knowledge, teaching methods and strategies, and educational background (Chiș & Grecb, 2016). Employing modern technology in education is among the factors that influences the education environment. Technology provides numerous ways of and forms to deliver learning content which might create positive effects to learner's academic performance (Mellati, 2018). Nevertheless, even though technology is regarded as a potential resource in enhancing education, in some cases the efforts to integrate technology in the classroom have brought with it some negative impacts (Atsari, 2020); these negative impacts need to be considered before planning to use technology in the classroom. Failure normally results from lack of sufficient ICT infrastructure, instructor's technology capacity, lack of plans and strategies for technology use and lack of pedagogical knowledge (Conger et al., 2017; Rana, 2017). According to Okojie et al. (2006) and Tondeur et al. (2016), the degree of success with technology-based education depends on the ability of instructors to explore the relationship between technology and pedagogy. Apart from just considering the integration of technical aspects when integrating technology in education, educators must also consider learning theories, strategies used to select appropriate technologies, instructor pedagogical beliefs and innovativeness, skill to use and evaluate the technologies and skills on how to apply such technologies to address the instruction problems (Okojie et al., 2006; Tindeur, 2016). These are the aspects of technology affordances which need to be identified and analyzed in the development of every education situation (Badia, et al., 2011). Consideration of

these aspects will foster the development of new instructional design guidelines which are based on a solid theoretical framework for technology-based teaching.

Beside this, modern technology has unique attributes which provide positive pedagogical affordances (Gibson, 1979) hence it requires the ability to manage and coordinate the technological resources in order to facilitate the teaching and learning process (Park, 2011; Okojie et al., 2006). According to Eady and Lockyer (2013), technology provides different learning opportunities including the ability to create classrooms which are engaging, interactive and collaborative. These technological capabilities have impacted instructors and learners' roles hence demand for a new integrated pedagogy (Web & Cox, 2007; Hassan & Mirza, 2020). The use of technology can change the pedagogical role of a teacher hence teacher's knowledge, beliefs and values should be favorably aligned with affordances provided by new technologies (Galvis, 2012). In order to make technology a valuable education asset, Tshuma (2016) and Cubukcuoglu (2013) pointed out that the curriculum should take into account the context, the disciplinary knowledge and pedagogy, as well as the assumed knowledge and experiences of the instructors and learners. In this case, Chișand Grecb (2016), pointed out that there is a need to adjust the teaching and learning strategies based on student's potential and learning style in order help students increase their learning efficiency. The section below describes important pedagogical aspects that need to be considered when integrating technology in the classroom.

2.6.1.1Employ Technology that Suits the Needs for Learners, Instructors and Other Parts

Integrating technology in education constitutes some form of change in the teaching and learning process; the selection of appropriate technology should consider the learning needs as well as the ability of both students and instructors to adapt and use such technology to fit the learning activities (Chiș & Grecb, 2016; Cubukcuoglu, 2013). Whatever technology employed by

educators, they must ensure it makes learners excited, informed, and confident as well as to ensure they possesses skill to apply the selected technology (Raja & Nagasubramani, 2018; Gibson, 2001). It is also important to ensure that the selected technology is highly accepted by learners, teachers and other involved parties such as parents and policy makers (Schweighofer & Ebner, 2015). This argument is supported by Web and Cox (2007) who pointed out that when examining pedagogy with respect to technology, educators must take into consideration the affordances of the whole learning environment which includes instructors, learners and other education stakeholders.

2.6.1.2 Employ Technology that Enhances Educational Process

Shulman's (1987) model for pedagogical reasoning focuses on teaching processes; the model incorporated actions that teachers undergo during the learning process, comprehension of subject knowledge, evaluation of student learning and instructor performance, the curriculum and pedagogy that occurs prior and throughout instruction and during evaluation (Starkey, 2010; Web & Cox, 2007). This also, involve selecting instructional technology that match with the learning objectives (Okojie et al., 2006). It is important to ensure that technology used for presenting instruction, evaluating courses and to support access for additional resources should match with the learning objectives; method of instruction; learning style; and mode and pace of the course (Okojie et al., 2006). Atsari (2020) pointed out that humans learn in different manners, rates, and under different circumstances. However, the quality of the education system is influenced by teaching performance. Therefore, it is important for instructors to use diverse teaching methods to address these differences and should ensure the evaluation of the education quality defers to the existing education theories (Codruta et al., 2011); this will help to maximize the delivery of teaching materials.

2.6.1.3 Employ Technology which is Appropriate to the Course

Different subjects need different technological tools to facilitate learning; for example, engineering subjects requires computer-aided drawing and design (CAD) software e.g. AutoCAD, simulation products, animation, and multimedia applications (Alazzam et al., 2012). In this respect, teachers should select technologies which are appropriate for a specific course when designing the course (Schweighofer & Ebner, 2015). Educators should identify latest technologies which are relevant to different subjects including science-based technologies applications such as simulations, modeling, and graphic visualizing tools in order to make teaching meaningful and real (Aramide, et al., 2015).

2.6.1.4 Employ Technology to Suit Demographic Characteristics

Understanding the demographic characteristics of the community and their influence towards the use of particular technology is important given the existing gap between information haves and have-nots (Aramide et al., 2015). Aldowah et al. (2017) and Tweed (2013) pointed out that demographic information is a critical issue when planning to integrate technology in schools. Such demographic elements include learner's age, cultural differences, social economic status, skills as well as gender differences (Schweighofer & Ebner, 2015; Zinger et al., 2017). Tirado-Moruetaa et al. (2018) and Aramide et al.(2015) pointed out that there is a strong association between age and digital divide which describe the lack of access, skills and/ or knowledge that result into being information poor especially for old people.

Some studies found that women still lag behind in terms of technology use compared to men (Tirado-Moruetaa et al., 2018; Aramide et al., 2015); due to their responsibility as family caregivers, women are more preoccupied with other issues as a result most of them miss access to education and the opportunities of employment. Lack of access to education limits their

opportunity to gain skills needed for technology use. Another critical factor to consider when integrating technology in education are socio-economic variables such as income, education level, job nature; according to Becker et al. (2019), before integrating technology in the classroom there is a need to think about ways to use, adapt technologies based on status of different individuals as well as their environments. Angello (2017) pointed out that in Tanzania technology is mainly concentrated in the capital cities with little deployment or access in rural where people of low income live. Research by Ramadhani et al. (2017) reveals that only 18.8% of individuals in rural Tanzania own a smart phone which provides access to internet, the rest, about 81.2% own feature mobile phones hence do not have access to internet. This information inaccessibility challenge among rural Tanzania is mainly due to social-economic factors as well as infrastructure (Ramadhani et al., 2017). However, Tirado-Moruetaa et al. (2018) suggested that lack of social and economic resources could be compensated for through government or donor support programs.

2.6.1.5 Choice of Technology should Consider Prior Knowledge and Experience

Possession of digital literacy among learners and instructors is an important for making meaningful use of technology in the classroom (Ezziane, 2007). According to Tondeur et al. (2016) and Aramide et al. (2015), technology competence and experiences has been identified as a crucial factor influencing teachers' adoption of technology. Shulman's Model focuses on the extent of knowledge level of the teacher on the subject matter (Shulman, 1987). This model can be extended to the teacher's technological adaptability and knowledge in the technology-based learning (Muniandy, 2015). Instructor's digital literacy leads to higher order thinking skills and provides creative and individualized options for students to express their understandings, which can better prepare learners to engage with the ongoing technological change in their community (Sabzian et al., 2013; Aldowah et al., 2017). On the other hand, learners who possess high level

of communication and collaborative skills are more likely to adopt new technologies. This is because they have ability to apply technology in a variety of manners and bring their visions and ideas alive through different types of media (Eady & Lockyer, 2013). In this respect, both instructors and learners should be prepared for effective technology integration (Ezziane, 2007; Vidosavljevic & Vidosavljevic, 2019). The effective way to inject knowledge to instructors is to provide them with the opportunity to learn about technology integration by evaluating, and (re-)designing curriculum materials (Tondeur et al., 2016; Alazzam et al., 2012).

2.6.2 Pedagogical Practices for Technology-based Learning

There is no doubt that technology has revolutionized the education business (Tshuma, 2016); it has created the possibility for learning to occur anywhere and anytime (Martin et al., 2013). Both learners and instructors use modern technological tools to facilitate their education practices. Technology makes learning interesting and engaging; it fosters better classroom management; removes the needs for physical meetings; and can accommodate different ways of learning (Riddh, 2021; Winters-Robinson, 2019). Modern tools have also fundamentally altered classroom teaching practices from curriculum development, instruction delivery, communication and assessment (Shaffer et al., 2015). Kulmagambetovaa et al. (2016) point out that each technological tool has a purpose, application, limitations and innovative possibilities hence it is important to select relevant tools for different education settings. In this respect, in order to realize the value added when technology is integrated in the classroom, 21st century learners must be equipped with skills that promote creative thinking, critical problems solving, collaborations and communication skills (Dreyer et al., 2012; Kulmagambetovaa, et al., 2016). Appropriate teaching practices enabled by technology should be adopted to improve the quality of teaching and maximize the attainment of education goals. However, the importance of using pedagogical technologies in the teaching and learning process should not be ignored.

Gao et al. (2019) have categorized the educational technologies into pedagogical and operational technologies. Pedagogical technologies involve technologies that are directly used to support the teaching and learning process (Tashkenbayevna et al., 2020; Gao et al., 2019); it is a pedagogy that is designed for the purpose of instilling knowledge and skills to learners. Pedagogical technologies and are split into tool-based and program-based technologies. Tool-based technologies give teachers means to become innovative and create new ideas for developing learning activities (Gao et al., 2019). Program-based technologies are those which are developed through research-based practices. On the other hand, operational technologies are those which assist the operational or administrative part of education process (Gao et al., 2019). Table 1 below illustrates some examples of pedagogical and operational technologies.

Table 2.2

Pedagogical and Operational Technologies

Technology category	**Examples**
Pedagogical technologies	- Microsoft Office for instruction delivery, e.g. Power Point. - LMS for instructional delivery and feedback e.g. Moodle and Blackboard - Smart board - Learning games - Artificial intelligent tools - Digitized contents such as e-books and videos - Smart boards - Video conferencing tools - Simulation softwares

	- Internet and Social Media sites - Research tools such as Mind mapping - Web 2.0 technologies - MOOCS
Operational technologies	- Email for communications support - Information systems for data management - Microsoft office for administrative assignment such as MS Word for report writing, MS Excel for grade computations and record keeping etc.

Application of appropriate pedagogical technologies can greatly improve the quality of the education as well as to enhance the education process (Kulmagambetovaa et al., 2016). Kulmagambetovaa et al. (2016) pointed out that technology provide tools that enable students to learn by doing; learn from experience; and allow students to try different methods of learning, support ideas from others and mostly important give space to think and act individually.

Technology-based pedagogy can simply mean the effective use of technology to promote meaningful learning (Zinger et al., 2017). It consists of a range of modern technological tools and practices to make the education context appealing and match with the need for learners in the digital age. Shulman (1987) emphasizes that instructors should create a variety of teaching and class management activities. However, according to Web and Cox (2007), teachers with higher level technological and teaching skills can lead to creation of a good classroom environment; such instructors are capable in developing activities which promote the development of creative thinking among students, which also provide instructors with opportunities to detect learner's

personal qualities (Kulmagambetovaa et al., 2016). Through technology, instructors can make scenarios which motivate students to learn independently (Bhaskar, 2013). These include creating activities that encourage student access to e-resources. Table 2 illustrates examples of technological resources available.

Table 2.3

Technology Resources

Technology Resource	**Examples**
E-resources from websites	- e-journals - Articles - Documents - Education videos - Apps - Online lectures
Social media for social engagement	- Social media sites (Facebook, Twitter, LinkedIn) - Blogs - Wikis
Resource to facilitate interaction	- e-mail - Instant messaging - Voice and video calls
Resources for Feedback and collaboration	- GoogleDocs - YouTube - Slide share

However, the use of technology in education can enhance participatory pedagogical practices; it can be used to promote active learning, collaboration, engagement and reflective practices among students and instructors (Adu-Gyamfi et al., 2020).

Zhou et al. (2011) suggested that collaborative practices are beneficial to both instructors and learners; fostering student's interest; improving teamwork; and improving capability for learners to critically evaluate problems (Junor et al., 2009). It enhances the learning outcome due to the monitored nature of learning through regular feedback to instructors (Junor et al., 2009; García-Valcárcel, et al., 2014). Collaborative practices allow students to share ideas, experiences and perspectives which increase cognitive thinking and understanding (Mallon & Bernsten, 2015). There is wide range of potential tools available for facilitating collaboration; according to Mallon and Bernsten (2015), such tools include tools for idea generation and brainstorming such as Google Docs and real time collaborations tools; tools for online group work such as Google Drive and Zoho; tools for online communications such as GoToMeeting, Skype, Zoom and Google Hangouts. Beside this, the use of social media can also facilitate cross-school working and collaboration beyond geographically based local networks (McAleavy, et al., 2018).

Reflective practice is an important component of professional growth; it involves the ability to continuously question one's own aims and actions, monitor teaching practices and outcomes, and consider the short-term and long-term effects upon each learner (Junor et al., 2009; Habib, 2017). Reflective practices promote constructivism (Osterman, 1998); they help learners to develop, assess and organize their thoughts (Mugambi, 2018). Beside these, integrating reflective activities in the classroom can foster positive change in the behavior and mindset of learners (Bankhead et al., 2016). Reflective practices involve review of previous experience, analysis of cause and effect and drawing conclusions which may lead to future changes and improvement

(Mathew et al., 2017; Strampel & Oliver, 2007). In this case, integrating activities that promote student's reflection in the course can encourage students to reach deeper levels of learning (Habib, 2017). The use of modern technological tools can facilitate creation of supportive strategies that foster the highest level of reflection; such strategies include reflective online diaries and journals; audio and video recording of lessons for preview; instructors and students reviewing and feeding back on sessions through online collaborative tools; action research which leads to progressive problem solving; and reflective discussion forums that promote creative thinking (Strampel & Oliver, 2007; Mathew et al., 2017; Habib, 2017). According to McAleavy et al. (2018), social media activities such as blogging can also support reflective practices if appropriately used.

Arghode et al. (2017) highlighted that engaging practices are vital to maintaining students' attention, stimulating the learning process and improving academic achievement. Applying technological pedagogical practices can lead to greater student engagement (Khan et al., 2017); utilizing online tools for interactions such as online discussion forums; building online communities – groups, scheduling live classes and integrating gaming activities can promote learner engagement (Lange, 2018). Technology such as flipped learning can motivate both instructors and learners to engage with digital resources before attending the live sessions (Mcleavy et al., 2018). Integration of electronic resources such as text, audio and video contents, online quizzes, and online communication tools such as Skype, zoom, mobile technology and computer gaming can greatly influence learner's engagements (Mcleavy et al., 2018). These practices are linked to constructivist design because they are based on social negotiation; foster collaboration; facilitate critical thinking and problem-based learning; and can support building of learner's mental model (Mugambi, 2018).

2.6.3 Implications of Technology Integration within Pedagogy

Technology plays a leading role in the classroom scenario (AlDahdouh et al., 2015; Cubukcuoglu, 2013); its prevalence created significant positive effects in the education field. The rapid integration of technological tools in the classroom has created a challenge for educators to keep pace with new innovations which has seriously affected the curriculum (Grimus, 2020; AlDahdouh et al., 2015). Integration of technology in education has promoted learners' motivations and engagement to learn; this has broadened their skills and improved their work experiences thereby preparing them to meet the demand for the 21stcentury labor market (Adedokun-Shittu et al., 2014). According to Sammel et al. (2014), utilizing new digital technologies for learning may shift between processes and stages in a dynamic way depending on the experience, motivation and disposition of the teacher and the learner. The existing pedagogy does no longer fit to support the diverse learning styles and experiences influenced by digital technologies (Sammel et al., 2014). The following section describes the implications of technology integration with pedagogy.

2.6.3.1 Created Demands for New Education Theories

One of the critical challenges when integrating technology in education has been how to position technology within an appropriate theory of learning (Grimus, 2020; Chetty, 2013). To overcome this challenge new learning theories in education have emerged to negotiate the changes in learning design resulting from technology integration in the classroom. Beside this, technology integration in education has afforded a personalized learning environment which promotes initiation, creativity and critical thinking and has created an education environment which is controlled by learners themselves (Tashkenbayevna et al., 2020; Dočekala & Tulinská, 2015); these practices provide intrinsic motivation to learners (Legault, 2016). In this respect, it is critical that instructors understand the education theories that are attached to digital pedagogy.

According to Muianga (2019), pedagogical models are views of pedagogical theories or approaches that are used to guide the education practices and create systematic ways of teaching and learning; this relates with the methodologies and strategies that the teaching and learning processes are organized. Although theories such as behaviorism, cognitivism and constructivism are still relevant, AlDahdouh et al. (2015) pointed out that some ideas in these theories fails to address learning that occurs outside the classroom; initiated with the fore grounding of new epistemologies and ontological theories within the digital age (Chetty, 2013). The main reason for this is the fact that technology has introduced a new learning design which requires new skills and knowledge for teachers; however, according to Amin (2016), it is not possible for teachers to possess all kinds of knowledge and skills to teach individually each student with their different talents. To address this challenge, the concept networking or distributed learning was introduced; networking learning considers what learners reach in the external network as part of knowledge (AlDahdouh et al., 2015; Siemens, 2008). In addition to this, introduction of new methods and approaches for teaching and learning demanded for new or modified education theories (Muianga, 2019). Today, many new theories which seem appropriate for teaching and learning in a digital age are coming to the fore; connectivism is among the latest theory introduced to support this new education paradigm (Matter, 2018; Chetty, 2013).

2.6.3.2Technology Induced Changes to the Teacher – Student Relationship

In the traditional learning environment, the relationship between teacher and student was an unequal relationship because teachers were more superior, and students were considered as subordinate (Yan, 2019). However, Yan (2019) suggested that in order for the teacher to stimulate and inspire students' self-directed learning, teachers should create a supportive, equal, relaxed and motivating learning environment. Similarly, Freire (1970) pointed out that education can be achieved only when there is an equal and respectful relationship between a teacher and

learners. Beside this, integration of technologies such Mobile Learning, Audio and Video Tools, Social Networking, Digital Gaming and Simulations tools for pedagogy has forced educators to understand the leveraging of these technologies which created changes to teacher-student relationship (Singh, 2016). Both learners and instructors find these tools fascinating hence its impact was already felt in many elements of pedagogy (Singh, 2016). In the traditional setting, teachers were the controller of everything and there was no room for student self-discoveries; technology provides room for teachers to engage students to improve the teaching goals hence strengthening the relationship between teachers and students (Egemen, 2018; Higgins & BuShell, 2018). This relationship plays an important role in striving to validate teaching practices and the relationship between pedagogical theories and learning outcomes (Yan, 2019); this has shifted pedagogy from the pedagogy of oppressed to the pedagogy of hope (Freire, 1970).

2.6.3.3 Technology Induced Changes to Instructor's Roles

Beside this, according to Hassan and Mirza (2020) and Dhanda (2015), technology has shifted teaching practices from teacher centric to learner centric; teacher's roles have changed from being an expert in the classroom to being the co-collaborator, constructor, facilitator, coach, and creator of learning environments (Luan et al., 2008; Amin, 2016). In the traditional educational setting, teachers were the main sources of knowledge transmission which is not the case at present; today, teachers' endeavors open more sources of information and knowledge to students as well as providing guidance on how to explore alternative sources of knowledge (Hassan & Mirza, 2020; Dhanda, 2015). This change of roles demands teachers to express different sets of skills, attitudes and knowledge which were not relevant in the traditional education; this fact has also affected the pedagogy (Hassan & Mirza, 2020). Now, teachers must be able to connect

subject matter knowledge with pedagogical knowledge; and provide extended, well-mentored field experiences (Finley, 2000).

2.7 Technology-Enhanced Pedagogical Designs

Contemporary society is awash with innovations in information and communication technology. The invention of the Internet and other modem technologies has been considered as the major landmark which fosters multiple way of doing work (Mota et al., 2014). In the field of education, technology integration has changed teachers' pedagogical practices and renewed learning strategies amongst learners (Panagiotidis et al., 2018); a number of initiatives are in place to keep up with the changes in educational theories due to introduction of new technologies (Mota et al., 2014; Halverson & Smith, 2009). Technology has become an important layer for instruction, hence when applying technology instructors must consider the learning content, learning objectives, instructional strategies and how the instructions is represented and controlled using the selected technology. According to Lakkala (2007), modern technology has created new possibilities in the teaching and learning process which leads to the emergence of new kinds of teaching practices. However, in order to reap the potential of new technology, new strategies should be developed to enable learning designs which cater for the learner's needs, interest or preference (Mota et al., 2014; Tondeura et al., 2016). In this respect, Lakkala (2007) pointed out that it is important to understand how technology should be used to inform the design of learning content that will serve as an advanced way of learning including opening up new opportunities that will improve the teaching and learning process (Groff, 2013). However, combining different technologies is essential since applying different tools can impact education in different ways (Jaldemark et al., 2018). This section describes various instructional designs which are relevant in the technology-based education field. The discussion includes instructional design to enhance

student's engagement, creativity and innovation as well as addressing student's motivations, collaboration and information access.

2.7.1 Technology-Based Design to Enhance Students' Intrinsic Engagement

Engaging students in learning has been positioned as a fundamental characteristic for quality education (Ashwin & Mcvitty, 2015; Gebre et al., 2014); it is viewed as an important element to address educational problems such as low student achievement, high student dropout rates and student isolation. According to Olson and Peterson (2015), engagement refers to an individual's degree of interest and passion about the course or topic which impacts academic performance and behavior; it refers to students' connectedness—to their lessons, to one another, and to the general principle that learning goals are worth committing to (Ferlazzo, 2019). Students who are intrinsically engaged in learning are likely to improve their learning outcomes; improve attendance, retention and academic resilience (Ashwin & Mcvitty, 2015; Olson & Peterson, 2015; Parsons et al., 2014). However, effective engagement should include creating a sense of ownership in the classroom as well as interest, curiosity or enthusiasm about the course, topic or assignment (Parsons, 2014). This is achieved when a teacher promotes students 'self-discoveries; become a partner and not provider; create space for opinions and mistakes; and create supportive and caring environment (Lee, 2019; Plotinsky, 2019)

Introduction of technology in the classroom has influenced an increase in student's engagement; it has increased the possibility of student's active participation in learning (Wajszczyk, 2014). Modern technology-based tools have helped teachers to create and present interesting and relevant content to students (Wardlow, 2016**).** Technology has also helped to incorporate new ways of teaching and learning which increases students' and teachers' engagement (Perdue, 2016; Himmelsbach, 2019). According to Olson and Peterson (2015) and Himmelsbach (2019),

creating relevant content to foster student activeness will help students to better engage with their learning materials. However, in order to increase learner's engagement teachers should be aware of its effective, behavioral and cognitive dimensions (Parsons et al., 2014; Bond & Bedenlier, 2019). In order to make truly engaging content, the content must be interactive (Himmelsbach, 2019). In this respect, teachers should create opportunities for active learning; encourage autonomy and further independence through choice; focus on building students' relationships; create content which makes learning fun; and should use methods and content which are relevant to students (Olson & Petersons, 2015; Perdue, 2016).

There are many contextual factors which are vital and must be considered in order to influence engagement in the teaching and learning process (Bond & Bedenlier, 2019). Institutional support is very important to enhancing student's engagement; this includes implementing digital strategies and developing the technological pedagogical skills of teachers (Bond & Bedenlier, 2019). Institutions must also provide adequate learning supports such as digital libraries, develop relevant educational policies and social events; ensure the availability of technology to enable access to online learning and use of social media; creating conducive learning environment including ensuring class size is limited to provide opportunity for interaction, incorporation of feedback and discussion elements; and creation of opportunities for participation such as practical's, group discussion and collaborative learning (Himmelsbach, 2019; Villiers & Werner, 2018; Bond & Bedenlier, 2019). Integrating technologies such as web-conferencing software, blogs, wikis and social networking sites to pedagogy can influence student engagement (Schindler et al., 2017). Scholars have suggested application of different technological strategies to enhance engagement in the teaching and learning process.

a. Web conferencing software – this can provide virtual spaces to share files (audio and video) or instant messages in real time. It provides room for interaction between peers as well as tutors. Dames et al. (2016) suggested a number of potential web conferencing software including those which are open source and free tools such as Big Blue Button, and WIZIQ and commercial ones such as WebEx, Adobe Connect, Illuminate, and GoToMeeting.
b. Blogs–these constitute a way of new content sharing and can create opportunities for student's engagement and communications (Angelaina & Jimoyiannis, 2012). Blogs can be used to post ideas, and experiences which promote dialogue between learners and instructors; it can also support reflective learning which leads to deeper understanding and knowledge construction (Angelaina & Jimoyiannis, 2012; Shana & Abu-liben, 2015).
c. Wikis –these are an effective tool for constructive learning; it allows learners to construct their knowledge through engagement with others which also strengthen learner's cognitive skills (Helly, 2018). Wikis allow editing of contents by multiple users hence it is a suitable pedagogical tool for group assignments, whereby users can work collaboratively. Example of free and easy to use wikis includes EditMe and WikiBooks.

2.7.2 Technology-Based Design to Address Students' Motivation

Motivation is a way of creating passion to achieve certain goals (Haque et al., 2014); it is a predictor of student achievement (Johnson, 2017). According to Girmus (2012), learning does not occur without a preceding motivation event. Generally, motivation means to be an innate desire to do something (Ryan & Deci, 2000; Johnson, 2017); it is regarded as a set of external and internal forces that elicits, controls, and sustains certain behaviors (Ayari et al., 2012; Haque et al., 2014). Redondo and Martín (2015) have defined motivation as individual state influenced by different factors such as belief, interest, goals and wishes that demands efforts from learners;

it is an individual's disposition to learning activities that can be modified by the learner him/herself and by the environmental circumstance. Gordon et al. (2016, p.1) has also defined motivation as a desire to accomplish a certain goal; it is "a reason for learners to act or behave in a particular way as they are engaging with learning". Motivation directs behavior toward achievement hence it is an important determinant of student academic performance (Steinmayr et al., 2019).

Motivation is categorized into intrinsic or extrinsic motivation. Legault (2016) and Reiss (2012) pointed out that intrinsic motivation refers to the engagement in behavior that is inherent satisfying and enjoyable while extrinsic motivation is the performance of behavior that is aimed upon achieving a certain goal. Intrinsic motivation is derived from internal motives because it either brings pleasure that students think is important or feelings that the learning content is significant to them (Ayari et al., 2012; Reiss, 2012). On the other hand, extrinsic motivation is influenced by the needs to attain certain goal; it depends on the external factors which compel learners to act on a certain behavior or to do something (Ayari et al., 2012; Reiss, 2012).

Technology has created both practical and pedagogical opportunities (Taylor & Parsons, 2011); through technology materials that can be shared between individuals where access is provided and monitored (Gordon et al., 2015). Sharing information can help improve learners experience and create relationships which increase their motivation (Ghaisani et al., 2017). Technology is a powerful tool to facilitate student engagement both inside and outside the classroom which is an important element for students' motivation (Ayari et al., 2012). Technology has fostered the development of instructional content which is enjoyable thus encouraging learner's motivation. Modern tools have also directly impacted the teaching and learning process including the ability to capture student's opinions and feedback (Ayari et al., 2012; Gordin et al., 2015). According to

Hamidun et al. (2012), instructor feedback can have strong effect in motivating learners as it allows learners to communicate effectively with their teacher hence improving their performance level. Furthermore, technologies such as video content, interactive games and other relevant tools can promote student motivation (Ayari et al., 2012); such tools encourage the student's participation to their learning which increases their level of understanding.

Teachers have the role to build and keep student motivation (Johnson, 2017) hence they must fully understand the concept of motivation and the fact that each student is unique (Khikmah, 2019). Teachers can influence students to develop personal interest, increase their responsibility, and sense of ownership over their studies, which aids in motivation (Johnson, 2017); however, teachers choice of using specific activities can have a positive or negative impact on student motivation. In this respect, the choice of technological tools must suit a student's characteristics (Khikmah, 2019). Developing activities that cater for students' own needs and interests can increase students' willingness to respond (Granito & Chernobilsky, 2012; Kariuki & Mbugua, 2018; Autio, 2011); this is a kind of intrinsic motivation. In this respect, students should be supported to familiarize themselves with the selected technology in technology-based learning. Applying activities that are perceived to be more positive is reliant upon intrinsic motivation (Gordon et al., 2015). Integrating the following aspects and technologies in the education process may promote students' motivation in technology-based learning.

a. Games rewards elements such as badges, leader boards, and automated recognition encourage progression through tasks by offering progress markers with the aim to achieve curriculum needs (Baker, 2018). Schindler et al. (2017) pointed out that application of gamified elements, such as digital badges and leader boards, may provide additional motivation for completing assignments and other learning activities. However,

the design of games should be aligned with specific learning objectives (Raba & Tanni, 2014).

b. Feedback and other practices can increase the level of extrinsic motivation; technology can facilitate prompt feedback among students. Pedagogical approaches of formative and summative assessment have been highly improved by technology integration. The use of automatic online discussion forums, automated online quizzes and tests can increase flexibility hence making students' motivated (Xie et al., 2005).

c. A social networking property is another important area to exploit when designing pedagogy for technology-based learning. It helps to facilitate the development of networks among learners which can foster learner's motivations, increase commitment levels and encourage construction of knowledge (Tanni, 2016; Perdue, 2016). Learners' motivation is boosted when they find that their posts were read by and commented on by an authentic audience (Domalewska, 2014; Thangiah, 2018).

d. The use of mobile phone to access resources, read emails, texting/charting as well as other communication apps can enhance student's engagement which is an important element for motivation (Gordon et al., 2015).

e. Integrating videos, and video conferencing through Skype, Zoom and other software are also potential technologies that help to exploit technological affordances for students learning and motivations. Video conferencing have a potential to provide opportunity for online collaboration hence create successful learning because it allows students to obtain support from each other in different ways (Osterman, 2016).

2.7.3 Technology-Based Design to Enhance Students' Creativity and Innovation

In the 21st century education system, innovation and creativity are critical requirements (Henriksen et al., 2018); in this instance, greater emphasis should be given to the role of

designing an education system that fosters creativity and innovation (Cropley & Cropley, 2010). Creativity is all about production of new concepts, interesting ideas, artifact, alternatives and possibilities in the realm of human activities (Al-Ababneh, 2020; Surbhi, 2018; Creely & Henriksen, 2019); the created ideas should provide useful solutions and appropriate in solving a certain or range of problems (Henriksen et al., 2018). Creativity is an essential thinking skill to create utility and valuable educational innovation (Seechaliao, 2017). On the other hand, innovation refers to the application of new ideas to make changes to existing objects for the purpose of adding its value and contributing to the knowledge (Surbhi, 2018); it involves transforming ideas into practices or a process which turn the ideas into new value (Zawawi et al., 2016; Shaver, 2014). The difference between these two elements lies on the fact that creativity is about creating new concept and ideas while innovation is about introducing new changes to the existing systems (Surbhi, 2018).

Connection between technology and creativity is the key issue for the modern education (Henriksen et al., 2018). Digital tools and devices provide learners with opportunities to develop their cognitive and critical thinking skills, increasing reasoning capacity and communication skills (Al-Ammary, 2012). Emerging technological tools can be used to develop instructional models to promote creative thinking (Creely & Henriksen, 2019). However, before integrating technology in the classroom, educators must first consider how to enact creativity in the classroom setting; this is the major requirement in addressing problems in the 21st century (Henriksen et al., 2018). Learning Management System's (LMS) in virtual classrooms exert a sufficiently significant influence with learners receiving a stimulation effect from the use of the media in the learning process which can afford new ways of being creative and knowledge communities (Dasmo et al., 2018; Creely & Henriksen, 2019); collaboration and communication

tools, technology media and resources enables feedback, collaboration and sharing, which fosters creative thinking (Creely & Henriksen, 2019; Seechaliao, 2017).

Educators must consider designing an education environment which provides opportunities for divergent thinking; creates problem-solving, collaboration and student engagement when integrating technology in the classroom (Cochrane & Antonczak, 2015). There are potential pedagogical technologies that educators must consider when designing their pedagogy for technology-based learning. These include:

a. Creation of online learning spaces such as discussion boards, or simulations which are potential tools to promote creativity. These creative learning spaces provide opportunities for learning through discussion, inquiry and practices which enhance student understanding; create opportunities for reflection; promote sharing of perspectives in resolving problems and creating valuable and useful solutions (Creely & Henriksen, 2019; Chudinova, 2019).
b. Mobile learning to facilitate personal learning which also provides the potential for collaborative interaction and encourages learners to develop innovative approaches (Cavus & Uzunboylu, 2009). Mobile learning has the power to transform the student learning experience and provide learners with skills to elaborate ideas creatively; planning and analyzing skills when responding to issues around them (Cochrane & Antonczak, 2015; Astuti et al., 2018).
c. Webinar is another potential pedagogical area to offers opportunities to promote interactive dialogue and promotes collaborations (Gamanik et al., 2019). Creating role-play simulation activities in a webinar can encourage students to disengage from their

own views and develop an alternative solution which is an extremely valuable method for learning as it encourages thinking and creativity (Kartika & Budiana, 2017).

d. Social media applications such as Facebook, MySpace, Flirk, YouTube; online games and blogging can offer opportunities for students to express their creative and innovative ideas (Thangiah, 2018); the ideas can also be made available to large audience for recognition (Ferrari et al., 2009; Gamanik et al., 2019).

2.7.4 Technology-based Design to Address Collaborative Issues

Collaboration is associated with working as a team or group in order to gain a new impetus and achieve a learning goal (Laal & Laal, 2012; Roselli, 2016). Collaborative learning is a type of education practice that involves "a group of learners working together to solve a problem, complete a task, or create a product" (Laal & Laal, 2012, p.491). Chandra (2015) pointed out that an educational experience that promotes students' activeness, social interaction and engagement can lead to deeper learning. Collaborative practices can enable students to develop high levels of thinking, communication and presentation skills, self-management, self-esteem and responsibility (Chandra, 2015). When students collaborate, individual knowledge acquisition is enhanced; application of knowledge improved; and social competence is increased (Pozzi & Persico, 2011; Domalewska, 2014); students can discover, construct and transform the knowledge gained (Laal & Laal, 2012).

There are potential technological tools that can be used to create collaboration in the teaching and learning process; however, educators must be aware of relevant technology applications that can promote learners group work and shared experiences (Resta & Laferriere, 2007).

a. Integrating instructional technology such as Internet tools, software applications, and mobile devices can offer a valuable complement to the teaching and learning process;

these tools facilitate teachers and students' interaction asynchronously and synchronously (Matthews & Johnson, 2017).

b. Email communication, blogs, and Google Docs are highly interactive tools (Domalewska, 2015); teachers, as well as students, can interact asynchronously.
c. Conferencing applications such as Google Hangouts or Zoom, and instant messaging can facilitate real time interaction among students and instructors (Matthews & Johnson, 2017).
d. Mobile devices and apps have widely penetrated today's technology; these devices and apps have created possibilities for learners and instructors to explore collaborations creatively. Mobile devices provide access to a range of online tools and corresponding apps such as YouTube and WhatsApp. Integrating these apps can help students to create both their own identities and express their ideas/views; they offer many options for both teachers and learners and encourage reflective practices hence students can gain deeper understanding.

2.7.5 Technology-Based Design to Address Information Accessibility

Access to education is a right of every individual regardless of their physical status (Limaye, 2016). Access to information depends on formalized structure to ensure the location of the information is known and the required information is available (Opara et al., 2008); in particular, access to information for learning should be reachable by all the intended audience (European Agency for Special Needs and Inclusive Education (EASNIE), 2015). Technology has made it possible for many people to create and share information. According to EASNIE (2015), information access is an ability to create and share information in a way that the content is adaptable by the user and allows the user to customize the information's to suit their needs. Information access "refers to the means or modes through which information is made available

or to an entire range of possibilities for making information and information services available to the users' (Manjunatha & Shivalingaiah, 2003, p. 85). It is about ensuring all individuals, regardless of their social economic environment and physical status, can access information equally (EASNIE, 2015).

The exponential growth of technology has greatly influenced the methods and media for information access; it has tremendously increased the ability to access, store and process information (Chirwa, 2018; Bhoi, 2017). Technology has facilitated pedagogical strategies that have potential benefit for learners (Rodrigues & Biagi, 2017). Some pedagogical technologies for consideration when designing pedagogy to address information accessibility should include the following.

a. Communication technologies such as email (textual or voice) to exchange electronic messages and information (files, pictures, sound, article) for education purpose.
b. Social media applications such as Facebook, Twitter and Blogs to share/disseminate e-resources to largest part of user. It makes information virtually accessible anytime and anywhere (Thangiah, 2018).
c. Digital library and repositories to facilitate information access; in digital library entire contents including electronic books, HTML, PDF, audio and video files as well as other services can be made accessible online (Bhoi, 2017).

Beside this, technology has a potential to facilitate inclusion of students with different disabilities (Fichten et al., 2009); Foley and Ferri (2012) pointed out that social inclusion should be a key consideration when educators design pedagogy for technology-based education. A range of technological tools are available for supporting individuals depending on the nature of their disability and access they need.

a. Specific, for individuals with special needs, technologies such as screen magnifiers, large-key keyboards or phones, input devices such as touch screen displays, trackballs and joysticks, eye trackers for use in gesture or pointing based, voice recognition software's and Braille are relevant in supporting their access to education (Pal, 2015).
b. The use of video or audio, text recognition capabilities of smartphone, screen readers can be tactile for people with visual impairments and
c. Captioned videos in YouTube for deaf people (Quarless, 2016; Pal, 2015).

However, Foley and Ferri (2012) argued that the focus of technology is not to address a particular disability but to address accessibility issues, hence the tools are integrated to support different formats of content to ensure that content is inclusive.

2.8 Chapter Summary

The chapter discusses the published information which relates to the research topic, the discussion begins by presentation of the underlying theoretical framework which explains how the research was constructed with theoretical grounds (Adom et al., 2018). Five educational theories of which the research was grounded were discussed. This were followed up by presentation about learning concepts and techniques; the discussion focused on the definition of learning and how the learning occurs, the delivery modes, teaching approaches and lastly the learning strategies were presented. The purpose of the study was to design an appropriate technological pedagogical model; the researcher understanding of these concepts and its relevance was found to be necessary to understand these concepts as it enabled the researcher to identify elements that are relevant for the design of the model. The discussion also provided the description of the benefits and limitations of each education delivery mode (traditional face-to-face, flipped/blended and online/distance) as well as the teaching approaches (teacher-centered

and student-centered). In the next section of the literature the researcher provided the discussion on technology integration in the education, starting with the description of the concept of education technology, milestone, affordances, and roles. This was followed up by the discussion about the potential of technology in education and the challenges associated with integrating technology in the education process. An understanding of the potential of each learning delivery mode and instruction approach helped to inform the design choices; that is to enable the researcher to make an informed decisions about what technologies are relevant in designing and supporting learning activities (Conole, 2010).

In addition to this, the researcher presented a list of emerging technologies with their potential benefits as well as the limitations; the discussion focused on evaluation of its impact. A range of emerging technologies such as LMS, Mobile Learning, Video Conferencing, AI, and Games were presented. This information helped the researcher to evaluate its potential values in supporting the education process (Ahmad & Awan, 2020). In the next section of the chapter the researcher discussed the concept of pedagogy and pedagogical models, principles and practices. This enabled the researcher to understand available pedagogical models, principles and practices to inform the design of the mode. Thereafter, the researcher described the pedagogical aspects that are useful in technology mediated teaching. Lakkala (2007) pointed out that a successful application of technology in education may create changes in the whole education process hence it is critical for the researcher to deeply understand these concepts so as to be able to define important issues that are necessary when designing technological pedagogical model. The implication of technology to pedagogy was also discussed in this chapter; this is of utmost importance for making wise decisions regarding teaching and learning with technology (Kruse, 2013). In the last section of the chapter the researcher presented a description on pedagogical design relevant to technology-based education. According to Bower (2017), most of the learning

technology research focuses on identification of benefits, issues, and design that relate to a particular technology or technologies. This section enables the researcher to understand the potential technological tools relevant for technological pedagogical designs.

Chapter 3: Research Method

3.1 Introduction

The main purpose of this qualitative study was to establish a pedagogical model for technology-based teaching among Secondary Schools in Tanzania. The process involved a critical analysis of the available education practices and identified core pedagogical practices that would afford meaningful technology-based learning. As an outcome of this process, the researcher's expectation is that the resultant model will guide the effective integration of technology in teaching and learning process among secondary schools in Tanzania. Integrating the model into schools and practice will maximize teacher's pedagogical knowledge and competence which is crucial to effective teaching practices. This study aspired to prompt the Tanzanian Ministry of Education Science and Technology to review its strategies towards technology integration among secondary schools and adopt modern practices that are relevant for technology-based education. In this respect, the pedagogic potential of available technologies in education will be increased. Finally, it was the researcher's expectation that the proposed model would contribute to the development of a new tranche of education and training policies; it will inform policy makers and education practitioners about how to engage the model when implementing on-line learning.

This chapter aims at explaining the research methods and the strategies which were followed when undertaking this study. The first part of the chapter describes the different research design forms available; based on the nature of the study the chosen form of research design is identified and justified. This is followed by a discussion on the philosophical conditions under which the research was built; the discussion focuses on the positivist and constructivist ontological and epistemological perspectives which underlie the research design. The chapter then goes on to discuss the research approach employed during the research and the process which was followed.

In this research, a case study approach was adopted and justification of this method as relevant for the study is given; in addition to this the steps towards implementing the case study approach are described.

The second part of the chapter discusses the population and sample of the study; this includes a presentation of the study area and the target population. Thereafter, a discussion of the sample size; sampling techniques; sampling distribution of the respondents; and description of the sampling strategy is presented. In the third part of the chapter a discussion of the material/instrumentation of the study ensues; this includes a description of the data collection instruments and a discussion of the relevance of the selected instruments. This is followed by a discussion on how each selected instrument was administered in order to obtain relevant data for the study. The chapter then discusses the ethical considerations specifically, the ethical procedures and principles employed throughout the research process. In the fifth part of the chapter, a discussion of how the data were analyzed and validated is presented; this includes a discussion of the different methods used in analyzing the data and how data were triangulated in order to capture more dimensions of the phenomenon of study and how the results were validated to meet the aims and objectives of the study. Finally, a summary of key issues which are discussed throughout the chapter is presented.

3.2 Research Design and Approach

In order to execute the research process efficiently, a researcher must integrate different components of the study in a methodical manner. This process is termed a research design; it describes the research types and the process which were followed to arrive at a valid set of conclusions. According to Akhtar (2016) and Boru (2018), a research design articulates the arrangement of research or relation between components of research. It is a logical plan,

structure and strategy that are utilized to conduct research; it involves arranging of the research elements in a systematic way to enable the researcher to achieve the study's intended purpose and objectives (Boru, 2018). In the study process, research variables and tools for collecting and analyzing data were identified. However, the goal of sound research design is to provide credible results. Akhtar (2016) suggests that a good research design must be theory grounded and is characterized by flexibility, appropriateness of methods, efficient and cost effective.

The choice of the research design depends on the purpose of the research topic. According to Boru (2018), three possible forms of research design are available; these are descriptive, explanatory and exploratory. The main purpose of descriptive research is to gather information about the current position of a phenomenon with respect to the variables and the real time conditions; it is basically quantitative in nature. On the other front, explanatory research is used to explain for the descriptive information; it aims at discovering the relationship between different aspects of the phenomenon under study (Akhtar, 2016). Exploratory research design is used to investigate problems that have not been clearly defined; the purpose is to gain insight and familiarizations for later investigations (Boru, 2018). It forms the basis for further research by establishing an understanding of how best to proceed in studying the topic and brings about the conclusive results. The main focus of this design is to gain insights about the subject using a set of research questions which can greatly increase the usefulness of a study's results (Yousaf, 2021). This study attempts to explore the insights regarding pedagogical practices applied in technology-based education. To achieve this, the study concentrated on understanding the pedagogical practices that are relevant for technology-based education. Therefore, based on the nature of the study the primary research design is obvious exploratory qualitative design which allows in-depth understanding of the situation. However, in order to minimize error due to variation in the questions asked and to promote standardization the researcher employed an

embedded approach. In this research quantitative data were collected and analyzed within larger qualitative design; that is the quantitative elements were embedded to strengthen the primary design of this study (George, 2021).

Incredible efforts have been made to integrate technology in education, especially in secondary schools, which gained momentum after the inception of the COVID-19 crisis (Todd, 2020); however, prior to this limited groundwork has been undertaken regarding the pedagogical practices which are relevant for technology-based learning. Employing exploratory design helped the researcher to better understand the situation through gaining an in-depth understanding of the emerging educational response, to discover new facts, and to develop knowledge of the phenomenon of study while completing structured interview.

3.2.1 Philosophical Condition of an Exploratory Approach

Philosophical ideas can influence research practice hence it is important to make explicit the philosophical ideas which frame the generation of knowledge through research (Bori, 2018). In this respect, the research design process must begin with philosophical assumptions that the researcher adheres to when committing to a research study. Kivunja and Kuyini (2017) describe the philosophical paradigm framing a research study as the conceptual beliefs and principles that help a researcher to see the world and interpret actions within that world. It reflects the researcher's beliefs, values and assumptions about the generation of knowledge and its relationship to the world that ultimately guide research action (Singh, 2019). Amongst these assumptions and beliefs are the ontological and epistemological frames.

3.2.1.1 Ontological Perspective

Ontology is concerned with the nature of existence, and what is possible to know about the real world; this assumption is crucial to understanding how, in a study, the data gathered can be made meaningful (Kivunja, 2017). It involves responding to the questions about what is in the world that can be known (Ahmed, 2008). Ontology is concerned with the questions pertaining to the kinds of objects that exist within a community; the assumptions we make about the kind of reality we perceive and the nature of reality (Al-Saadi, 2014). According to Slevitch (2011), the ontological position of the quantitative studies assumes that the reality exists independent of human perception thus, the reality is fixed. It does not consider knowledge obtained from interpretation of respondents. In qualitative studies ontological position assume that the meaning applied from the reality can vary; that is there is no single reality but multiple realities exist based on individual construction and interpretations (Slevitch, 2011). Reality can continues being recreated by individual based on inter-subjective understanding.

Despite the fact that the study involved embedded quantitative data which were made available during structured research interviews but this study was primarily qualitative in nature; the focus was to determine pedagogical practices in technology mediated learning. The ontological position of this study lies in the belief that reality can be derived from the subject's perspective. In this regards, an interpretivist approach was used; this is because the problem statement of this study was influenced by the participants opinions, perspective and experiences (Brink, 2018). The qualitative methods of data collection specific semi-structured interview facilitated the presentation participants' opinions, feelings, experiences and inner thoughts regarding the existing pedagogical practices; this enabled the researcher to uncover the meaning/realities from the individual knowledge and experiences. In addition to this, participants use conversation to comment on, qualify, and elaborate their answers during structured interview, despite the formal

questioning structure; these data offered additional value-added dimension, that enabled the researcher to full understand individual expressed experiences (Abendstern et al., 2019).

3.2.1.2 Epistemology

Epistemology is concerned with the assumption about what kinds of knowledge are possible and exist and what is the nature of knowledge and knowing, and how to make this knowledge genuine (Ahmed, 2008). It is a way of looking at the world and making a sense of it; how to study the natural world and communicate the knowledge to the community (Kivunja, 2017; Al-Saadi, 2014). The most important question in epistemology is "how we know what we know"; it involves investigating the truth and helps the researcher to ask factual questions, such as "how do we know the truth?"and "What counts as knowledge?" (Kivunja, 2017 p.27).

This study did not focus on the generalization of information and prediction of human behavior, rather it focused on the knowledge generated from the instructors, students and education administrator responses through on technology integration in schools, its challenges and proposed ways to overcome the challenges. In this regards, the nature of this study required the creation of facts or information and sophisticated knowledge construction about pedagogical practices and how to translate these practices to enhance education through technology; hence epistemological assumptions were critical to the research process. The assumptions focuses on perceived knowledge from participants (Brink, 2018); multiple cases were used to intensively investigates if the integration of technology has considered the important educational issues. Notably, in this study knowledge is perceived as subjective since the researcher considers knowledge as something interpreted by individuals and given validity through social meaning (Rashid et al., 2019).

3.2.2 Philosophical Paradigm

According to Rashid et al. (2019), a study approach can be affected by the philosophical stance framing the research. Research paradigms are used to outline the beliefs and values that for guide the research method and analysis; understanding principles and origin of different philosophical paradigm has a significant implication for every decision that is made in a research process including relevance research context, design, methodology and analysis (Blackwell, 2018; Kivunja & Kuyini, 2017). It helps the researcher to elucidate the quality of the research findings and identify gaps in generating sound evidence (Park et al., 2019). It provides guidance on how to construct meaning from the collected data based on the researcher experience. In this regard, it is important for researchers to clearly state a philosophical paradigm that underpins their studies at very early stage of the research process. Due to advancement of human knowledge and way of thinking, there are different types of philosophical paradigms which are used to explain the occurrence and implication of phenomenon in the real world (Adom et al., 2016); positivism, for example, is a paradigm which relies on experience as a valid source of knowledge, whilst constructivism is based on the understanding of human nature and the varying roles individuals play in the world (Adom et al., 2016; Levers, 2013).

3.2.2.1 Positivism

Positivism focuses on the viewpoint that the researcher needs to find evidence when searching for the truth (Al-Saadi, 2014). Its assumptions are inflexible; it believes that knowledge is obtained through direct observation and measurement of a situation; that is everything can be quantified through measurement and calculation. Positivists seek to construct the connection between identified variables which can constitute social phenomenon. Research that is located in this paradigm relies on deductive reasoning, hypothesis formulation and testing, mathematical expression and calculations, to derive conclusions (Kivunja & Kuyini, 2017); research

explanations and prediction are derived from verifiable empirical data to support the chosen theoretical framework. According to Kivunja and Kuyini (2017), the results from positivist studies are generalizable; that is the results are applicable to other situations hence is advocates the use of quantitative research methods. However, according to Park et al. (2019), positivist does not always rely on quantitative research; it can also fit, in some experimental study to examine the effects of intervention through qualitative methods

According to Rehman and Alharthi (2016), even though objective and scientific methods are appropriate for studying natural objects, it is too unrealistic when used in complex social phenomenon especially studies that test human behaviour. This is because it is very difficult to detach oneself from hypotheses; positivism has not considered the unique ability of an individual to interpret their interest and experiences hence it is based on purely on facts and consider the world to be external and objective. Another drawback of positivism is the fact that if the collected data are inaccurate, it is likely to change the end results of the hypothesis; this is because positivism beliefs that everything is measured and calculated and do not consider unexplained phenomenon (Rehman & Alharthi, 2016). In this regard, positivist studies produce descriptive results which lack understanding of in-depth issues.

3.2.2.2 Constructivism

Constructivism is founded on the assumption that apart from direct observations other ways to understand the world do exist. These include individual perceptions and interpretations of the world which results from consideration of actions that are happening instead of relying only on individual experiences (Al-Saadi, 2014). According to Adom et al. (2016), constructivism paradigm asserts that individual construct meaning of the world from their experience and reflecting of those experiences. Different from the positivist view, the researcher can be part of

the meaning making and interpretation, based on the information obtained from the participants. A researcher personally engages in the study and has influence over the findings through her perspectives and values. Different from positivist philosophy which mostly depends on quantifiable variables, constructivism focuses on understanding situations hence it is mostly considered in qualitative research (Adom et al., 2016).

The constructivist paradigm is used for research that involves understanding the influence of social behavior or studies that aims at examining individual or group practices and its implication towards their attitudes in particular society (Adom et al., 2016). It acknowledges role of social values, collaborations and ethical responsibilities in shaping description of the findings. However, applying minimum guided approaches as practiced through constructivist paradigm ignore empirical findings (Alanazi, 2016); also, unguided instructions are not effective in producing accurate results. Researchers can interpret the world differently hence it is important to connect their knowledge with tangible objectives to ensure accurate interpretations.

Accordingly, this study necessitated a qualitative approach to encourage research participants to describe their experiences regarding the topic (Levers, 2013). Interactions among individuals enable them to share their interests which facilitate creation of meaning. In this respect, the constructivist paradigm was the underpinning philosophical basis of the study. This is because the focus of the researcher was to seek to develop knowledge about the topic through information obtained from participant's experiences using different data collection methods. This study sought to understand the topic; it considered the beliefs and experiences of participants regarding pedagogical practices relevant to technology-based education, therefore rejecting the positivist philosophical paradigm and adopting the constructivist philosophical paradigm.

3.2.3 Study Approach

An approach to research consists of the systematic steps to be followed when conducting a research study; this includes methods used to collect data, analyze data and interpretation of the findings (Chetty, 2016). Almalki (2016) documented three distinct approaches to conducting research: (1) quantitative, (2) qualitative and (3) mixed methods. Quantitative research involves looking at the common factors/elements of a certain phenomenon and determining how these factors are related to each other. It employs a deductive reasoning approach which starts from making general statements and determines to reach specific scenarios or statements (Burney & Saleem, 2008). Quantitative approaches start with hypothesis generation from existing problems and involve the design of research strategies to evaluate the strength of evidence in order to examine the relationship between variables. According to Apuke (2017), quantitative research seeks to describe the current situation involving the generation of hypothesis, collecting numerical data and carry out statistical analysis to compare variables or examine the association between variables hence this approach is mostly appropriate when a researcher want to confirm or test hypothesis. The findings of quantitative research are generalized and applied across a group of people (Almalki, 2016; Apuke, 2017).

In contrast, qualitative research involves developing a broader understanding of the complexities of a situation. It focuses on exploring and gaining perspective on issues by investigating them in their own specific context (Almalki, 2016). The meanings are drawn from the participant's opinions and experiences. This approach is subjective; it focuses on description and interpretation which leads to development of new concepts (Hancock et al., 2009). Qualitative research employs inductive reasoning; it draws general conclusions from specific a set of observations (Thomas, 2003; Burney & Saleem, 2008).

The third approach, mixed method research, involves combining both quantitative and qualitative approaches in a single study to provide complete understanding of the research problem (Molina-Azorin, 2016). This approach is mostly used to assess complex interventions as it uses several means to examine the phenomenon. Data are collected and analyzed quantitatively and qualitatively, the findings are integrated, and conclusions drawn using both approaches (Doyle et al., 2009). This approach plays an important role in research because using different methods has a greater potential to enrich the understanding of the problems and questions. Bryman (2017) pointed out that combining quantitative and qualitative findings offers potential insights that cannot be obtained using a single approach alone (Molina-Azorin, 2016).

This study required obtaining in-depth understanding about pedagogical practices from a small sample. The nature of the study did not demand for comparison or testing hypothesis rather gaining a better understanding of a subject. The study followed qualitative approach; however, due to limited time and resources as well as to minimize research bias the quantitative elements where embedded to strengthen the qualitative design. The aim to explore relevant pedagogical practices and the challenges associated with technology-based learning. According to Busetto et al. (2020), a qualitative approach aims at understanding an existing situation to which an intervention is to be introduced. The embedded quantitative elements were used to supplement the qualitative data by allowing participants to clarify the meaning during the structured interview (Rashidi et al., 2014). The close interaction between the researcher and participants through both face-to-face and telephone interview makes it easy for participants to contribute to shaping understanding and knowledge construction regarding the current pedagogical theories, principles and approaches. Individual thoughts, interpretation and experiences were examined to understand the pedagogical technologies that are relevant in the current education setting and which conform to educational theories that can help to improve the quality of education. The

approach is associated with the constructivism paradigm which is based on the view that individuals can actively construct knowledge through their experiences; and that the meaning is influenced by interactions of prior knowledge and events (Yazan, 2015; Adom et al., 2016).

3.2.4 Research Design Method

Any research requires systematic method so that the results are genuine; applying appropriate research methods can improve the quality of research results (Teegavarapu et al., 2008). For the researcher to better understand the participants' responses and construct meaning from her experience, a strong collaboration between researcher and participant was established. This collaboration led to creation of social meaning from the analysis of the interactions which is in-line with constructivism research paradigm. Through this interaction, the researcher was able to interpret and make sense of participant's views and experiences (Adom et al., 2016). The analysis of data offered insight into the relational aspect of the self and process to which the meaning and knowledge were constructed. Therefore, framing the study within the constructivist paradigm helped the researcher to recognize the importance of the subjective human creation of meaning (Teegavarapu et al., 2008). Considering all this, the case study method was considered appropriate for this study.

3.2.4.1 Case Study Description

According to Patnaik and Pandey (2019), case study is a common method which as associated with qualitative studies and has become an effective approach for investigating complex scenarios. The main goal of case study research is to undertake an in-depth and detailed investigation of phenomenon in a real-world context (Crowe et al., 2011; Teegavarapu et al., 2008; Patnaik & Pandey, 2019). Interview, observation and desk review are the main research instrument used to obtain in-depth information when conducting a case study researches.

According to Siemears (2007, p.16), the case study is used to "investigate contemporary phenomenon within its real-life contexts". It gives the story behind the result by describing what happened when, to whom, and with what consequences hence bringing an opportunity to highlight success and challenges of the phenomenon under study (Neale et al., 2006). The method is considered as an intensive study of the unit under consideration in order to complete a detailed account of a social situation which can stimulate new research areas (Devi, 2020). Employing case studies design helps the researcher to collect details on diverse issue in a situation under investigation; in this respect, information on sensitive areas of the phenomenon as a real person experience is recorded.

There are different types of case study methods; however, the selection of case study is guided by the research purpose and the one that best answer the research question (Baxter & Jack, 2010; Patnaik and Pandey, 2019). Three categories of case study exist as explanatory, descriptive and exploratory (Patnaik & Pandey, 2019). Explanatory case studies are used to examine causal relationship in real life situations that are too complex for survey and experimental designs (Baxter & Jack, 2010); hence they are used for testing theory. Descriptive case studies are used when the researcher is attempting to describe an intervention in real life context; it is used to discover issues facing individual groups and how it can be addressed. Exploratory case study allows the researcher to generate new idea or theory for later investigation; it mainly used to explore situations has no clear outcomes (Baxter & Jack, 2010). However, case studies design has some limitation; according to Devi (2020), in case studies difficulties arises due to inconsistency in data, it is not possible to generalize the findings. There is a high possibility of participant or investigator bias which may distort the quality of the results. Beside this, the method is effective when investigating big and complex scenarios as it is used in limited units.

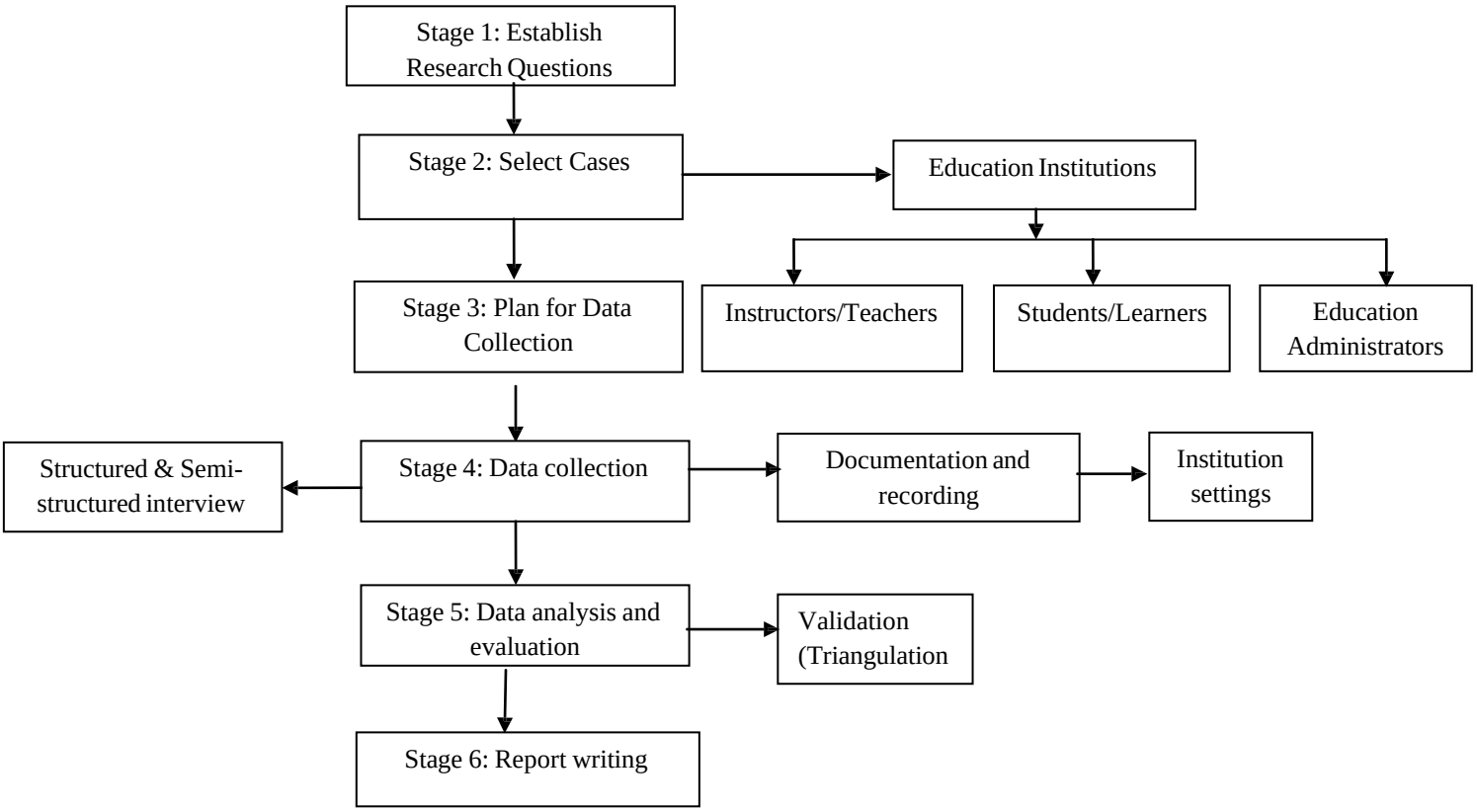
The expected study outcome is a model for technology-based education among secondary schools in Tanzania which demands for an in-depth examination. According to Patnaik and Pandey (2019), case study is particularly useful the study topic is not studied before and when the purpose is to propose new approach; in this kind of studies the experiences of participants is important to obtain additional information. This method appropriate as it helped the researcher to obtain additional insight into existing gaps regarding pedagogical practices relevant for technology mediated learning. Bhatta (2018) pointed out that the main strength of the case study is intensive study that illuminates meaning that expands the researcher's understanding of multifaceted phenomenon. The new concepts and ideas uncovered are then integrated into existing knowledge to expand the theory in order to inform the pedagogical model for technology-based education. The study was approached from a constructivist epistemological standpoint; therefore, the main researcher's role was to interpret the constructed knowledge that they have gathered from participants (Yazan, 2015; Crowe et al., 2011).

3.2.4.2 Steps Involved the Research Process

The case study constitutes empirical research (Teegavarapu et al., 2008); in this respect, it is a systematic way to investigate contemporary phenomenon using verifiable evidence as described in figure 3.1.

Figure 3.1

Steps in Research Process



3.2.4.3 Description of the Case Study

Step 1: Establish the Research Questions

The first step was to define the study focus by preparing questions informed by the literature as well as prior appreciation of the theoretical issues (Crowe et al., 2011). In this study, people or groups of people were the research participants; each participant was linked to issues related to the situation.

Step 2: Select Cases

Multiple cases were identified which are: 1) instructors/teachers, 2) students/learners, 3) education Administrators; each case was treated as a unique using its own facts and merits. This allowed the researcher to compare results obtained across several cases and/or replication.

Step 3: Plan for Data collection

According to Rashid et al. (2019) and Teegavarapu et al. (2008), case study research generates a bulky amount of data collected from multiple cases hence a need for systematic organization of data is vital. The systematic arrangement of data will deter the researcher from losing focus of the research goal and objectives. For the purpose of this study, a database that helped to categorize, classify, store and retrieve data for analysis was developed.

Step 4: Data Collection

The researcher collected multiple sources of evidence using a range of qualitative techniques (semi-structured interview, documentation and recordings) while a quantitative technique (structured interview and observation checklist) were used to collect standardized data for strengthening the collected qualitative data. The process helped the researcher to discover convergent lines of inquiry and patterns. During the interview additional questions were posed to participants and their responses were systematically documented; for the standardized questions participants were asked to evaluate and clarify their answers during the follow up interview session. Throughout the process the researcher remained open to new ideas and insights; qualitative data collected using different methods were triangulated to strengthen the results while the quantitative data were embedded to enrich the qualitative data (Goetzen, 2020).

Step 5: Data Analysis and Evaluation

Data from individual cases were first analyzed and later the comparison across cases was made. Special attention was given to variation within each case and where necessary the causes, effect and outcome.

Step 6: Report Writing

Complex issues were transformed into one that could be understood by readers who were independent to the researcher. Findings from individual cases were separately presented and later the findings were combined across cases. The reports presented the feeling of specific stories related to each case that were transmitted during the investigation and responses or comments in relation to each research questions.

3.3 Population and Sample of the Research Study

3.3.1 Study Area

The study was conducted in Tanzania, East Africa (see Figure 3.2); the country is divided into thirty geographical regions; a simple random sampling was used to sample three regions for this study. Thus, relevant education institutions were purposively selected (details to follow) from the sampled regions: (1) Dar es Salaam, (2) Arusha and (3) Morogoro (see Figure 3.3).

Figure 3.2

Map of Africa Showing Location of Tanzania

Figure 3.3

Map of Tanzania showing sampled regions

3.3.2 The Target Population

Research is based on objectives which clarify the study subjects (Shukla, 2020). The research objectives also clarify to which group the research results will be applied or generalized; this group is known as the study population. Population is defined as a "set or group of all the units in which the findings of the research are to be applied" (Shukla, 2020, p.1). It consists of all individuals or members who meet a certain set of criteria. Population involves elements which possess different variable characteristics that need to be studied for generalization. In this study, the population comprises of three groups: (1) instructors – teaching staff, (2) education administrators – education support staff and (3) students/learners, participants were all from both public and private education institutions. At the initial stage, cluster sampling was used to select three regions; thereafter, a purposive sampling technique was used to identify education institutions from the three sampled regions. The eligibility criterion for inclusion were that institutionshad, to some extent, introduced technology in their teaching and learning process. Following purposive sampling, participants within each institutions were sampled based on the following inclusion criteria:

a. Instructors from public and private education institutions, or
b. Education administrators from public or private education institutions, or
c. Currently enrolled students aged between 14 and 22 years or age; and,
d. Fluent in English and Swahili languages

3.3.3 Sample Size and Sampling Techniques

3.3.3.1 Sample Size

Some studies target small populations which warrant the inclusion of all cases of the population in a single study. However, most studies entail a large population which makes it difficult for the researcher to study all cases in the population hence a portion or a subset of the population is

chosen to represent the population. Again, studying the entire population needs more time and resources; in this regard, studying just a portion of the population minimizes time and resources (Taherdoost, 2016). The process of selecting a subset of the population for the research purpose is known as sampling and the portion or a subset of the population selected for study is known as the sample. According to Kabir (2016) and Bhardwaj (2019), a sample can be a group of people, objects or items which represent variable characteristics of the population. However, Majid (2018) suggested that a sample must be accurately representative of a population to enable the researcher to collect the most accurate answers for the research questions. A good sample must be able to reproduce the imperative characteristics of the population under study as closely as possible.

It is approximated that, Tanzania has a total of 47 accredited higher learning institutions, 436 technical education and training institutions and 5,001 secondary schools (Tanzania Commission for Universities [TCU], 2021); National Council for Technical Education [NACTE], 2021; Education Sector Performance Report [ESPR], 2018-19). However, due to the qualitative nature of this study only 10 education institutions were purposively selected from the three sampled regions, which were themselves identified purposively for this study.

Table 3.1

Education Institution in Sampled Region

Region	Higher Learning Institution		Technical Education and Training Institutions		Secondary Schools		Education Administration	
	Total	**Sample**	**Total**	**Sample**	**Total**	**Sample**	**Total**	**Sample**
Dar es Salaam	10	1	79	0	327	1	4	2
Arusha	4	0	37	1	252	3	-	0
Morogoro	3	0	24	0	246	2	-	0
Total	**17**	**1**	**140**	**1**	**825**	**6**	**4**	**2**

Source: TCU (2021), NACTE (2021) and ESPR (2018 -19)

3.3.3.2 Sampling Techniques

In order to draw conclusions about the population from which the sample is drawn, the sampling procedure must ensure the selection of a sample which is a truly representative of the population so that the findings can be generalized to the population (Bhardwaj, 2019). Generally, sampling methods are divided into two categories namely probability and non-probability sampling (Taherdoost, 2016). Probability sampling is a type of sampling method that gives opportunity for every possible element of the population to have same chance of being selected for inclusion in the sample (Taherdoost, 2016). These include simple random sampling, systematic sampling, stratified sampling, cluster sampling and multi-stage sampling (Taherdoost, 2016). According to

Showkat and Parveen (2017), in probability sampling there is an utmost probability of a representative sample; the results are likely to be more accurate to reflect the entire population. However, probability sampling is very costly and time consuming (Howard, 2019; Taherdoost, 2019).

On the other hand, non-probability sampling is a sampling method whereby not every unit or element of the population has the same chance of being included in the sample (Etikan & Bala, 2017; Taherdoost, 2016). According to Teherdoost (2016) non-probability sampling includes quota sampling, snowball sampling, convenience sampling and purposive or judgement sampling. Showkat and Parveen (2017) argue that a non-probability sampling technique enables the researcher to study particular phenomenon with a potential to generate important insights. Non-probability sampling are commonly associated with qualitative case studies (Taherdoost, 2016). The techniques are very effective when the researcher is trying to generate ideas and get feedback; however, the results obtained from non-probability sampling cannot be generalized to the entire population (Howard, 2019). Beside this, Ayhan (2011) pointed out that non-probability sampling uses individual judgment and utilizes convenient selection of units in the population. In this respect, it is a cost effective way of sampling as it involve small sample to examine real life phenomenon.

3.3.3.3 Appropriate Sampling Techniques for the Study

The research approach applied in this research is primarily qualitative case study; the study does not intend to test a hypothesis rather to develop the knowledge base surrounding the topic from a small and specific portion of a population. In this regard, the study employed non-probability sampling methods.

(a) Selection of Regions

A non-probability purposive or judgemental sampling technique were employed to select sampled regions. The selection was based on geographical location and reliability of information; due to limited resources the researcher selected regions which are not far away from her home region. This is to enable the researcher to travel to the selected regions and undertake the study with limited resources available. In addition to this, the researcher considered the region with sufficient numbers of both teaching and non-teaching institutions in order to provide a broad options to select the institutions that can provide relevant information for the study. Using purposive sampling the researcher selected 3 regions out of 30 regions available in the country that is Dar es Salaam, Morogoro and Arusha; this makes about 10% of the entire population hence less resources and labor were involved (Singh, 2015).

(b) Selection of Institutions

A non-probability sampling approach was employed to select education institutions for the study; a sample was selected on personal judgment rather than non-random criteria. Purposively the researcher selected 10 education institutions which met the inclusion criterion; cases that shared a set of characteristics and were rich in information necessary for the study were given first priority. In this respect, only education institutions which were relevant to the research design were selected.

(c) Selection of Participants

Purposive sampling was used to select 51 participants which comprised of instructors, students and education administrators from the sampled institutions. Only individuals who were willing to provide the information which was relevant to the study by virtue of their knowledge or experiences were selected (Etikan, 2016). The process involves recruiting participants who are

willing to participate, and were able to present their ideas, opinions and experiences in a clear and comprehensive way.

(d) Selection of Documents

The documents were purposively selected; only documents which were considered relevant for the topic were reviewed. The sampled documents were selected among other documents available from institutional official websites, libaries and journals.

Table 3.2

Sample Distribution of the Respondents of the Study

Type of Respondents	**Population in the sampled institutions**	**Selected Individuals**	**Percentage (%) of Total Population**	**Gender**	
				Male	**Female**
Instructors	696	22	3.2	14	8
Students	18,333	25	0.14	14	11
Education Administrators	44	4	9	2	2
Total	**19,073**	**51**	**0.3**	**31**	**22**

Field data, 2021

Table 3.3

Sample Distribution of the Respondents per Region per Institution

Table 3.3 Sample Distribution of the Respondents from Total Population

Region	Institution	Instructors	Students	Education Administrators	Total Sample	Total Population	Percentage
Dar es Salaam	The Open University of Tanzania	4	7	-	11	13,082	0.1
	Makongo High School	5	5	-	10	1,092	1
	Tanzania Education and Research Network	-	-	2	2	12	17
	National Council for Technical Education	-	-	2	2	32	6
				Total	**25**	**14,218**	**0.2**
Morogoro	Kilakala High School	2	2	-	4	716	1
	Morogoro Secondary School	2	2	-	4	2,035	0.2
				Total	**8**	**2,751**	**0.3**
Arusha	Monduli Teachers College	3	3	0	6	883	0.7
	Arusha Science Secondary School	3	5	-	8	163	5
	Turkish Maarif Schools	2	1	-	3	510	0.6
	Kimaseki Secondary School	1	-	-	1	606	0.2
				Total	**18**	**2,162**	1
	Total	**22**	**25**	**4**	**51**	**19,174**	**0.3**

Field data, 2021

3.3.3.4 Recruitment Process

The recruitment process involved identifying the potential research participants and providing them with sufficient relevant information about the research study for them to gain interest to participate (Manohar et al., 2018). Relevant education institutions registered under the three sampled regions were identified; the process involves conducting a document review of material from institutional websites as well as obtaining preliminary information, through email communication with contact personel at each institution, in order to identify relevant institutions. Fourteen institutions were identified, and the gatekeeper letter was then sent to these institutions in order to obtain permission for research data collection.

Out of the fourteen institutions completed gatekeeper letters were received and permission was granted from only ten of the 14 institutions approached. The researcher then met separatelyface-to-face with the head of each institution to discuss and recruit appropriate individuals for the study. For each institution/school, instructors who possess technology proficiency were identified; thereafter, the researcher picked the required number of instuctors from the list to participate in the study. The same process was used to identify students who had opted to learn technology as a discrete subject for recruitment to the study. Since information Technology is an optional subject, in most schools in Tanzania, not all schools offer this subject. In this respect, the researcher purposively selected the required number of students from the list of students taking Information Technology subject for inclusion in the study. Contacts including email and telephone with individuals were established and each was given a copy of the participant Information sheet which provided detailed information about the subject of study; thereafter, upon their confirmation to participate in the study the researcher sent each participant, who had shown a willingness to be interviewed, a blank copy of the consent. In the case of any students under the age of 18 years, verbal assent was first gained by participants through their school

head, either by a telephone conversation or through a face-to-face discussion; thereafter, the researcher approached requested their parents/guardians provide written consent forms on their child's behalf. This is a mandatory procedure for Unicaf when undertaking research that involves children below 18 years.

3.4 Materials/Instrumentation of Research Tools

The data collection techniques were chosen based on the study purpose and the questions that guided the research study (Kabir, 2016). The study employed both primary and secondary data collection methods to obtain insights tithe phenomenon. Three methods of data collection were used to collect relevant information for the study, namely (1) interview, (2) direct observation and (3) documentary review.

Table 3.4

Example of Data Collection Instruments used in the Study

Data Collection Method	**Instrumentation**	**Participant Group**
Interview	Structured and semi-structured questionnaire	Students, Instructors and Education Administrators
Observation	Observation checklist	The Researcher, Students and Instructors
Document review	Content analysis	The Researcher

3.4.1 Interview

Interview is the most popular qualitative research method for data collection especially if the number of respondents is small; in most cases it involves verbal conversation where one participant (researcher) asks questions and another participant respond to questions (Davis, 2021; Mathers et al., 2000). According to Jong and Jung (2015), interviews are used to collect information about individual practices, beliefs, or opinions hence, in this study, it enabled the researcher to obtain background information and tap the expert knowledge of respondents. Interview always consists of two participants; an interviewer who is the main coordinator of the interview process and the controller of the conversation and interviewee who responds or answers a set of interview questions (Davis, 2021). Interview method is mostly relevant in exploratory descriptive studies that require elaboration about a given phenomenon from individuals or groups. It can be conducted through a face-to-face meeting, telephone conversation or email (Bolderston, 2012). Depending on the subject being addressed, interviews are classified into three groups namely structured, semi-structured and unstructured (Yong & Jung, 2015). The three groups are differentiated by the design of the interview questions; semi- structured; unstructured interviews encourage detailed responses whilst structured interviews are designed to elicit short and specific answers (Mathers et al., 2000). This study employed both the structured and semi-structured interview methods which allowed the researcher to construct meaning from respondents through the analysis of participants' perceptions of events and experiences of the phenomenon under investigation. The researcher focused on specific areas of the phenomenon in order to answer the research questions; in this respect, structured and semi- structured interviews were considered more relevant than unstructured interviews that generates large amount of data which are difficult to categorize.

3.4.1.1 Structured Interview

Despite the fact that this study is primarily qualitative in nature, the structured interview were also employed and the results were embedded in a qualitative design to enrich the qualitative results. It involved the use of a standardized sequence of questions for data gathering. The interview questions were designed in a structured manner and provided a fixed range of answers (Davis, 2012; Rashidi et al., 2014); the questions were formulated based on the problem/issue being addressed and were informed by literature review (see Appendix A). Each participant was provided with the same sequence of questions set within the same context and in a similar order. Since the research instrument consisted of all the possible text-based choices of answers related to technology-integrated pedagogical practices the researcher easily made a comparison of responses across the sample (Rashidi et al., 2014). This enabled the researcher to collect a standardized set of responses because the answers were organized and stated in the same form. According to McLeod (2014), employing the structured interview method enables the researcher to easily test the reliability of data because the responses to the research questions can simply be compared. Jong and Jung (2015) pointed out that structured interviews are most valuable when the basic straight forward data is needed to provide answers to the evaluation questions. However, using the structured interview method makes it difficult for the researcher to establish a rapport with the participant which may lead to irrelevance of the topic being studied (Rashidi et al., 2014). In this study, the individuals who filled structured questionnaires were contacted through telephone in order to help the researcher to gather additional information and qualify, and elaborate their responses during standardised interviews, despite the formal questioning structure (Abendstern et al., 2019).

3.4.1.2 Semi-Structured Interview

Semi-structured interviewing involves the use of a loosely structured set of questions which gives the respondent more opportunity to fully express their views using their own words; it allows the interviewer to probe based on the responses received from the interviewee during the interview (Davis, 2021). Semi-structured interviewing is one of the most used data collection methods in qualitative studies to explore new knowledge in an existing phenomenon (Rahman, 2019). It consists of open-ended questions which are often accompanied by additional questions about why or how (see Appendix B). The method provides guidelines and instructions to respondents hence providing reliable and comparable qualitative data. Semi-structured interviewing affords respondents the flexibility to express new ideas; this allows the researcher to generate deep understanding of issues related to the topic. In this study, the approach was used to interview the education administrators; this format afforded mutual connection and an interface for engagement between the researcher and the interviewee; hence they were able to share information, create room for arguments, reflection and learning (Jong & Jung, 2015). However, according to Kalilla (2021), the language barrier may result in limited responses (Kakilla, 2021); in this study, the researcher noted that some participants are not fully conversant with English language. Therefore, the researcher allowed participant to opt to use either English or Swahili languages.

3.4.1.3 Justification for Using the Structured and Semi-Structured Interview Method

The objectives of this study were to:

(1) Critically analyze the pedagogical tools and practices available in the literature that are relevant for technology-based learning.

(2) Study the current pedagogical practices used in schools in relation to application of technology.

(3) Examine the pedagogical challenges experienced by instructors and students in the technology-based environment and lastly.

(4) To design a theoretically informed and evidence-based pedagogical model to guide the technology integration among Secondary Schools in Tanzania.

To achieve the study objectives an observation and analysis of a number of elements related to pedagogical practices in a technology-mediated learning were considered. The elements were derived from a highly developed literature search which provided the researcher with adequate knowledge about the topic, hence enabling the development of the meaningful and relevant research questions.

Structured interview provided guidance to respondents regarding the existing elements in the literature. Employing structured questions made the interview format incredibly easy to complete as it promoted standardization (Rashidi et al., 2014); involving systematically asking of questions to respondents which further minimized time used for coding and content analysis of data (Mathers et al., 2000). The ultimate purpose of structured interview was to ensure that each session of interview is presented with exactly the same questions in similar order; this will make possible for the researcher to aggregate participants responses and make comparison between samples for meaningful analysis (Rashidi et al., 2014). Beside this, during the interview, where necessary the researcher requested any other information that she found relevant in answering the research questions. During the literature review, the scope of details for the study was well documented; this enabled the researcher to obtain more accurate information that guaranteed the generation of reliable results. The researcher was keen to gather information on whether education institutions use technological pedagogical approaches and practices and, if yes, how effective are these approaches and practices. The focus was to gather and analyze data to arrive

at a conclusion about how the existing pedagogical practices can be translated into a valid theoretically informed and evidence-based model for technology-based education. Semi-structured interviewing provided a flexible way of gathering detailed information; the non-pre-determined set of questions also provided room for probing questions which enabled the researcher to elicit detailed information from respondents. The format provided respondents with the freedom to present their ideas in their own ways. Knowing that e-pedagogy is a new field for research in Tanzania, a small sample was purposively selected to obtain a broad understanding about the topic. The semi-structured interview method helped the researcher to obtain rich and detailed data through the exploration of participants' thoughts, beliefs and experience about the topic (De-Jonckheere & Vaughn, 2019). The interview questions were informed by the literature and were focused on the problem/issue to be addressed; this ensured the main points of interest were satisfied during the interview (Jong & Jung, 2015; O'Keeffe et al., 2016). The researcher considered this process as an appropriate way for digging deeply into personal and sensitive information which enabled new and novel information to emerge. In the semi-structured interview, the interviewees not only provided answers to questions but also the reasons for those answers; this provided space for the researcher to obtain valuable information and knowledge needed to answer the research question.

3.4.1.4 Administration of Structured and Semi-Structured Interviews

Structured interviewing using an online questionnaire was conducted with two groups of participants, instructors and students who were from different education institutions. Standard, predetermined questions were developed and sequenced in a specific order; Google Forms was used to set up the questions and the hyperlink to the online survey was shared with the selected participants for familiarization before responding to the questions. Follow up telephone calls was made to each participant to help them interpret questions which were not well understood

without jeopardizing the integrity of the interview. Participants responded to the online questionnaire by selecting the correct answers from a list of options provided. Participants who had no internet access were given the questionnaire in a hardcopy format to complete in a place of their choosing. In case an individual ignored some questions, a further telephone call, (for those who responded online) and physical discussion (for those who responded through face-to-face mode) was used to persuade interviewees to provide answers to all the questions as well as to provide room for clarifying their responses. The structured interview reinforced the validity of the data; that is the methods or procedures used to acquire information were fair and not influenced by perspectives, judgment or any personal interest. However, the researcher was keen to talk with participants rather than just asking them to answer the questions; this ensured the accuracy of data collected.

Semi-structured interviews were conducted with education administrators from education support institutions in Tanzania. Individual semi-structured interviews were administered in a face-to-face interaction with individuals; the researcher met separately with each participant on site in their institutional settings and each individual was interviewed for duration of 25 to 30 minutes in his or her private office. A set of open-ended questions related to the topic of study were prepared in an orderly manner and the researcher met with everyone separately to discuss the questions and obtain their responses. The developed questions were shared in advance with the prospective participants through their email addresses in order to familiarize them with the questions before the interview date. The format of the questions allowed the interviewee to present their thoughts, opinions and experiences about the topic under study.

However, before the researcher administered both the structured and semi-structured interview, she considered developing positive relationships with respondents. According to Owton and

Allen-Collinson (2013), creating a positive relationship influences expressiveness and empathy between researcher and respondents. In this respect, during the meeting the researcher first explained the purpose and duration of the interview to the respondents and offered the consent form to each in order to confirm their willingness to participate. For children below 18 years parental consent was sought; there were no individuals who rejected to participate in the study. In any research setting data are recorded through handwritten notes or audio recordings; this gives the researcher an opportunity to review the notes and to ensure no missing information from the interviewee during the data analysis. The researcher requested permission to record participants' responses and assure them that information collected would only be used for the stated purpose and was to be kept private and secretly (Dikko, 2016). Two types of recording were used to capture the participants' responses, audio or sound recording using the researcher's mobile phone and note taking. Both sound recording and note taking were used during the face-to-face interview with education administrators while only note taking was used to record data during the follow up telephone calls with instructors and students who responded to online questionnaire. The questions were asked in a sequential order; for the semi-structured interviews the probing questions were asked to encourage deep thought which allowed the researcher to obtain more information from respondents where they did not extend answers towards that direction (Dikko, 2016).

3.4.1.5 Pre-Testing of Interview Questions

Majid et al. (2017) suggested that pre-testing of interviews is crucial in any research study; it helps to test the questions in order to address possible practical or technical issues that might affect the interview process. In this study, only structured interview questions were piloted with a subset of individuals to test the relevance of the questions and enable the researcher to "highlight the improvisation to the major study and to provide the researcher with some early suggestions

for improvement on the viability of the research" (Majid et al., 2017 p. 1073). The pilot study was carried out in one education institution in Dar es Salaam; it involved three instructors who taught information technology and three students; one from each information technology class. The piloted data were not included in this study. Rather, the pilot study enabled the researcher to determine if all necessary elements to answer the research questions were incorporated and could elicit adequate responses (Dikko, 2016). The pilot study also helped the researcher to improve her interview skills, including interview time management and identification of important areas for clarification. For the semi-structured interview, ambiguous and offensive questions were identified and resolved during the interview sessions.

3.4.2 Direct Observation

Direct observation involves collecting information by viewing or listening to the research subject without being part of the action which is being observed (Crossman, 2019). In this study, an observation checklist was used to gather data from education institutions to verify information obtained through the structured interview method. This included instructors' practices such as approaches to teaching, use of physical spaces, classroom culture, technology infrastructure and use. The researcher spent one to two hours in each institution and visited different places across the institution to document some key elements and practices including classroom practices and other existing technological infrastructure. Secondly, the direct observation method helped the researcher to obtain details such as instruction approach, physical spaces, classroom culture and technology infrastructure especially those which could not be captured during the interview.

3.4.3 Documentary Review

Document review is a method of data collection through reviewing of various existing documentation that are relevant to the topic. According to Ahmed (2010), documentary review

involves analyzing and interpreting documents in order to generate meaning around a study topic. In this study, nine documents were reviewed under three categories of documents as stipulated in table 3.4

Table 3.5

Example of Documents Reviewed by the Researcher

No	Document Category	Reason for Selection
1	Tanzania ICT Policy for Basic Education – 2007 and Tanzania Education and Training Policy - 2014	These documents helped the researcher to examine specific strategies that the government intends to focus in integrating technology in the education field as well as the documented strategies to guide the application of emerging technological trend.
2	Institutional ICT Policies, eLearning Strategies and other available Education Technology Guiding Documents	These documents manifested the state of art regarding technology integration in the classroom therefore enable the researcher to determine the best solution and practices that can enhance the technology mediated teaching and learning
3	Research Reports related to the topic	The reports helped the researcher understand the current situation for the technology integration among Tanzania Secondary Schools; identified the pedagogical challenges that hinder technology integration in classrooms and proposed suggestions for improvements.

3.4.3.1 Authenticity and Credibility of Documents

Mogalakwe (2006) refers to authenticity as to whether the documents referred to are genuine and have integrity while credibility refers to whether the documents are accurate, that is free from error. To ensure authenticity and credibility of the documents, only formal documents, which were available online through the government and institutions websites and libraries, were considered as valid source of information. This also included official documents which were supplied by heads of institutions during the research process.

3.5 Study Procedures and Ethical Assurance

3.5.1 Study Procedures

Ethics refers to the moral related values that arise when undertaking research (Chowdhury, 2016). It refers to the rules and guidelines that define researcher conduct during the research process (Akaranga & Makau, 2019). Fleming (2018) pointed out that ethical consideration in research is becoming fundamentally important hence it is important for researchers to seek ethical approval when undertaking research that involves human subjects. The main purpose of research ethics is to protect respondents and the society from damage and to ensure the researcher acts honorably, honestly, justly and fairly (John et al., 2016). To afford the best outcome, it is important to consider how the research was conducted. In this regard, one way to bring values into one's work is to ensure good conduct when implementing research activities.

Researchers must protect the dignity of their subjects when collecting, analyzing and publishing information obtained from research. Mannan et al. (2013) suggested that the researcher conducting research that involves human subjects must limit access to private information of individuals unless the researcher has the participants' permission to share the information. Beside this, the researcher has a duty to ensure the established professional standard for

managing scientific and educational research is adhered when carrying out the research activities. Throughout the research stages the researcher observed appropriate procedures available as well as the ethical values (Akaranga & Makau, 2019). These include completing gaining ethical approval for the research and informed consent from the participants.

3.5.1.1 Completing Research Application Form

This study followed the standards for conducting scientific studies; the researcher completed the initial Research Application Form (REAF) which was reviewed and later approved by the University Research Ethics Committee (UREC), Unicaf University Zambia. The forms were completed by the researcher under the supervision of the research supervisor. The process involved submitting the populated REAF together with the participant information sheet, consent form, gatekeeper letter and data collection tool to the School for Doctorial Studies. The forms were reviewed, and formative feedback was given to the researcher on 5th August 2021; after the researcher had responded to the comments, through making changes to the forms, they were re-submitted to the UREC on 11th August 2021 for final review. The forms were finally approved on 25th August 2021 and the researcher was granted approval to proceed with the data collection process.

3.5.1.2 Gaining Consent

According to Fleming (2018), informed consent is the cornerstone of ethical research; it is a legal requirement of any research project that involves human subjects (Nijhawan et al., 2013). It can be considered as a contract between the researcher and the respondents. In conducting this study, the researcher ensured that each research participant was provided with sufficient information about the study in order to give them an opportunity to make an informed decision on whether to participate in the study or not. The information provided included the purpose of the research,

participant's roles, methods used to protect anonymity and confidentiality, estimated time for the interview, the participant's right to withdraw at any time as well as predictable risk and possible discomfort if any (Nijhawanetal., 2013). Only those who agreed to become part of the study were recruited and were asked to provide written consent (see Appendix C).

For participants who were below 18 years of age, verbal assent was gained by the researcher; this involved obtaining a simple oral description from the children indicating their willingness to participate in the study which was done through the school head. Guardians/parents who were willing to provide consent for their child or children to participate in the study were given a written consent to sign on behalf of their child or children before they were allowed to participate in the research (see appendix D).

3.5.2 Ethical Assurance

The researcher strove to ensure that the research adhered to all ethical principles and standards. Stuart and Barnes (2005) and British Educational Research Association (2018) mentioned anonymity, confidentiality, privacy, self-respect, justice and protection of participant's well-being as important ethical principles that need to be considered when undertaking any scientific research. In this study, the researcher attended tall these principles as required.

5.2.2.1 Anonymity, Confidentiality and Privacy

Many researchers point out the need for special protection against harm among research participants. According to Surmiak (2018), one way to protect them is to maintain anonymity and confidentiality. Anonymity means hiding the respondent's identity by avoiding referring them by their names or any unique identifier or not revealing sensitive information about the participant (Akaranga & Makau, 2019). Maintaining anonymity preserves the integrity towards

the research participants by protecting the privacy of human subjects. On the other hand, confidentiality refers to modification of information in such a way that no participants personal information can be identified (Coffelt, 2017). According to Parveen and Showkat (2017), observing confidentiality can help to stop personal information or identifiable data from being publishing or sharing. In this study, although respondent's information was known by the researcher, they were protected from public exposure by ensuring personnel information was not connected to data. Maintaining the confidentiality of data can enable the researcher to ensure the privacy of information including authorization to view, share or use of the collected data.

According to Le and Bala (2010), several measures are available to researchers to keep subjects confidential; these include the use of a password to protect soft copy documents, encryption when sending information as well as keeping the devices containing data in secured places. Since the study was qualitative in nature individual ideas and experiences were of more interest rather than public exposure of individuals (Tilley, 2019). However, most of the respondents wanted their information to be considered only for the study purpose and not by their respective institution for the reason of avoiding negative repercussions. In this respect, the private practices of anonymity and confidentiality was appropriately considered in the study in order to protect the privacy of individuals who volunteered to participate in the study (Coffelt, 2017). At some point, the researcher had connected with each participant, either by telephone or face to face and was therefore potentially able to recall a participant's personal information including their name and other unique identifiers, as well as potentially recognising individual voices in the data. In this respect, only the researcher knew the respondent's identity and collected records.

Beside this, the information obtained during the data collection was kept confidential and stored anonymously; a coding system was used for record keeping and all the identifiable information

was removed in the final report. This process ensured the results were not attached to individuals' personal details thus could not be identifiable by anyone outside the research. There were no potential risks, psychological harm and/or ethical issues associated with the study.

3.5.2.2 Respect of a Person

Freedom is an important aspect in human development; according to Jafarzadeh and Beheshti (2012), freedom is considered as among human basic needs. Fouka and Mantzorou (2011) pointed out that respect means protecting others from conditions that may cause harm and protection of public or individual interest. People have freedom to decide the type of data or information to share with others. Individuals entered this study voluntarily and only after they were given sufficient information; however, the researcher continued to acknowledge their rights in order to ensure they did not lose their moral authority. Throughout the research process the researcher was responsibly accountable for any action when interacting with instructors, students and education administrators whilst attempting to ensure promotion of participants' autonomy (Rossi et al., 200).

3.5.2.3 Principle of Justice

Justice is essential part of ethics and should be given due consideration when undertaking any research project (Damtew, 2018). Researchers must ensure each individual participant in a research study is treated equally. This study involved interacting with instructors, students, and education administrators; in this respect, the researcher considered and developed the welfare of all participants. Throughout the process the researcher acted justly, honestly and promoted fairness. Individuals were treated equally and were fairly selected to participate in the research. Together with heads of institutions, the researcher purposively identified the relevant individuals whom they thought would have the knowledge and experience required to respond to each

research question. The process enabled the researcher to obtain relevant information which was used to create a useful solution that had the potential to be accepted by majority of individuals in Tanzania.

3.5.3 Researcher Roles

Another important ethical concern lies in the end results of the study which is a pedagogical model for technology-based education. In this case, the literature review described the extent of current technological practices and issues that needed to be addressed before the adoption of the developed model were also documented. The overarching purpose of the study focused on convincing educators to accept the model and not to enforce its adoption. However, before educators opt to adopt the model, they must agree to transform their practices. Karlsson (2003) pointed out that human attitudes and behavior towards the environment are the main aspects of ethics. In this respect, individual culturally specific norms, values, behaviors and practices were first studied; the study approach was framed around the core cultural integrity by giving due attention to cultural relevance, contextuality – sensitivity to conditions that contribute to participants responses; appropriateness – use of appropriate communication style; mutual respect – respecting both participants and researcher; and flexibility– flexible in terms of language and time (Pelzang & Hutchinson, 2018).

In this regard, the researcher was able to address the confounding variables that may have influenced the research outcome which increases the credibility of the results. Also, in the new model, instructors and students are required to transform their practices and adopt new practices such as recording lectures; participate in online discussion forums; instructors must search for relevant digital resources to incorporate in their courses. In order to smoothen the transition and increase community ownership and acceptance these issues were discussed at early stages of the

research. During the initial discussion with participants the researcher introduced the way the technological development is becoming the strongest factor in shaping the education landscape today. She discussed various technological progresses in different countries to encourage and different option available to facilitate technology integration in education.

3.6 Data Collection and Analysis

3.6.1 Data Collection

Data collection is a systematic approach of gathering evidence on targeted variables from research participants. According to Parveen and Showkat (2017), data collection is the central part of any research study; it involves the gathering of desirable information for the purpose of analyzing the information in order to obtain a complete and accurate picture of a given phenomenon. Kabir (2016) pointed out that data collection involves procedures for gathering and measuring phenomena from a variety of sources in a systematic fashion for the purpose of using such data to answer the research questions. Based on the research discipline, the researcher may choose to employ single or multiple methods and techniques for gathering data; however, the method for data gathering is always determined by the type of data needed (Madziwa, 2016). Beside this, the accuracy of data collected can greatly determine the research integrity; wrong or incorrect data may affect the validity of the research results. Hoylman (2017) pointed out that overall quality of organization decisions is nurtured by quality of data or information used; inaccurate data may lead an organization into making the wrong decision (Choughri et al., 2018). In this respect, a researcher must ensure the data or information's gathered are complete and consistent in order to lead organizations/communities in correct decision making.

Data are categorized into primary and secondary data (Ajayi, 2017). Primary data are those data gathered by the researcher first hand while secondary data are those which were already collected and compiled by other researchers and are publicly accessible (Parveen & Showkat, 2017; Ajayi, 2017). Data can be qualitative – non numerical, descriptive, and nominal or quantitative – numerical data that can be computed mathematically (Kabir, 2016). Based on the nature of the research and type of data needed various techniques for collecting data are available. Quantitative research relies on three common data sources: (1) administered survey,
(2) experiments and (3) observations while (1) documentations, (2) in-depth interviews, (3) focus group discussions and (4) observations are main sources of qualitative data (Ahmad, 2019; Kabir, 2016). However, according to Canals (2017), the methods used for data collection are determined to large extent by the research questions and objectives.

This study involved the collection of qualitative nominal data – data that can be classified into categories or labeled with no specific order; hence a multiple case study design was employed to obtain in-depth and detailed information across cases. The aim was to obtain insight about pedagogical practices applied in the technology-based environment and how they are being used to facilitate the teaching and learning process. Both primary and secondary data were collected from the selected institutions. Interviews, documentary sources of information and observations were the main techniques employed for data gathering; the choice of the techniques considered the fact that the study focused on obtaining an in-depth analysis of the phenomenon.

3.6.2 Data Analysis

Data analysis involves organizing the collected data in order to make sense or create meaning from the data (Kawulich, 2004). Qualitative data refers to non-numeric data such as text-based documents, images, sound or video; in this case an in-depth analysis and interpretation is

required to elicit meaning from the data. According to Kawulich (2004), analyzing qualitative data requires an active and demanding analytical process; the researcher should continue reading the data and interpret them throughout the research process to identify the patterns and themes, whilst looking for the relationship between the data. The analysis process involves identification of common themes of interest, extracts useful information from responses and relates it with the material acquired from the literature (Mohajan, 2018). In this respect, a number of techniques to analyze qualitative data are available; these include content analysis, thematic analysis, narrative analysis, grounded theory analysis and framework analysis (Vaismoradi et al., 2013; Nigatu, 2009). The choice of the analysis method depends on questions that need to be answered; data type; quantity and format of data; and the available skills and resources.

Whilst primary data collected were qualitative in nature during data analysis qualitative data collected from structured interview were transformed into quantitative data. Descriptive statistics and content analysis are the two methods which were used to analyze data from this study.

3.6.2.1 Descriptive Statistics

According to Allanson and Notar (2020) descriptive statistics is used to describe the characteristics of the collected data and identify their relationship; this technique was used to analyze nominal data which were collected using the structured questionnaire. The purpose of descriptive statistics describes, summarize and organize the data and make statements from them; mathematical calculation and graphical illustration are associated to this method to make the researcher easily interpret the results. In this study, nominal data collected from structured interview and observation method were grouped together to form categories and for each category frequency tables and percentages were calculated. Data were also presented visually to

produce charts and graphical representation using Microsoft Excel. Thereafter, the data were then summarized to gain an overall understanding.

3.6.2.2 Content Analysis

Content analysis is one of the data analysis methods used to determine the presence of various concepts, themes or categories in given qualitative data; the main purpose of the method is to quantify the data that are in the form of text and analyze the meaning from certain words in order to reveal certain information from the collected data. Parveen and Showkat (2017) pointed out that content analysis involves subjective interpretation of the content of text data. This method is mainly used to analyze data that was collected form narrative responses, interviews, focus groups, desk review and open-ended survey questions. The process involves counting and compare keywords or contents appeared in data; the process is followed by interpretation of the results to supportthe development of new theories or models or validates the existing theory or model as well as to providing in-depth description of a particular phenomenon (Parveen & Showkat, 2017).

Contents analysis is good method that allows information to be generated from social groups; it allows the researcher to process data in the form of texts that are significant, meaningful, informative, and even presentational to others. Qualitative content analysis can help the researcher to deeply understand the meaning from individual values, intentions, attitudes and cognitions hence it is an ideal approach for scientific research (Macnamara, 2005; Vitouladiti, 2015). This method can be useful even in analyzing large amount of data from broad range of text, interview transcripts and discussions; however, contents analysis can be costly, intensive and time consuming (Aacharya, 2022); however, according to Macnamara (2005), using this method it is difficult to conform to scientific reliability. Beside this, content analysis is limited

only to the available information hence it cannot reveal the underlying motive of the observed patterns (Vitouladiti, 2015; Aacharya, 2022).

Specific to this study, data which were collected from documents and semi-structured interview were analyzed using content analysis techniques. The inductive contents analysis was applied to reduce the collected qualitative data from interview and documents to enable the researchers to answer the study questions. The process involves carefully re-reading and review data in order to make sense of it; important concepts were developed from these data and were grouped based on research questions. Thereafter, themes under each concept were identified; categories were formed under each theme. To ensure research validity data which were not related to the research topic were omitted and were not included as part of the findings. Thereafter, data were coded and tabulated into Microsoft Excel and frequency, direction and intensity of data were identified and interpreted for final report. The same codes used in the interview transcripts were used for analyzing data collected from documents.

3.6.2.3 The Coding Process

According to Linneberg and Korsgaard (2019), analysis of qualitative is very challenging; it requires deliberate work to identify important elements from non-numeric data that can help answer the research questions and provide insights that is reliable to the data. The best way to undergo this process of turning the collected raw data into communicable information is to code the data. Code is used to reduce huge amount of raw data into a form that is accessible and make analytical tasks easier. Coding is referred as presentation information in way that can be quantified (Parveen & Showkat, 2017); it involves identifying portion of meaning into the data and label them with code – a word or a short phrase to summarize, or otherwise capture some attribute of a portion of textual or visual data in order to interpret the meaning from the data

(Linneberg & Korsgaard, 2019). Coding can be catergorized into deductive or inductive coding; deductive coding involves developing a set of predefined codes in a given dataset, that is the researcher develops codes and fit the data in those pre-determined codes. In inductive coding the researchers starts with no codes and continues to develop codes through the analysis process of the dataset (Haug et al., 2021; Stuckey, 2015).

Coding process is very useful as it enables the researchers to organize and group similarly coded data into categories, those which shares common characteristics. The process makes data easily accessible and retrievable for review, interpretation and analysis. According to Linneberg and Korsgaard (2019), coding enables the researcher to acquire deep, comprehensive and thorough understanding about the data. It allows the researcher to pick relevant parts of data for the reader; this can develop evidence about the researcher argument and can show how the conclusion was reached (Linneberg & Korsgaard, 2019). Coding data can also help ensure that the responses are directly related to the research questions hence increase validity of the results. Despite the fact coding is an important tool for qualitative data analysis but it involves tedious work and consumes a lot of time; Gheyle and Jacobs (2017) pointed out that the process of coding unstructured texts into categories (inductively or deductively) needs an intensive work. Applying inductive coding is it sometime difficult to decide the end of coding process; in some cases, this may cause a researcher to miss important concepts.

The first step for coding qualitative data involved going through the data and break them into pieces to examine and compare the similar dissimilarities of the data. Different parts of data were given defined labels or codes to identify it for further analysis. At this stage, different concepts were identified from data. The researcher continued to analyze the codes to find the similarities and group them into categories based on their common properties. The data were later refined to

obtain final codes. These codes were created from collected qualitative data and documents; the researcher assigned meaningful names that reflect different concepts. Further refinement of data lead to the emergence themes; these themes helped the researcher to determine the true results of the research as it shows where a large amount of data inclines.

3.6.2.4 Codebook

According to DeCuir-Gunby et al. (2011), a code book refers to a set of codes used as a guide for analyzing the data. It contained information about each variable of each dataset. These codes are generated in iterative process that may necessitate revising definitions as the researchers gain clear insights about the data. Codebook is important as it enables the researcher to communicate the research data to others and ensure that readers understand the data and can interpret accordingly.

Example of Codebook

RQ3 - What are the pedagogical barriers (as experienced by both teachers and students) hindering technology integration in the classroom?

Table 3.6

Example of Codebook

Inductive Code	Description/Meaning	Example
Competence	This applies to instructors, learners and administrators. Available instructors with technological pedagogical knowledge, learners with capacity to use available technological tools and availability of staff to handle technical issues.	"We do not have technicians to support and maintain technological tools in schools" the school depends on ICT teachers to act like technicians.
Culture	This involves values, expectations and practices of individuals (instructors & learners) or institutions	"Instructors especially those with old ages are not willing to use technology" so most of them do not focus mainly on traditional style of teaching and are not ready to adopt new teaching style with technology.
Facilities	This involves the existence of technological tools, equipment and gadgets, as well as services such as wired and wireless internet to	"Technological facilities available in our school are not proportional to the number of students". When students

	enhancing classroom teaching and student learning. It also involves facilities to enhance remote access to contents.	are given assignment that needs to work using computers or other tools some fail to submit or meet deadline because the available facilities are insufficient.
Finance	This refers to unavailability of funds to support technology adoption and application in schools. It includes funds to acquire application software, pay for internet bills and software licenses as well as to acquire physical facilities such as computers, smart boards, projectors, printers, scanners etc.	"My school is private so it depends on internal generated funds to cover all cost associated with school services". In this case the budget allocated for acquiring technological facilities and pay for technological services is insufficient.
Moral Values	It refers to a set of principles or guidelines which assist individual to act good or wrong. It governs individual behavior and choices. It includes being honest, compassionate, responsibility, respect, corporation etc.	"Students spend more time on issues that are not useful for their studies". This is because most students focus on making friendship and network with their friends to share photos and stories.
Policies	This are documents that governs schools to use technology in a way that creates efficiencies and improve learning outcome, it includes ICT policies, strategies, eLearning implementation plans, ICT security policies etc.	"At our institution we don't have a policy or strategy which guide the use of technology or enforce its usage". As a results teacher may decide whether to use or not to use technology for teaching.

3.6.3 Triangulation

According to Chako (2017), triangulation is the combination of two or more data sources, theories, methods investigator and environment; this process can create innovative and clear way of understanding the topic as well as to check consistency of the results generated through different research methods. Application of different research methods can aviate bias hence increase the researcher confidence about the accuracy of the findings. In this study, data came from multiple sources mainly individual responses through interview; observations; and documents. In this regard, data were triangulated by looking at concepts that were agreed by different groups of individuals (Guion, 2002); these concepts were likely considered to be a valid research outcome (Table 3.5). On the other hand, data from single source were collaborated to compensate the weaknesses in one method with the strengths of the other. This is in accordance with Symonds and Gorard (2009) who stated that using multiple methods provide better quality data than single method; multiple findings can either confirm or confound each other and can reduce the possibility of bias and limited results. However, in this study the major aim of triangulation was not only to cross validate-data but also to capture the different dimensions of the same phenomenon to understand the phenomenon more clearly.

Table 3.7

Summary of Data Collection, Analysis and Triangulation

Data collection method	Data Collection Process Description	Data Analysis Techniques	Data Analysis Process Description	Triangulation
Research Questions1 - What are the pedagogical tools and practices documented in the literatures that are relevant for technology-based learning?				
Document review	The researcher identified and documented data related to the topic from past research and other institutional documents	Content analysis	Contents were coded to identify common themes and patterns.	**Data Triangulation -** concepts/ideas that came from different documents or those which were agreed by different authors were considered as the valid research outcomes.

RQ2 - What technology-mediated teaching approaches are used in Tanzanian Secondary School?				
Structured interview	Questions were created online, the hypelink was shared through participant's emails or WhatsApp and they were asked to complete the online questionnaire. This was followed up by a telephone conversation to resolve any ambiguities. In other cases, participants were interviewed in face to face; participants were asked to fill the paper-based questionnaire which was then followed by a discussion to clarify some responses.	Descriptive statistics	The data variables and value labels were defined; responses were coded entered into Microsoft Excel. Responses were linked to identify repeated similarities. Simple cross tabulations were carried out to calculate the frequency and determine number of each response.	**Data Triangulation** - data were collected from instructors and students. Responses across the two groups were compared to provide clear picture of the situation.

Observation	The researcher recorded the findings based on observation checklist	Content analysis	Information from the observation checklist were coded and chunked, the chunked codes were organized. The important intersections, patterns and themes were identified, and the meaning was generated from it.	**Methodological Triangulation**- the findings from the observational data/checklists were merged with the one obtained from the analysis of the structured interview to enhance the validity of the findings.
RQ3 - What are the pedagogical barriers (as experienced by both teachers and students) hindering technology integration in the classroom?				
Semi-structured interview	Interviews were conducted in a face-to-face environment. Each participant was interviewed individually in their office location	Content Analysis	Data were coded based on participants' responses. Codes were then sorted into themes	**Data Triangulation** - concepts which were found from different groups of participants

			and patterns to provide more structured data.	(teachers, students and education administrators) were put together to supplement one another in order to increase the validity of the research findings.
RQ4 - How can the pedagogical barriers be eliminated in the technology-based teaching environment?				
Semi-structured interview	The data were collected through a face-to-face interview with individuals. Each individual was interviewed separately.	Content Analysis	Data were coded based on participant's responses. The coded data were compared in order to look for the pattern and themes. Related themes and patterns were put	**Data Triangulation** - concepts from different group of participants (instructors, students and education administrators) were put together to supplement each other so as enhance the validity of

			together in order to frame the theoretical perceptions (Alhojailan, 2012)	the research findings.

3.7 Chapter Summary

This chapter has described the methodology used to collect and analyze the data required to address the research questions of the study. Both ontological and epistemological philosophical perspectives were considered. The ontological stance asserts that social meaning was developed through individual knowledge and experiences. In this respect, the selected methodology - case study and interview - focuses on the interpretation of participant's inner thoughts, feeling and experiences. Whilst the research relied on the constructivist epistemological stance; this is because the construction of meaning was based on human interactions; the interaction during the interview sessions and systematic observation of individual practices produced relevant knowledge for the study. The intersection between the two philosophical stances generated critical reflection on how the knowledge was gained: principally through the construction of personal meaning by the researcher and affording the possibility of adding new knowledge to the field of study. Chapters 4 and 5 explore how this knowledge can potentially influence education practice.

Chapter 4: Discussion of Research Findings

4.1 Introduction

The purpose of this study was to develop a model that would guide educators in the process of technology integration in the education with particular consideration to critical and contemporary issues involved in the teaching and learning. A critical review of the available literature on pedagogical approaches and practices was conducted as well as investigations of those practices which are being applied in Tanzania Secondary Schools. There is little doubt that the development of digital tools has impacted almost all sectors including the education sector. However, successful technology integration in the classroom requires careful planning and depends largely on the existence of relevant policies to guide the process. According to Ejiaku (2014), majority of the developing countries including Tanzania have adopted digital technologies and innovations in the education process without modifying them to suittheir education context; this has created the need for effective education models that will provide a connection between education theories and technology application. This study intended to explore the technological pedagogical approaches and practices used in the Tanzanian education system; challenges associated with the adoption of digital tools and ways to overcome the challenges. The results of this study were used to develop an appropriate pedagogical model that will ensure that technology integration in education is considered along with education theories, principles and practices involved in the teaching and learning process.

In the first section of this chapter, the researcher discusses the trustworthiness of data; this involves the discussion on how the researcher has established the degree of confidence about the collected data, its interpretations, and the methods used for data collection as well as quality of

the study results. In this section the researcher presented information to satisfy the four criteria of trustworthiness of data known as credibility, transferability, dependability and confirmability. The discussion focuses on how the truth of the research results was ensured. Next the chapter presents a discussion on validity and reliability of data; it describes the accuracy and consistency of the measure. The focus is on explaining how the validity and reliability of the study were established; these aspects are fundamental features used to evaluate instrument or tool for robust research.

The third section presents a description on how the institutions were sampled as well as the general description of each institution that is name, nature of the institution (private/public), education services offered, number of instructors available and students currently enrolled. Thereafter, demographic information of participants is presented; followed by the description of the document review process that is a discussion on the criteria used to select documents, information about the documents which were reviewed, and type of data which were analyzed. This section provides explanation of the checklist items used in the observation process as part of primary data collection.

The fourth section presents the results of the findings including graphical illustration of the data which enhances the presentation of the results. Both primary and secondary findings collected through different methods are presented in tables and graphs in order to obtain the meaning of each piece of data. Secondary data collected from documents such as past research reports, papers, journals and books are presented in tables describing the author(s) and the findings in

relation to the research questions. All data are presented in order and are categorized on the basis of the research question of which they intend to answer.

In the final section, the researcher presents an evaluation of the results; the discussion is organized based on the research questions. Each research questions forms a section header; this is followed by a discussion of responses given under each question available in the study questionnaire. The findings from observation checklists and desk review are discussed and evaluated against the relevant research question. The discussion of the results from study questions, observation checklists and documents are linked to the theoretical framework and the important issues which were presented in each part of the section.

4.2 Trustworthiness of Data

Trustworthiness of qualitative data refers to a way of establishing how a research study's findings are credible, transferable, dependable and confirmable (Nowel et al., 2017). These four dimensions are termed as indicators of trustworthiness (Chowdhury, 2015). Trustworthiness is one way for the researcher to convince the readers that the research findings are worthy of attention. In this study, the researcher chose the criteria and techniques that were proposed by Lincoln and Guba (1985, as cited in Shenton, 2004 p. 64) in pursuit the principles of trustworthy as credibility, transferability, confirmability and dependability.

4.2.1 Credibility

Credibility is about how confident the researcher is that the study findings are true and accurate (Korstjens & Moser, 2018; Moon et al., 2016). Credibility deals with the question of how a

study's findings concur with real situations. This is one of the important factors in measuring the trustworthiness of qualitative data as it promotes the researcher's confidence that the recorded data are an accurate representation of the phenomenon under the study (Nowell et al., 2017). Credibility can be established through strategies such as data and method triangulation, researcher prior understanding of the research environment, participants' culture and relevant choice of research methods (Moon et al., 2016).

This study adopted well established research methods; sampling techniques, data collection and analysis methods were derived from those which were successfully utilized from past projects of the same nature. Utilization of purposive sampling techniques enabled the researcher to obtain information from rich cases hence ensured relevant data needed to answer the research questions were obtained (Johnson & Rasulova, 2016).The researcher also ensured she had obtained prior understanding of the participants and institutional culture; in this study, formal documents which were available online through the government and institutions websites and libraries were consulted, as well visits to the institutions for informal discussions with participants. The process helped the researcher to familiarize herself with participants and institutional culture and established a relationship with participants. Further, the interview process was conducted by a researcher who possessed relevant knowledge and research skills; follow up questions were also used to enable the researcher to clarify and confirm the participants' responses. Participants were encouraged to support their statements with examples and the interview process provided room for prompting and additional questions (Korstjens & Moser, 2018). The process helped the researcher to build rapport with the research participants which ensured the collection of relevant

data. Observation of the phenomenon under study in real context also increased the degree of accuracy of the collected data.

During the analysis, qualitative data were coded to different concepts, themes and categories which enabled the researcher to obtain the true characteristics of the data. This was achieved by iterative re-reading of data and revising the concepts, themes and categories until the conclusion was reached (Bowen, 2009). Data from documents were organized into categories related to the central questions. Further to this, the study employed two forms of triangulation, (1) methodological triangulation in which the limitation of one method was compensated by another method and (2) data triangulation which involved the use of a wide range of data sources (Denscombe, 2008). Triangulation helped the researcher gain a more complete and more stable view of reality through validation the analysis and findings which increases the plausibility of the results (Johnson & Rasulova, 2016; Korstjens & Moser, 2018). For methodological triangulation, interviews, document review and observation methods were used for data collection while data triangulation involved collecting data from education administrators, students and instructors' hence rich data were constructed from a range of individuals. Further, the research provided participants with opportunities to give free and informed consent for their participation in the study. This process ensured collection of relevant data because they were obtained from individuals who were genuinely willing to take part in the study and were ready to respond freely (Manandhar & Joshi, 2020).

4.2.2 Transferability

According to Korstjens and Moser (2018), transferability involves the extent to which the study findings can be applied to other contexts; it is mainly concerned with the applicability of the study findings. Normally, the findings of qualitative studies are specific to a small population hence it is not possible to generalize the findings to the broader population (Moon et al., 2016). However, the research can provide a thick description of the findings for the readers themselves to assess if they relate to other situations (Nowell et al., 2017).

In this study, the researcher described the contextual information of the research process, the sampling process and strategies, the study coverage, and the data collection and analysis procedures. The contextual information involved the description of the organizations in which the research was carried out including the location, the profile of the research participants, the duration of the interview and the time period of which the data were collected (Kennedy-Clark, 2012). Besides this, purposive sampling of institutions and participants helped the researcher to ensure that the characteristics of the selected participants from each institution related to the demographic information of their respective institutions. In places where the demographic characteristics were not represented the researcher ensured the gap was immediately filled (Johnson & Rasuliva, 2016).

4.2.3 Confirmability

Confirmability involved establishing whether the researcher's interpretations and findings were derived from participants' responses. It involved ensuring that researcher bias did not twist the individual responses to a certain tale. To achieve confirmability, the researcher must demonstrate

that the respondent's ideas and experiences are linked to the findings and not to researcher beliefs and values (Moon et al., 2016). According to Forero et al. (2018), reflexivity and triangulation are the common methods used to establish confirmability; reflexivity involves the researcher assessing his/her judgments, practices, and beliefs in order to identify any personal beliefs or action that may incidentally affect both the research process and outcome (Haynes, 2012). In contrast, triangulation means using multiple theories, data sources, methods in a single study in order to avoid the potential bias and to confirm the suggested findings (Heale & Forbes, 2013).

In this study, the researcher penned a reflexive journal in order to record all that happened during the research process with regard to the researcher's values and beliefs. This included field notes and reports of particular importance. The relationship between the reflective notes and participants' responses were examined during the data analysis. These notes were used by the researcher to trace changes in the design, challenges or problems which arose and the reason for any decisions that were made during the research process. In this respect, the researcher's awareness of her own bias and assumptions are increased (Johnson & Rasuliva, 2016); however, in this study, the researcher did not influence the result in order to obtain the outcome she wanted. The process enhanced the truth and replication of the study. Beside this, both methodological and data source triangulation were used to reduce any potential investigator bias (Shenton, 2004).

4.2.4 Dependability

Dependability involves measuring consistency of the research findings with the raw data collected; it measures the extent to which the same results would be obtained if the research process was repeated in the same context using the same methods and participants (Shenton, 2004). In this respect, dependability confirms that a study can provide enough information if another researcher decides to replicate it and it produces similar results. Dependability can be established in many ways such as the establishment of thick description of the research process and conducting an audit trail (Korstjens & Moser, 2018; Johnson & Rasulova, 2016). Thick descriptions are established by documenting the entire process followed during the research inan order which gives the reader full details of the study (Moon et al., 2016); this includes details of the study purpose; study limitations; method used for data collection and analysis; and how the decisions were reached (Johnson & Rasulova, 2016). In this study, the audit trail involved reviewing the accuracy of the research process and assessing whether the selected data analysis techniques and methods were used accordingly.

A systematic search of existing literature was developed from the beginning of the study followed by rich description of the study; this involved developing a detailed draft of the study protocol which was reviewed at each stage of the research process. All changes and revisions made in the research protocol were documented; a track of when and how changes were implemented was also maintained. The detailed coverage of the process enabled the reader to assess the degree to which appropriate research methods were followed; employing appropriate research methods increased dependability by increasing transparency of the research process (Moon et al., 2016; Shenton, 2004). Further, the researcher engaged an independent verifier to

conduct an enquiry audit to examine the research process including data collection, analysis, and the study results. The auditing process helped to confirm accuracy of the results and measure how the results were supported by the collected data. It provided highlights of each step of the data analysis so as to provide the rationale for each documented decision; this enabled the researcher to ensure that the findings accurately portrayed the participants' responses.

4.3 Validity and Reliability of Data

Validity and reliability are the two important aspects of any research study and are necessary components to provide evidence about the quality of any research study (Cypress, 2017; Abib & Hoppen, 2019). It is important to consider these components during the design of a research study, data analysis phase, and when judging the quality of the research. The validity and reliability of the study help the researcher to assure that the research findings can be accepted by fellow researchers as credible and trustworthy. In this respect, researcher's undertaking qualitative research must be aware of issues related to validity and reliability. This is attained by implementing strategies that eliminate all factors that may pose risks to the validity and reliability of the research findings.

4.3.1 Validity

In qualitative research, validity refers to the appropriateness of the research methods and tools, processes and data (Leung, 2015). It is concerned with the accuracy and truthfulness of the scientific research findings (Cypress, 2017). Measuring research validity involves careful documenting and verification of data by the researcher during the research process. According to Leung (2015), the application of valid methodology and instruments may lead to valid

conclusions. Bapir (2012) pointed out that research validity can be categorized into internal –the extent to which the researcher's observations represent the truth of the population and external – the extent to which the findings can be generalized. Maximizing validity and reliability can produce credible results which may lead to possible generalization of the research findings.

The validity of this study was established using reflexive, recruitment of relevant samples and participant validation strategies. The reflexive strategy was used as a key strategy to minimize the researcher's bias (Cypress, 2017); the researcher critically engaged in self-reflection about the potential bias that she brought to the research. This process helped to increase the researcher's self-awareness which enhanced the researcher's ability to monitor and control any potential bias. During the research process, the researcher was very careful in ensuring that her perceptions and opinions were avoided as they may have tainted the research findings and conclusions. The researcher truly concentrated on the participants and listened and recorded their stories and experiences which were later used to derive the meanings.

The selection of the participating members was ethically conducted; this was important as it helped to ensure true representations of the population which increases the validity of the results. The assessment of individuals who possessed relevant experience of the phenomenon helped the researcher to obtain accurate information. The structured questionnaire was first tested with a few individuals and the statements that did not well reflect the study topic were removed, as well as other irrelevant contents before data collection commenced. Participant validation was another strategy employed to check the validity of the findings; this involved seeking feedback from participants to see if the results were correctly interpreted (Shruti & Chetty, 2020; Daytner,

2006). The researcher selected a group of participants to review the results in order to check if they had accurately reflected the meaning, opinions and viewpoint of the research participants. At first, participants were provided with the collected data including interview notes and observation check list, before the data were interpreted, to review and correct errors, as well as to incorporate missing information that was considered to be relevant in order to improve the data. Thereafter, the draft of the interpreted results was given to participants for them to review and check if it had reflected their meanings.

4.3.2 Reliability

Reliability of qualitative research refers to measurement of the consistency of results (Junior et al, 2019; Leung, 2015). Reliability aims at measuring replicability, repeatability, and stability of the study results (Cypress, 2017). This study employed triangulation and an audit check strategy to establish reliability. According to Zohrabi (2013), collecting data through different sources can reduce the potential bias of selecting a single approach and can enhance the reliability of data and the results. In addition to this, Bashir et al. (2008) suggested that combining methods strengthened the study results through corroboration of the findings which minimizes the potential bias hence leading to more valid, reliable and diverse construction of realities. In this study, data were collected from different sources such as learners, instructors and education administrators using different procedures such as interview, observation and desk review hence enhancing the reliability of the study results.

Beside this, the researcher provided a description of how the data were collected and analyzed; the way in which different themes and categories were derived; and how the data were

interpreted to reach the final decision (Zohrabi, 2013). According to Bashir et al (2008), the consistency of data is achieved through the verification of the research process. In order to establish the reliability of the study an audit check was conducted; readers were given clarification on how the decision was reached. Furthermore, in order to increase the reliability of the study the analysis followed the logical procedures dependent on the participants' narrations.

4.4 Results of Findings Including Graphical Illustrations

The goal of this research was twofold; first to understand pedagogical tools and practices that are relevant to technology-based learning and how they relate to and influence pedagogical practices, and secondly, to determine the pedagogical barriers hindering technology integrations in schools and how those barriers can be eliminated. The study participants were instructors who were currently employed in schools and colleges; current students; and other staff working in education institutions mandated to regulate or monitor the education quality in the country.

4.4.1 Selection of Education Institutions

The study considered both public and private education institutions including higher learning institutions, technical training institutions, education support institutions and secondary schools. The proportion of the number of instructors and students enrolled in an institution was also examined; this was done only for teaching institutions. Summary of the details of sampled institution is as described in table 4.1.

Table 4.1

Sampled Education Institutions

Institution	Type of Institution	Education Services Offered	Number of Teaching Staff	Number of Students (Active)	Education Administrators
Open University of Tanzania	Public	Higher Learning Institutions - bachelor and postgraduate courses	319	12,000	N/A
Makongo High School	Private	Secondary School Education – ordinary or advanced secondary education	92	1000	N/A
Kilakala Secondary School	Public	Secondary School Education – ordinary or advanced secondary education	58	600	N/A
Morogoro Secondary School	Public	Secondary School Education – ordinary or advanced secondary education	103	1,932	N/A
Arusha Science Secondary School	Private	Secondary School Education – ordinary or advanced secondary education	13	150	N/A
Monduli Teachers	Public	Technical Education and Training	43	840	

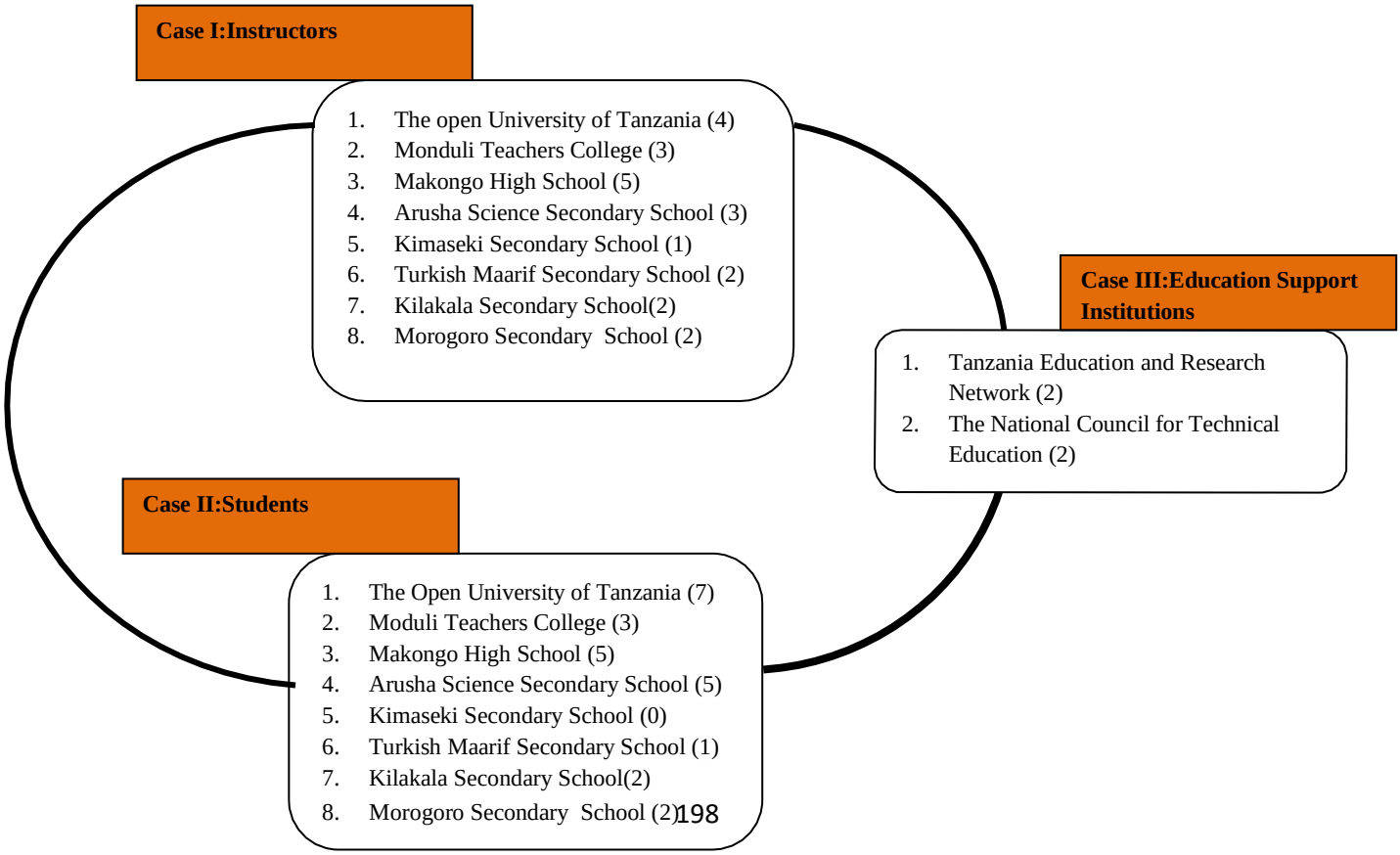
College		institution – certificate and diploma courses			
Turkish Maarif Secondary School	Private	Secondary School Education – ordinary or advanced secondary education	40	470	N/A
Kimaseki Secondary School	Public	Secondary School Education – ordinary or advanced secondary education	28	578	N/A
Tanzania Education and Research Network (TERNET)	Private	Education Administration – non-teaching (education support institutions)	N/A	N/A	12
The National Council for Technical Education (NACTE)	Public	Education Administration – non-teaching (education support institutions)	N/A	N/A	32

4.4.2 Consideration of Multiple Cases

The researcher used the data collected through ten education institutions to explore the use of technology in the teaching and learning process, associated challenges and ways to overcome the challenges. Data were collected in four phases as described in figure 4.1; the study participants were grouped into three categories which were reffered as cases; these are: 1) instructors, 2) students and 3) Education administrators. According to Gustafsson (2017), evidence generated from multiple case studies is strong and reliable as it allows a wider exploration of research question and theoretical emergence. In this study, the researcher analyses the data within case and across cases and compared the similarities and differences between cases. Multiple case study design enabled the researcher to use more than one method to examine the phenomenon in different contexts. Figure 4.1 presents data phases for data collection in a multiple case design.

Figure 4.1

Phases for Data Collection for the multiple Case Design for the Study



According to Schoch (2020), a case can be an individual, an institutions or group of institutions, a group of people, a community, a city or a nation. Data were collected from instructors, students and education administrators. In this regards, the study consisted of three cases in which participants with the same characteristics were grouped to make a single case. The first case consisted of instructors, second case consisted of students, the third case consisted of education administrators. The researcher focus in the first three cases was to conduct an intensive study about types of technological pedagogical tools, models, principles and practices applied in teaching environment as well as challenges associated with the application of pedagogical technologies. A set of 35 questions which leads to intensive analysis of the six broad areas: 1) education management and administration, 2) education service delivery, 3) technology application, 4) education pedagogical design, 5) pedagogical models, principles and practices and 6) technological pedagogical challenges. Information were obtained from instructors and students through structured interview followed by the telephone and face-to-face interview. On the other hand, the researcher focus for the fourth case was to find out the technological support offered in the education process. A set of 10 questions were used to collect information about technological pedagogical support provided to enhance the education process in Tanzania. The response of the questions leads to intensive study of the four key areas: 1) technological support offered to training institutions, 2) evaluation of pedagogical use of technologies, 3) availability of policies and guidelines for technology use and 4) technology investment initiatives. This case involved conducting a semi-structured interview to educational administrators.

4.3.3. Justification for Using a Small Sample

Composition and size of the sample are important consideration when evaluating the quality of qualitative research (Vasileiou et al., 2018; Daniela, 2020). However, sample for qualitative research is small in order to allow for an in-depth analysis of enquiry. The focus of qualitative research is to fulfill the research aim and unravel the phenomenon in-depth rather than to represent the large samples and to generalize the findings (Subedi, 2021). In addition to this, according to Vasileiou et al. (2018), most qualitative sample are purposive, that is samples are selected based on their capacity to obtain rich and relevant information required for the phenomenon under investigation.

According to Daniela (2020) and Aguboshim (2021), there are no published rules for estimating sample size; appropriateness of the sample size is a matter of judgment depending on the research purpose and the nature of problem under study. It can be small if the purpose of the research is to explore the prevalent ideas or a larger size if the research requires exploration of a broader range of ideas (Daniela, 2020). Beside this, Aguboshim (2021) pointed out that consideration of past qualitative case studies before data collection is necessary and can be assumed as a good working guide.

The study purpose was to obtain prevalent information regarding technology integration in the education process; a purposive sampling was used to identify relevant institutions and participants with the capacity to provide rich, more accurate, reliable and highly instructive responses for analysis. Interviewing small number of participant's enabled the researcher to generate great insights. Triangulation was used to double checks the results obtained from the

research to ensures confirmability of the results hence increases the credibility and validity of the findings. In addition to this, information from past research as well as from documents was used to provide more information to enable justify the results collected from individuals.

4.3.4 Demographic Characteristics of Study Participants

Demographic information including participant's age and work experience (for instructors and education administrators) and school year (for students) were gathered and are presented in Table 4.2

Table 4.2

Demographic Information of Study Participants

Age Range	Number of Participants	Percentage	Work Experience Range	Number of Participants- Instructors and Administrators Only	Percentage	School Year Range	Number of Participants- Students Only	Percentage
10 - 20	19	37	0 - 5	7	29.2	Form I – Form II	10	40
21 - 30	10	19.6	6 - 10	7	29.2	Form III – Form IV	7	28
31 - 40	13	26	11 - 20	9	37.5	Form V – Form VI	8	32
41 - 50	7	13.7	21 - 30	1	4.1			
51 - 60	2	3.9	31 - 40	0	0			
Total	**51**	**100**	**Total**	**24**	**100**	**Total**	**25**	**100**

***Note*:** The highest number of participants was those with age group between 10 – 20 years while the lowest number of participants is those with age group between 51 – 60 years.

4.3.5 Document Review

A desk-based review was used to access the pedagogical tools and pedagogical approaches which were considered relevant for technology-based learning. A number of documents were studied to examine the pedagogical approaches and practices.

4.3.5.1 Criteria for Selecting Documents

The researcher critically selected the documents for analysis; according to Bowen (2009), the researcher should establish the meaning of the document and its contribution to the phenomenon of study. In this study, only documents with content that related to the study topic were selected; the researchers first identified and evaluated the relevance of the documents to the research problem and purpose. This was followed by examining whether the content of the documents fitted the conceptual framework of the research. Thereafter, documents which covered some specific aspects of the topic and contained detail on some aspects were considered for analysis. Table 4.3 presents the type of documents reviewed and respective research focus areas.

Table 4.3

Sampling of Documents and Data Analyzed

Document Type	Number of Documents Reviewed	Data Analyzed
Tanzania ICT Policy for Basic Education – 2007	1	Strategies that the government intends to focus in integrating technology in the education field
Tanzania Education and Training Policy -2014	1	Strategies to guide the application of emerging technological trend
Institution ICT Policy	1	Strategies and practices that can enhance the technology mediated teaching and learning
Institution E-Learning Implementation Strategies	1	Strategies and practices that can enhance the technology mediated teaching and learning
Research Reports	5	- Technology integration in education situations - Pedagogical Challenges - Proposed solution for improvements

4.3.6 Observational Checklist

Among the study objectives, is to examine the existing teaching approaches and practices to identify critical pedagogical features which would afford meaningful technology-based learning. According to Hong et al. (2020), observation is regarded as a tool to improve teachers' teaching

efficiency through measuring the appropriateness of learning environment and consistence of teaching practices. The observation process helps to verify teaching strategies that are helpful to improve the quality of teaching evaluation.

During the research study, the researcher observed a number of teaching practices that were being conducted in teaching institutions. The observation checklist was used to gather useful information to provide more objective insight into the phenomenon. The observation checklist was comprised of four (4) categories namely instruction approaches, physical spaces, classroom culture/practices and technology infrastructure. Each category consisted of a list of practices relevant to the study.

4.3.7 Study Results

Data were presented based on the four research questions; data which were collected through structured interview and observation checklist were tabulated, and frequency and percentages of responses were presented in respect of the research questions. For open-ended questions, the number of responses for each sub-question was presented. Data from semi-structured interview were coded, and similar categories were drawn together to form broader themes which were further developed to form final themes. The final themes were presented under the relevant research question. Information from desk review was presented as derived from the documents and was presented against the relevant research questions to complement the results from other methods.

4.3.7.1 Research Question 1

Regarding pedagogical tools and practices documented in the literature that are relevant for technology-based learning.

a. Technological Pedagogical Tools

Author	**Pedagogical Tool**	**Support Functions**
Ndibalema (2020); Aldosari (2020); Mesonovich (2019); Mshangi (2013)	Learning Management System (LMS)	- Enable content creation and delivery - Facilitating collaborations among instructors and students - Facilitates learners interaction with instructors, contents and with peers - Facilitate charting among learners as well as with instructors - Facilitate discussion of the topic moderated by instructors, - Support learners and instructors engagement - Facilitate assessment both formative and summative assessment
Ndibalema (2020); Kumari and Naaz (2020)	Massive Open Online Courses (MOOCS)	- Enrich learning contents - Increase access to education – provide open access to

		education - Allows learners to learn anytime and everywhere irrespective of learner's time and interest. - Provide opportunity to connect to global learners (it brings learners together from all over the world) - It allows learners participations and open access via web
Aldosari (2020); Brewer et al. (2017); Khan (2021)	Online Library	- Provide crucial resources and services beyond books such as magazine, articles, papers, images, sound files, and videos - Increase students retention and information literacy - Facilitate availability of recources from multiple collection which eliminated physical obstruction of resources. - Enable learners get the most relevant (latest) informational of different formats (multmedia) in avery short time
Ndibalema (2020); Aldosari (2020); Barakabitze et al.	Modern software and hardware. Sofwares such as interactive	- Facilitate preparation of learning resources and produce digital contents

(2015); Mshangi (2013); Campos et al. (2020); Gunawardhana (2016)	animations, electronic games, simulations and multimedia softwares. Hardwares such as computers, laptops, smart phones, projectors, smart boards and scanners	- Helps students to easily understand difficult topics for example when contents is incorporated with multimedia or animations - Allow learners to practice what they have learned in their real-life situations - Enhance learners capabilities such as teamwork, problem-solving, decision making and critical thinking - Facilitate practical application especially in science subjects
Barakabitze et al. (2015); Karsenti (2019); Kuprenko (2020); Lu and Harris (2018)	Artificial Intelligent Systems (AI)	- Support individualized learning - Facilitate automatic feedback/assessment - Provide possibilities for instructors to analyze learners understanding - Enable automated tasks such as automatic grading, attendance recording and quiz generation.
Bidding and Ziden (2013);	Mobile Learning	- Provide mobility among learners

Alomary et al. (2016); Mehta (2016)		- Facilitates virtual learning anywhere at any time - Enable easy access to digital contents - Facilitate collaborations among learners - Enhance personalized learning - Facilitate continued and life-long learning
Kristóf (2020); Krutka and Carano (2016); Poderanga (2014)	Video Conferencing tools	- Facilitate interactions and collaborations between learners and instructors - Provide new ways of presenting contents - Helps improved communication and presentation skills - Provide opportunities for sharing resources - Enables access to national and international experts - Promotes learners-centered opportunities
Zirawaga et al. (2017); Papadakos (2018); Rabah et al. (2018); Lopes (2014)	Education games	- Facilitate creation of social interactions - Stimulate the learning process - Encourage development of critical thinking
Barakabitze et al. (2015);	Radio and Television	- Offer formal and informal education to learners who lack

Mshangi (2013); Potane (2022)		access to the internet or have low digital literacy - It can facilitates access to contents even for rural community - Increases learners learners motivations due to audio-visual effects - Helps learners to improve their listening, critical and creative abilities - Provide opportunity to see or hear instructors delivering the contents - Provide low cost education
Barakabitze et al. (2015)	Integrated databases	- Facilitate the process to distribute deploy and track professional development - Enable proper recording of education events - Easy management of education information
Jagota (2018); Viner et al. (2020); Quek et al. (2016)	Assistive technologies such as text-to-speech (TTS) software, Talking	- Allow learners with special needs to participate in the learning process

	spell-checker, text Magnification and hearing assistive technology, visual support systems, such as visual aids/technology, and math talk recognition software.	- Helps to create environment and opportunities where all students can learn. - Gives chances for special needs students and intellectual disabilities to be able to interact in educational or social environments - Enhance social development of students with special needs - Facilitate inclusive education
Alhumaid (2020); Yoo and Kim (2013); Mccarroll and Kevin Curran (2015)	Social networks such as Facebook, Twitter, YouTube	- Enable sharing of classroom updates and feedback - Facilitate communication among students and instructors - Enhance collaborations among learners - Allows for prolonged interaction among learners, instructors and parents to exchange knowledge in very easy accessible ways - Enable building engaging learning environment - Help learners to build communities which make individual to gain important teamwork skills

		- Facilitate knowledge creation through experience sharing
Majid and Verma (2018); Perumal and Vinothkumar (2022); Mccarroll and Kevin Curran (2015)	Web 2.0 technologies such as Grammarly, Slide Share, Survey builder, blogs, Google Classroom	- Facilitate collaborations among instructors, students and parents - Enhance communication - Facilitate the creation of user-generated-content - Enable creation and sharing of wide range of digital artifacts - Helps to build and connect education communities which can increase engagement and touch
Conger at al. (2017); Kioumarsi et al. (2018)	Wikis and wiki spaces	- Enhances collaborations among learners hence facilitate knowledge creation - Assist in project planning and documentation - Facilitating online learning groups discussions - Support dissemination of information to wide range of individuals

b. Technological Pedagogical Practices

Author	Pedagogical Practice	Support Functions
Kisanjara et al. (2014); Duchak (2014); Bakar et al.(2020); Dalali and Mwila (2022)	Visual Learning Practices – use of technological tools to create visual aid like graphics, charts, presentation and drawings	- It gives educators an opportunity to increase the quality of their teaching and connect learners in more interesting way - Improves learner's cognitive capacity by providing clarity - Facilitate communication about important concepts to help learners to build a deep understanding - Enable learners to attempt to identify and/or recognize its functions and attempt to interpret hence comprehend its application.
Kumari (1998); Costley (2014)	Teach through internet	- Sharpens learners ability to search, analyze and retain information - Enable to connect with information resources far beyond the physical resources - Provide an avenue to publish electronic portfolios of teaching activities

		- Locating good resources for further reading from world wide information databases - Creation and posting class activities, assignments, events and schedules, - Organizing online projects with an interactive aspect
Kafyulilo (2010); Holstermann et al. (2010); Ekwueme et al.(2015); Musharrat (2020)	Hands-on Practices	- Enables learners to remember the material better hence able to transfer the experience to the real world - Promote critical thinking through interpretation of the observed events - Influence students' interest which leads to positive motivation - Allows learner to see, touch and manipulate objects while learning - It encourage both instructors and learners creativity in problem solving, promote learners independence and improves understanding

Karim (2015); McKinney (2016); Alazemi et al. (2020); Volkova et al. (2021)	Group Work Practices through shared work spaces	- It gives more opportunities for learners to contribute on the topic - Foster social learning, peer interaction, cognitive and communicative processes - Encourage teamwork which enable learners to better understand the concept
Rashtchi (2020); Unin and Bearing (2016); Ammade (2018); Khan and Ashraf (2021)	Brainstorming Practices – using tool such as mind mapping and Mobile Learning	- Encourage actively participations among learners - Allows students to learn through sharing of thoughts, opinions and ideas - Enables learners to learn by their own observations hence able to develop creativity, critical thinking, collaboration, communication and problem-solving skills - Enables learners to identify and come up with real questions to include in learning projects - Enables learners to solve problem in an innovative way
Rashid and Qaisar (2017);	Role-Playing Practices	- Promotes critical thinking

Selvakumar et al. (2022); Hidayati and Pardjono (2018); Rahayu (2015)		- Improve communication skills for learners - Enable creation of activities that permits every individual in the class to practice and express interactive abilities - Facilitate interactions through discussions, debates or even casual conversations thus increase learners interest towards learning - It allows learners to participate in addressing problems, seeking alternatives and create solution to problems - Encourage learners reflections of the subject which deepen learners knowledge - It helps to promote interpersonal relations which leads to better learning
Bonney (2015); Minniti et al. (2017)	Case Study	- Promotes analytical skills - Improve learners ability to synthesize complex analytical questions
Basheer (2017); Hussain	Demonstration Practices	- Enhances learners reasoning abilities

(2020); Iline (2013)		- Promote learners active participations and involvement in tasks hence improve their understanding - Promotes learners active participation hence increases their cognitive and critical abilities - It helps learners to raise interest and encourage them to think about a topic

e. Significance of the Data

By collecting, organizing and synthesizing the available information in literature about the topic, the researcher gained an understanding of the existing technological pedagogical approaches and practices. This includes how these approaches and practices are applied and how these practices are useful in enhancing the teaching and learning process. In addition to this, the desk-based review data enabled to researcher to obtain details about essential tools including those that are relevant in facilitating the education process among special needs students.

4.3.7.2 Research Question 2

About the technology-mediated teaching approaches used in Tanzanian Secondary School?

I. Analysis of Structured Interview Data

a. Dedicated Technological Facilities for Students and Instructors

The result from questionnaire (Table 4.4) shows that 91% of the respondents agreed with the statement that there are available technological facilities dedicated to students and instructors, whereas no respondent has disagreed, and 9% were undecided.

Table 4.4

Dedicated Technological Facilities for Students and Instructors

Response Type	Frequency	Percentage %
Agreed	43	91
Disagreed	0	0
Total Responses	**43**	**91**
Undecided	4	9
Total	**47**	**100**

b. About Wireless Internet (WIFI) Access

The result from questionnaire (Table 4.5) shows that 80% of the respondents agreed with the statement that their institution have a wireless internet access, whereas 10% disagreed, and 10% were undecided.

Table 4.5

Availability of Wireless Internet (WIFI) Access

Response Type	Frequency	Percentage %
Agreed	37	80
Disagreed	5	10
Total Responses	**42**	**90**
Undecided	5	10
Total	**47**	**100**

c. Provision of internet Access to Students and Instructors

The result from questionnaire (Table 4.6) shows that 83% of the respondents agreed with the statement that their institution provide internet access to students and instructors, whereas 6% disagreed, and 11% were undecided.

Table 4.6

Provision of Internet Access to Students and Instructors

Response Type	Frequency	Percentage %
Agreed	39	83
Disagreed	3	6
Total Responses	**42**	**89**
Undecided	5	11
Total	**47**	**100**

d. Technical Measures to Prevent Access to Online Contents

The result from questionnaire (Table 4.7) shows that 55% of the respondents agreed with the statement that there are available technical measures to prevent access to online contents, whereas 45% disagreed.

Table 4.7

Technical Measures to Prevent Access to Online Content

Response Type	Frequency	Percentage %
Agreed	12	55
Disagreed	10	45
Total Responses	**22**	**100**
Undecided	0	0
Total	**22**	**100**

d.1 Technical Measures Available to Prevent Access to Contents

S/N	Responses about the availability of technical measures to prevent access to online contents	Number of Respondents
	Installed firewall	6
	The use of plug-in	3
	Installation of up-to-date antivirus software	10
	Desktop monitoring software	2

e. Documented Policies/Strategies/Guidelines to Promote Technology-mediated Teaching and Learning.

The result from questionnaire (Table 4.8) shows that 45% of the respondents agreed with the statement that their institution/school has documented specific policies/strategies/guidelines to promote technology-mediated education, whereas 42% disagreed, and 13% were undecided

Table 4.8

Availability of Documented Policies/Strategies/Guidelines

Response Type	Frequency	Percentage %
Agreed	21	45
Disagreed	20	42
Total Responses	**41**	**87**
Undecided	6	13
Total	**47**	**100**

e.1 Examples of Documents Available

S/N	Available Documents	Number of Respondents
	ICT policies	20
	E-learning implementation strategies	7
	OER Policy	2
	ICT security policy and operational procedures	9
	Computer lab guidelines	16

e.2 Technology Used to Support Operational or Administration Functions

S/N	Responses on the Available Technologies to Support Operational and Administrative Functions	Number of Respondents
	Students Management Systems (admissions, examinations and reporting)	15
	Microsoft office application	22
	Internet services	22
	Mobile applications for communications	8
	Human Resources Management System	7
	Financial Management Information System	9

f. Presence of a Special Department to Support Pedagogical use of Technology

The result from questionnaire (Table 4.9) shows that 91% of the respondents agreed with the statement that there is a special department to support pedagogical use of technology, whereas 9% disagreed and no undecided respondent.

Table 4.9

Presence of Special Department to Support the Pedagogical Use of Technology

Response Type	Frequency	Percentage %
Agreed	20	91
Disagreed	2	9
Total Responses	**22**	**100**
Undecided	0	0
Total	**22**	**100**

g. Scheduled Workshops and Trainings on Pedagogical Use of Technology

The result from questionnaire (Table 4.10) shows that 81% of the respondents agreed with the statement that there are workshops and training on pedagogical use of technology, whereas 8% disagreed, and 11% were undecided.

Table 4.10

Scheduled Workshops, Trainings on Pedagogical Use of Technology

Response Type	Frequency	Percentage %
Agreed	38	81
Disagreed	4	8
Total Responses	**42**	**89**
Undecided	5	11
Total	**47**	**100**

g.1 Details of the Workshop and Training on Pedagogical Use of Technology

S/N	Responses on the Availability of Workshop or and Training on Pedagogical Use of Technology	Number of Respondents
1	Basic computer applications provided to instructors and students	25
2	Workshop to orient students on how to use ICT to access online education resources (Library and LMS system)	15
3	No planned training	13
4	On job training through enforcing instructors to use the available technologies for producing reports and other administration assignments	12
5	Instructors trained on the application of	10

	pedagogical technological tools	
6	Basic computer applications provided to instructors	10
7	Instructors training on digitization of contents offered both online and through face to face	7
8	It is mandatory for form I and II students take ICT subject	6
9	Workshops on online facilitations	5
10	Training is only offered through projects by NGOs	4

h. Budget Set Specific for Acquiring and Maintain Technological Facilities

The result from questionnaire (Table 4.11) shows that 82% of the respondents agreed with the statement that there is a budget set specific for acquiring and maintaining technological facilities, whereas 13% disagreed, and 5% were undecided.

Table 4.11

Budget Set Specific for Acquiring and Maintain Technological Facilities

Response Type	**Frequency**	**Percentage %**
Agreed	18	82
Disagreed	3	13
Total Responses	**21**	**95**
Undecided	1	5
Total	**22**	**100**

h.1 Budget Sufficiency

S/N	Responses on Whether the Budget Set is Sufficient	Number of Respondents
	Budget depends on central government through the current ministry hence not guaranteed	10
	Budget is set on annual basis, but it is not sufficient	12
	The budget is sufficient	4

i. Learning Delivery Format

The result from questionnaire (Table 4.12) shows that 19% of the respondents use face to face as their learning delivery format, 53% use Flipped/Blended and 23% use E-learning, 4% of respondents did not respond to the question.

Table 4.12

Learning Delivery Format

Response Type	Number of Responses	Percentage %
Face to Face	9	19
Flipped/Blended	25	53
E-Learning	11	23
Total Responses	**45**	**96**
Undecided	2	4
Total Responses	**47**	**100**

j. Instruction Strategies

The result from questionnaire (Table 4.13) shows that 19% of the respondents use teacher-centered as their instruction strategies, 72% use student-centered and 9% of respondents did not respond to the question.

Table 4.13

Instruction Strategies

Response Type	**Number of Responses**	**Percentage %**
Teacher-centered	9	19
Student-centered	34	72
Total Responses	**43**	**91**
Undecided	4	9
Total Responses	**47**	**100**

k. Integration of Technology as a Pedagogical Tool

The result from questionnaire (Table 4.14) shows that 87% of the respondents agreed with the statement that technology was integrated as a pedagogical tool, whereas 13% were undecided.

Table 4.14

Integration of Technology as a Pedagogical Tool

Response Type	Frequency	Percentage %
Agreed	41	87
Disagreed	0	0
Total Responses	**41**	**87**
Undecided	6	13
Total	**47**	**100**

l. Integration of Learning Management System (LMS)

The result from questionnaire (Table 4.15) shows that 53% of the respondents agreed with the statement that their institution/school has an integrated LMS, whereas 34% disagreed, and 13% were undecided.

Table 4.15

Integration of LMS

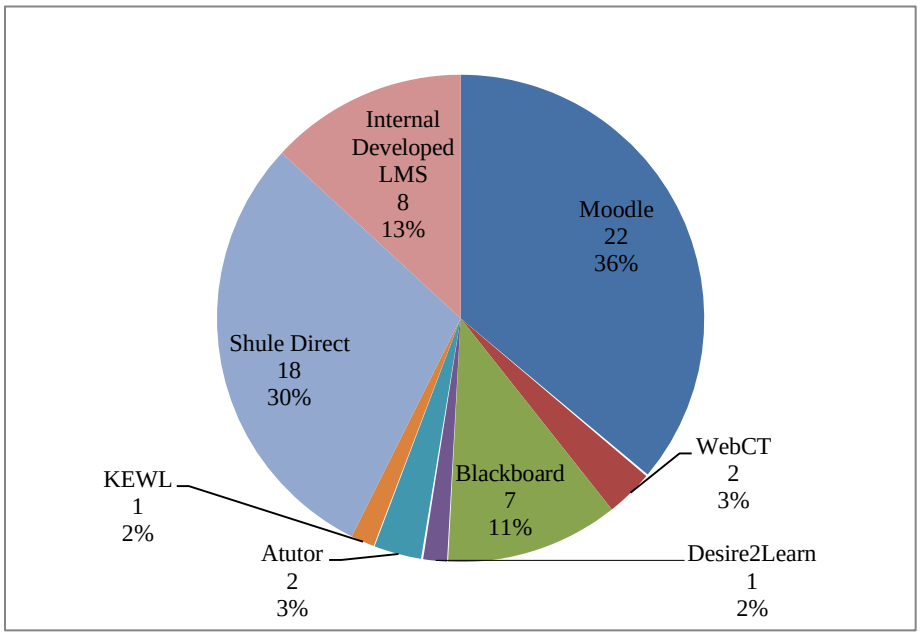
Response Type	Frequency	Percentage %
Agreed	25	53
Disagreed	16	34
Total Responses	**41**	**87**
Undecided	6	13
Total	47	100

m. Type of Learning Management System

The results from (Figure 4.16) shows that 36% of respondents use Moodle as their LMS, 30% use Shule Direct, 13% use In-house developed LMS, 11% use Blackboard, 3% use WebCT, 3% use A Tutor, 2% use KEWL and 2% use Desire2Learn.

Figure 4.2

Types of LMS Integrated

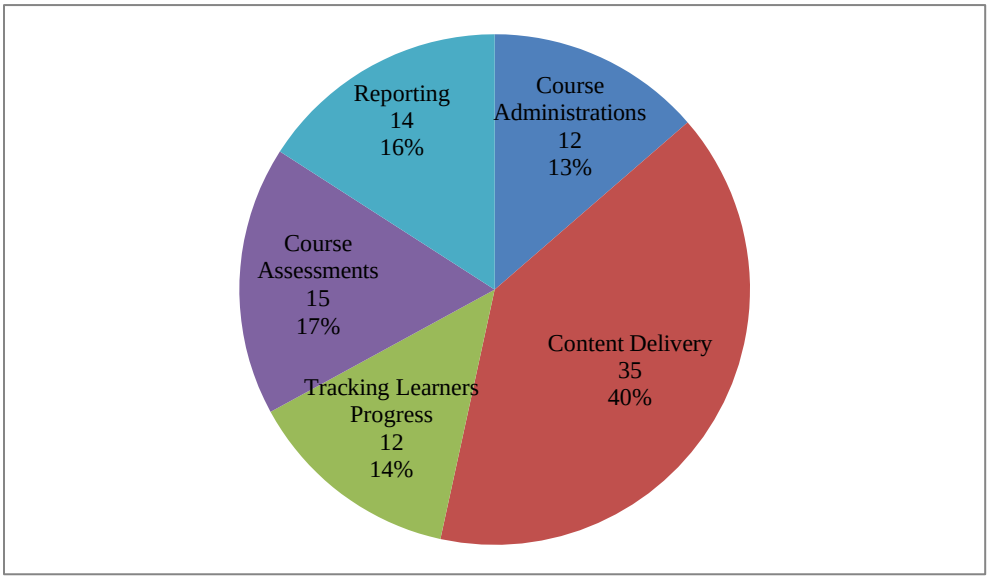


n. LMS Functions

The results from (Figure 4.2) shows that 40% of respondents use LMS for Content Delivery, 17% for Course Assessment, 13% for Course Administration, 16% for Reporting and 14% for Tracking Learners Progress.

Figure 4.3

LMS functions

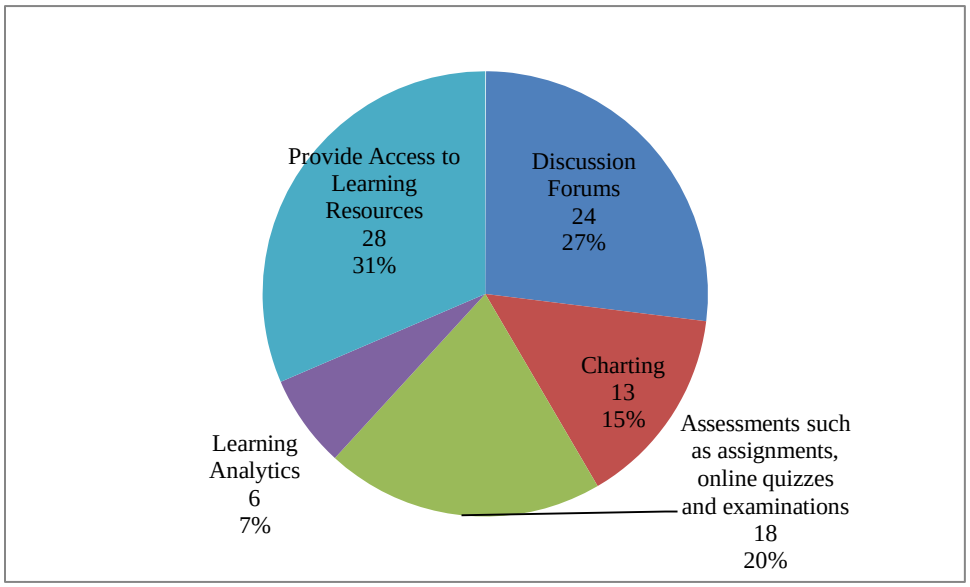


o. Other Supporting Functions of LMS

The results from (Figure 4.3) shows that 31% of respondents use LMS to provide Access to other Learning Resources, 27% for Discussion Forums, 20% for Assessment such as assignments, online quizzes and examination, 15% for Charting and 6% for Learning Analytics.

Figure 4.4

Other Supporting Functions of LMS



p. Special Techniques for Content Design

The results from questionnaire (Table 4.16) shows that 23% of the respondents agreed with the statement that institution/school have documented special techniques for content design, whereas 59% disagreed, and 18% were undecided.

Table 4.16

Availability of Special Techniques for Content Design

Response Type	Frequency	Percentage %
Agreed	5	23
Disagreed	13	59
Total Responses	**18**	**82**
Undecided	4	18
Total	**22**	**100**

p.1 Documented Special Techniques for Content Design

S/N	Responses on the Documented Special Techniques for Content Design	Number of Responses
	There is an institutional guidelines/format to guide online content design	5
	There are no guidelines/format for content design	17

q. Evaluation of the Institution/School LMS

The result from questionnaire (Table 4.17) shows that 47% of the respondents agreed with the statement that the institution/school regularly evaluate its LMS, whereas 34% disagreed, and 19% were undecided.

Table 4.17

Evaluation of the Institution/School LMS

Response Type	Frequency	Percentage %
Agreed	22	47
Disagreed	16	34
Total Responses	**38**	**81**
Undecided	9	19
Total	**47**	**100**

q.1 Open-ended Question on Evaluation of the Institution/School LMS

S/N	Responses on the Evaluation of the Institution LMS	Number of Responses
	Learners are provided with questionnaire to presents their opinions regarding their course	40
	Technical team evaluate the effectiveness of LMS including the status of each course and report to the management on quarterly basis	25
	Instructors are asked to provide feedback on regular basis	24
	A special department dedicated to monitor the quality of content and effectiveness of LMS	13

r. Application of Mobile Technology in the Education Process

The result from questionnaire (Table 4.18) shows that 32% of the respondents agreed with the statement that the institution/school apply mobile technology in their education process, whereas 51% disagreed, and 17% were undecided.

Table 4.18

Application of Mobile Technology in the Education Process

Response Type	Frequency	Percentage %
Agreed	15	32
Disagreed	24	51
Total Responses	**39**	**83**
Undecided	8	17
Total	**47**	**100**

r.1 Mobile Technology Use in Supporting the Teaching and Learning Process

S/N	Responses on How Mobile Technology is Used to Support Teaching and Learning	Number of Responses
	Use mobile to connect with fellow instructors, students and parents through SMS or WhatsApp groups	40
	Use mobile to search contents through internet	39
	Sharing of Learning Resources	20
	Available mobile app for learners to access contents (Elimu mobile, Moodle mobile) – Personalized learning	11

s. Application of Video Conferencing Tools

The result from questionnaire (Table 4.19) shows that 26% of the respondents agreed with the statement that the institution/school have installed video conferencing tools to support their education process, whereas 64% disagreed, and 10% were undecided.

Table 4.19

Application of Video Conferencing Tools

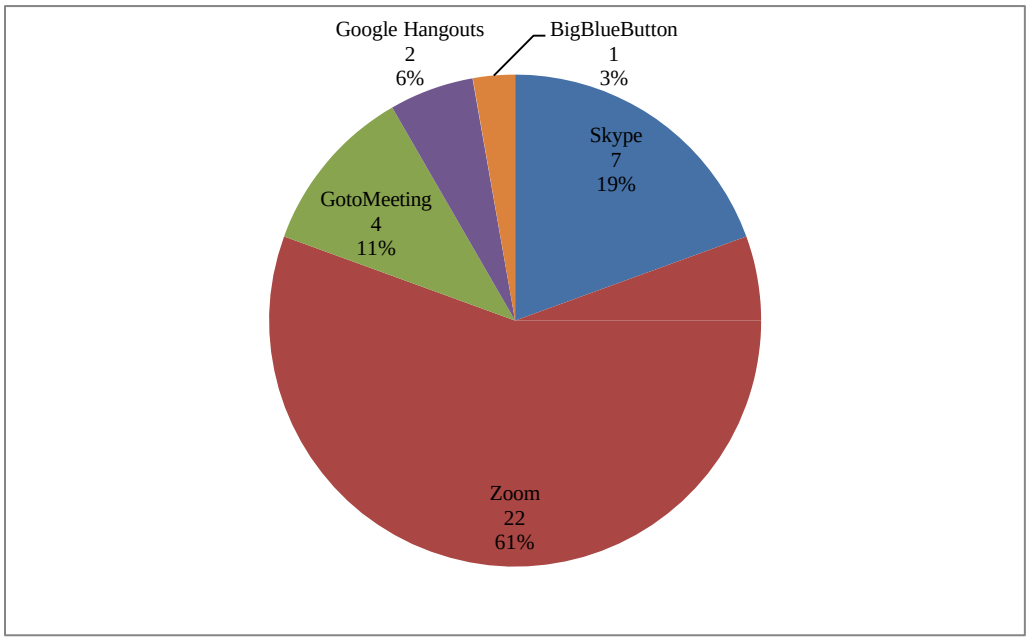
Response Type	Frequency	Percentage %
Agreed	12	26
Disagreed	30	64
Total Responses	**42**	**90**
Undecided	5	10
Total	**47**	**100**

t. Types of Video Conferencing Tools Installed

The results from (Figure 4.4) shows that 61% of respondents mentioned Zoom as the available video conferencing tool, 19% mentioned Skype, 11% mentioned GoToMeeting, 6% mentioned Google Hangouts, and 1% mentioned BigBlueButton.

Figure 4.5

Types of Video Conferencing Facilities

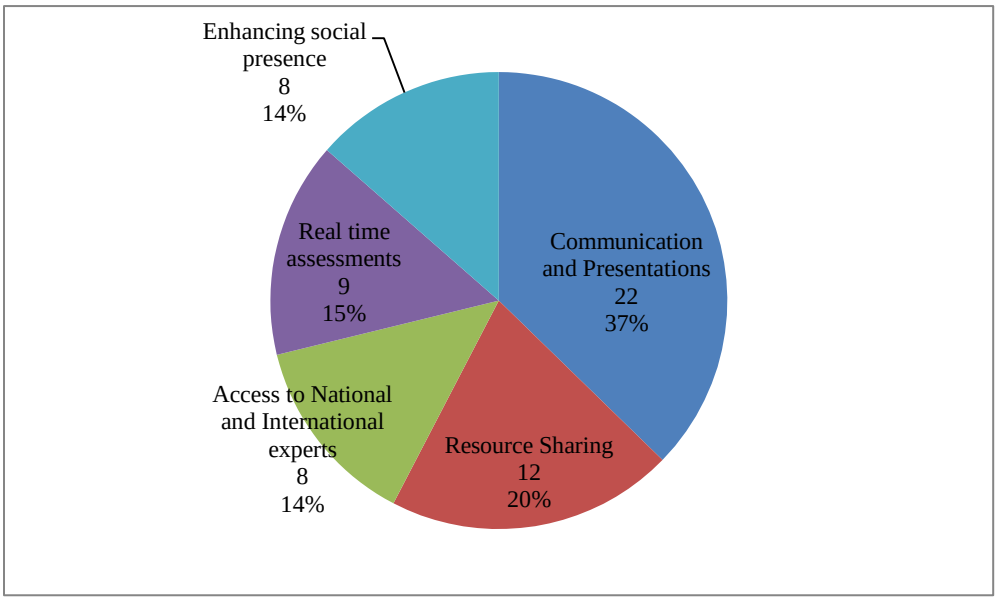


u. Education Functions Supported by Video Conferencing Tools

The results from (Figure 4.5) shows that 37% of respondents mentioned that the available video conferencing facilities are used to support communication and presentations, 20% for resource sharing, 14% for access to national and international experts and 9% mentioned that they are used for resource sharing.

Figure 4.6

Functions Supported by Video Conferencing Tools



v. Application of Games in the Teaching and Learning Process

The result from questionnaire (Table 4.20) shows that 21% of the respondents agreed with the statement the institution/school has integrated games in the teaching and learning process, whereas 62% disagreed, and 17% were undecided.

Table 4.20

Application of Games in Teaching and Learning Process

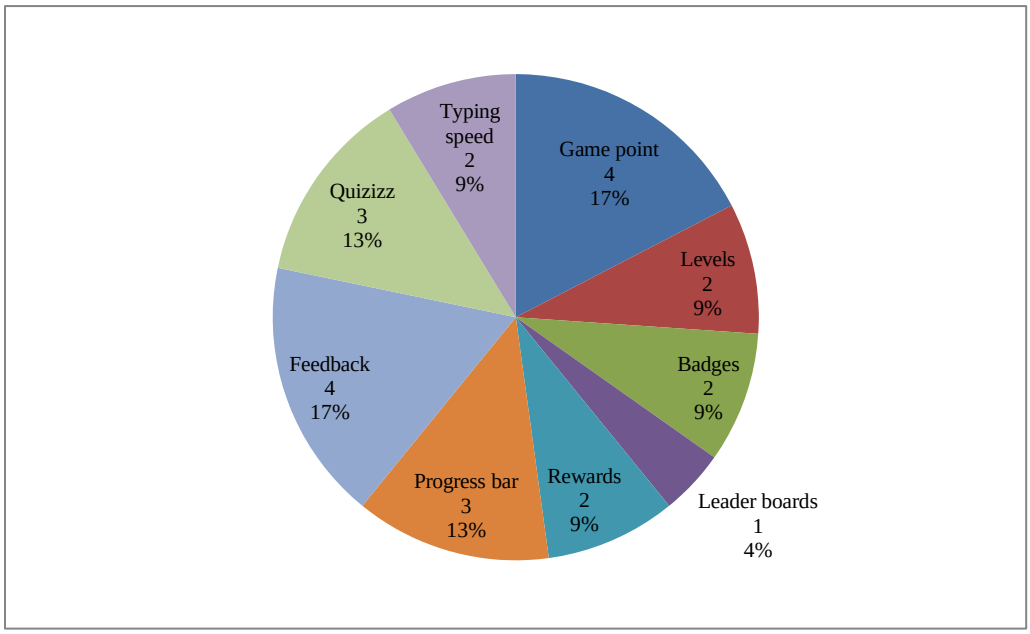
Response Type	Frequency	Percentage %
Agreed	10	21
Disagreed	29	62
Total Responses	**39**	**83**
Undecided	8	17
Total	**47**	**100**

w. Types of Games Designed Specific for Education

The results from (Figure 4.6) shows that 17% of the respondents mentioned Game Point and Feedback as a type of games integrated to support the education process, 13% mentioned Progress Bar and Quizizz, 9% mentioned Levels, Rewards and Typing Speed and 4% mentioned Leader Board.

Figure 4.7

Types of Games Designed Specific for Education



x. Commercial Games Customized for Education Support

The result from questionnaire (Table 4.21) shows that 9% of the respondents agreed with the statement that there are other commercial games that were customized to support education, whereas 30% disagreed, and 61% were undecided.

Table 4.21

Commercial Games Customized for Education Support

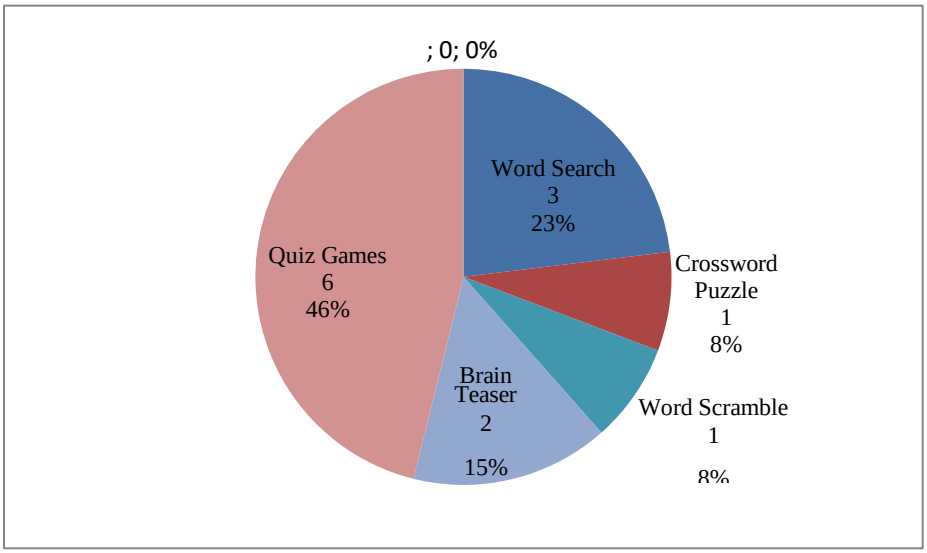
Response Type	Frequency	Percentage %
Agreed	4	9
Disagreed	14	30
Total Responses	**18**	**39**
Undecided	29	61
Total	**47**	**100**

y. Types of Commercial Games Customized for Education Support

The results from (Figure 4.7) shows that 46% of respondents mentioned Quiz games as a commercial game which was customized for education support, 23% mentioned Word Search, 15% mentioned Brain Teaser and 8% mentioned Crossword Puzzle and Word Scramble.

Figure 4.8

Types of Commercial Games Available



z. Integration of AI Tools

The result from questionnaire (Table 4.22) shows that 17% of the respondents agreed with the statement that the institution/school has integrated AI tools to support the teaching and learning process, whereas 72% disagreed, and 11% were undecided.

Table 4.22

Integration of AI Tools

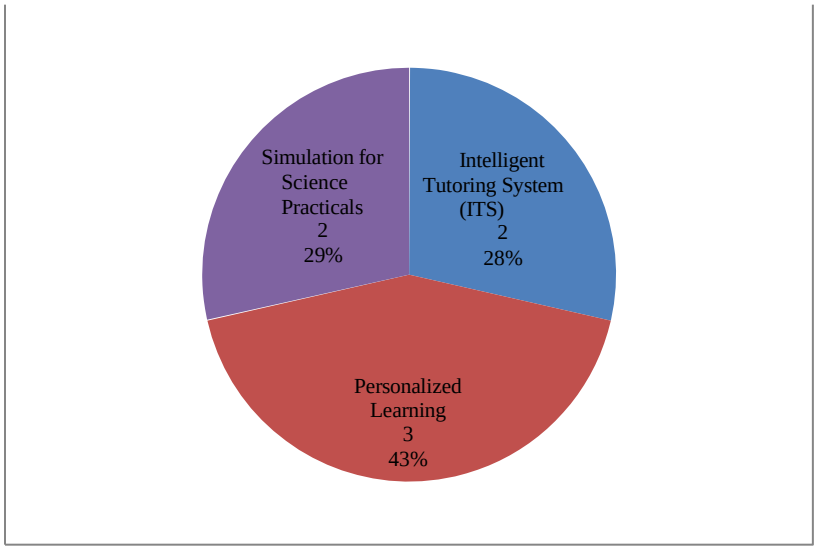
Response Type	Frequency	Percentage %
Agreed	8	17
Disagreed	34	72
Total Responses	**42**	**89**
Undecided	5	11
Total	**47**	**100**

aa. Types of Integrated AI Tools

The results from (Figure 4.8) shows that 43% of respondents mentioned Personalized Learning as a type of integrated AI tool, 29% mentioned Simulation for Science Practical's, 28% mentioned Intelligent Tutoring Systems.

Figure 4.9

Types of Integrated AI Tools

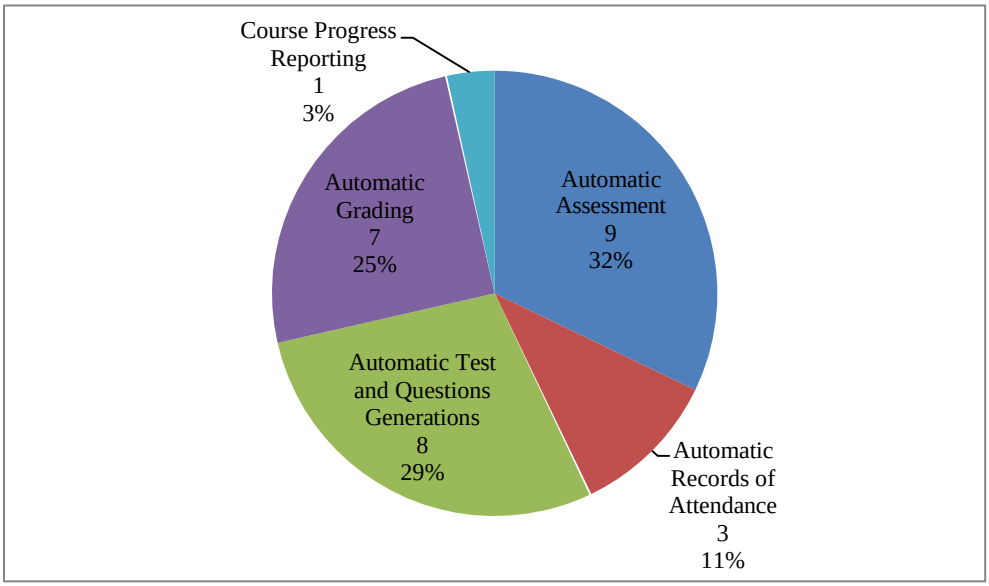


ab. Application of Adopted AI Tools

The result from (Figure 4.9) shows that 32% apply adopted AI tools for Automatic Assessment, 29% for Automatic Test and Questions Generations, 25% for Automatic Grading, 11% for Automatic Records of Attendance and 3% use for Course Progress Reporting.

Figure 4.10

Application of Adopted AI Tools



II. Analysis of Observation Data

a. About Instruction Approaches

The result from observation checklist (Table 4.23) shows that 87% of the sampled institution use direct instruction method, 63% use demonstration and 75% use coaching methods of instruction.

Table 4.23

Instruction Approaches

Instruction Approach	Number of Institutions/Schools	Percentage %
Direct instruction	7	87
Demonstration	5	63
Coaching	6	75
Number of sampled institutions in this case (N) = 8		

b. About Physical Spaces

The results from observation checklist (Table 4.24) shows that 100% of sampled institutions have classrooms dedicated for lectures, 100% have computer labs of different sizes and 38% have technology equipped conference facilities.

Table 4.24

Physical Spaces

Physical spaces	Number of Institutions/Schools	Percentage %
Classrooms	8	100
Computer labs	8	100
Technology equipped conference facilities	3	38
Number of sampled institutions in this case (N) = 8		

c. Technology Infrastructure

The result from observation checklist (Table 4.25) shows that 100% of sampled institutions have wired internet services and computers that are dedicated to learners, 63% of the sampled institutions have an installed computer for instructors and a projection system, 55% have an installed printer for education use, 37% have and installed interactive whiteboard and 25% possess a digital camera.

Table 4.25

Technology Infrastructure

Technology Infrastructure	**Number of Institution/School**	**Percentage %**
Learners' computer(s)	8	100
Wired internet services	8	100
Wireless internet services	5	65
Instructor computer	5	63
Projection system	5	63
Printer	5	55
Scanner	4	50
Interactive whiteboard	3	37
Digital Camera	2	25
Number of sampled institutions in this case (N) = 8		

III. Analysis of Semi-structured Interview Data

a. About Budget Source for Technology Integration

A certain level of financial investment is needed to appropriately integrate technologies in schools. The researcher was willing to know the institutions plans to ensure the substantial amount of funds is available for acquisition of technological tools and application. During the interview the participants said that the funds are generated from internal sources or from government support and other education supporting institutions. Participants from one of the private institutions said that:

> *My school is a private school, so the major source of funds is from internal generated sources mainly fees paid by students, available income generated activities or other special funds to manage all school services. The amount is not sufficient to pay for all services required by schools. In this regards, the budget for technology application is insufficient. In some cases we seek for donation and soft loans but still the money are not enough to cover all the services.*

Another participant complained that the budget allocated from central government is very low compared to the institution's requirements. The participant said that:

> *The government set budget to support the country education services, however, this amount is too small to facilitate the school academic and administration services. It is high time for the government to look for alternative sources of funds in order to ensure that the budget for technological facilities is sufficient. Students from public school are*

not paying school fees (free education policy) so the only support is the one which come from government. At least private institutions have gone far in term of technology application compared to government schools because some schools require students to pay technology fee separately from students' fee.

A summary of the results from semi-structured questionnaire is presented in (Table 4.26). The results shows that most of the private institution self-determine their budget to facilitate integration of technology whereby public institutions depends on government's central budget, parent's funds, on-governmental organizations (NGOs), contribution from members of the societies and donor funded projects.

Table 4.26

Budget Source for Technology Integration

Main Concept	**Theme**	**Categories/Sources**
Budget Source	Self-determined	School fees
		Income generation activities
		Donations/Special funds
	Supported	Central, regional and local authorities' budgets
		Parents
		Contributions from society members
		NGOs support
		Tanzania education fund
		Donor funded projects

b. Technological Support Related to Pedagogical Technologies

The researcher was willing to know the role of non-teaching institution in providing support related to pedagogical technologies. It was revealed that apart from regulating educational services these institutions do offer support related to pedagogical technologies. One of the education administrators said that:

> *Our institutions goal is to offer technological services to education institutions at affordable rate. We offers internet services at lower (educational) cost, most of the institution can afford to pay for this amount. We also negotiate with service providers for technological services such as bulk of software licenses and distribute to education institutions. We also facilitate collaboration with other institutions in order to enable institutions which are more advanced in term of technology to share resources and experiences with others which are still behind.*

Beside this, in a discussion with one participant it was revealed that apart from provision of technical support these institutions ensure the quality standards of the services. Different documents identifying required standards were developed and institutions are required to abide to. Regular evaluations are being conducted as a follow up mechanism to check if institutions adhere to the standards. One education administrator said that:

> *Our responsibility is to ensure that the institutions adhere to the standards procedures hence we conduct regular evaluations to every aspect of the education services including technological standards, teachers competences, examination regulation, infrastructure,*

facilities and other resources. In some cases, we offer training for teachers especially in pedagogical practices.

Furthermore, the interview with a participant from Tanzania Education and Research Network revealed that there is no direct financial support provided to teaching institution. Indirect support such as to supply high standards and affordable services, establish collaboration links with institutions which have advanced in some aspect of technology use. The participants said that:

We supply a low-cost internet services as well as to develop application software for schools' management such as student management system, library management systems and other educational materials repository. As we collaborate with other education networks, we also link teachers and students to various technological forums and competitions.

A summary of the results from semi-structured questionnaire is presented in (Table 4.27). The results shows that support institutions are provided with technological, pedagogical and financial services for instructor and students.

Table 4.27

Technological Support Related to Pedagogical Technologies

Main Concept	Theme	Categories/Sources
Technological Support	Technological Services	Network and System Administration support
		Encourage instructors to engage in professional trainings
		Connect institutions for experience sharing
		Coordinate collaboration with ICT professional bodies
	Pedagogical Services	Set technological standards
		Provide training on pedagogical practices
		Evaluation of technological facilities
		Regulate technological services
	Financial Services	Supply affordable education packages software
		Supply affordable internet services
		Link/Connect to donors

IV. Analysis of Desk Review Data

a. About Technological Integration Initiatives among Tanzanian Schools

The results from different research reports (Table 4.28) indicated that there are number of initiatives by both government and private sectors to enhance education through technology application.

Table 4.28

Technological Integration Initiatives among Tanzania Schools

Author (s)	**Findings**
Ndume and Kisanga (2021); Ngeze (2017); Sulemaniet al.(2021)	Installed technology equipment such as desktop computer, laptops, and projectors in some schools.
Tarimo and Kavishe (2017); Simba et al. (2009)	Availability of internet services in some schools (both wired and wireless internet)
	Increase use of mobile phones to facilitate education service delivery due to wide expansion of network coverage.
	Application centralized Education Management Information System (EMIS) to collect, process, utilize and disseminate education data as well as related information to educational stakeholders
Daudi and Nzilano (2019); Ngeze (2017); Selemani et al. (2021)	Application of other education systems such as School Information System (SIS) and the Primary Records Manager (PReM); SIS is used to collect information on teacher and student performance, daily attendance and other school management activities
	Increased level of digital literacy among instructors and students
	Teachers, use their personal devices such as laptops, smart phones and tablets to search for lesson material online

Selemani et al. (2021); Sodhi (2015); Kafyulilo et al.(2015)	Existence of policies in some schools to enforce instructors to make use of technology for elementary functions such as preparing examinations and other school report using word processing, process examination results with excel, use power point for presenting lecture notes
Daniel et al. (2016); Kasika (2017)	Some schools have an installed messaging applications such as WhatsApp to create groups that include instructors, parents and students to share written notes and recorded lectures
Feruzi and Li (2020); EDC (2010)	To some extent radio and television are being utilized to support student learning
Mtebe and Raphael (2016); Selemani et al.(2021); Kafyulilo et al.(2015)	A number of websites and applications related to education available including tHL, ShuleDirect and Tzshule, which contain learning material such as lesson notes and examination questions
	Some schools have developed their in-house LMS
	Several projects established with the aim of equipping schools with technological facilities

A. Research Question 2.1

Relationship between identified teaching approaches with pedagogical practices of teaching and learning.

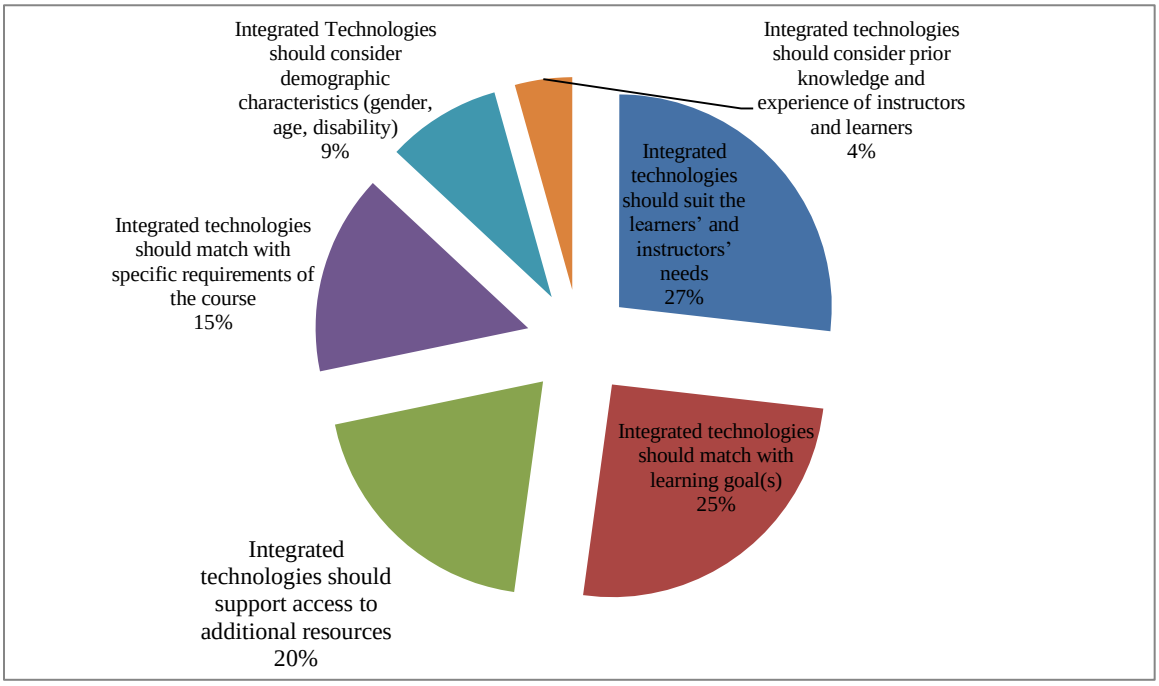
I. Analysis of Structured Interview Data

a. Pedagogical Aspects

The result from (Figure 4.10) shows that 27% said that integrated technologies should suit the learners and instruction needs, 25% said that integrated technologies should match with the learning goal, 20% said that integrated technologies should support access to additional resources, 15% said that integrated technologies should match with specific requirements of the course, 9% mentioned that integrated technologies should consider demographic characteristics (gender, age, disability) and 4% said that integrated technologies should consider prior knowledge and experience of instructors and learners.

Figure 4.11

Important Pedagogical Aspects

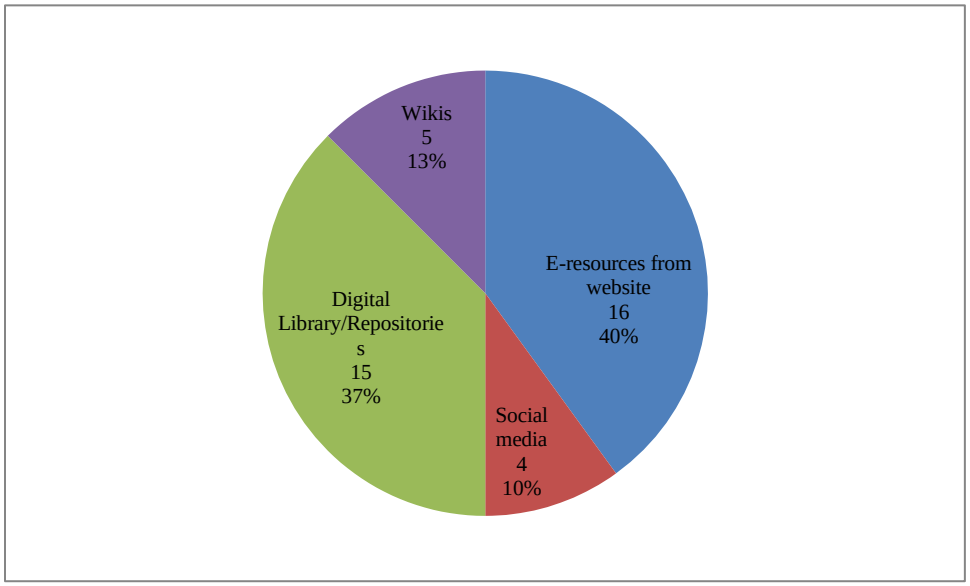


b. Pedagogical Technological Resources used by Instructors to Develop Scenarios which Motivate Students

The result from (Figure 4.11) shows 40% of instructors use e-resources from website to develop scenarios which motivate students to learn independently, 37% use digital library/repositories, 13% use wikis and 10% use social media.

Figure 4.12

Resources to Develop Scenarios which Motivate Students



b.2 Technological Resources Used to Enhance Students' Motivations

S/N	Pedagogical Technologies to Use by Instructors to Develop Scenarios which Motivate Students	Number of Responses
	MIT	13
	Wikipedia	18
	MOOCs	15

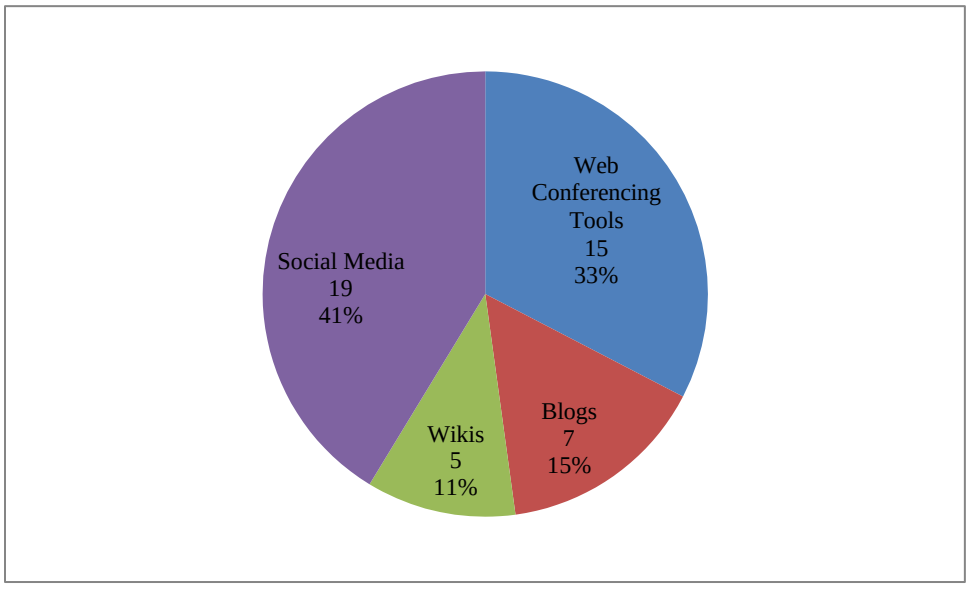
	Facebook	7
	Twitter	3
	Jstore	1
	Books4U	2
	KOHA Library	8

c. Integrated Pedagogical Technologies to Enhance Engagement

The result from (Figure 4.12) shows that 41% of respondents use Social Media Services to enhance engagement among students and instructors, 33% use Web Conferencing Tools, 15% use Blogs and 11% use Wikis.

Figure 4.13

Pedagogical Technologies Used to Enhance Engagement



c.1 Examples of Pedagogical Technologies to Enhance Engagement

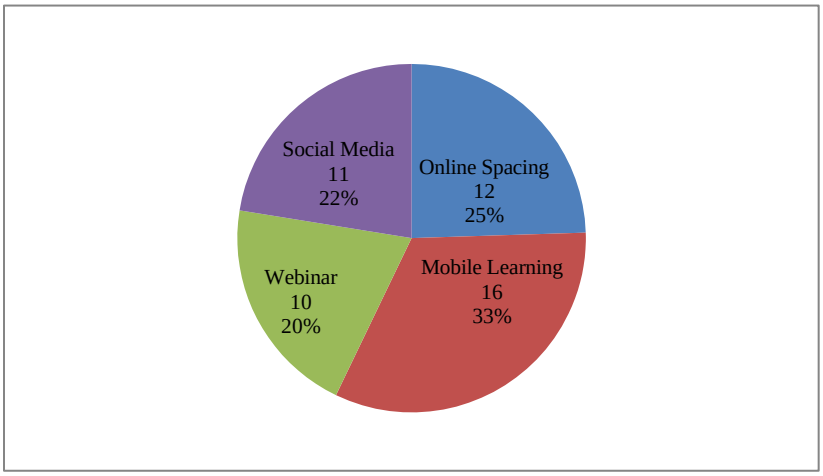
S/N	Examples of Pedagogical Technologies Used to Enhance Engagement	Number of Responses
	Zoom	21
	GoToMeeting	15
	Skype	12
	WhatsApp	32
	YouTube	29
	LinkedIn	3

d. Pedagogical Technologies to Support Learners Creativity and Innovations

The result from (Figure 4.13) shows that 33% use Mobile Learning to support creativity and innovations, 25% use Online Spacing, 22% use social media and 20% use Webinar.

Figure 4.14

Pedagogical Technologies to Support Creativity and Innovations



d.1 Examples of Pedagogical Technologies to Support Creativity and Innovation

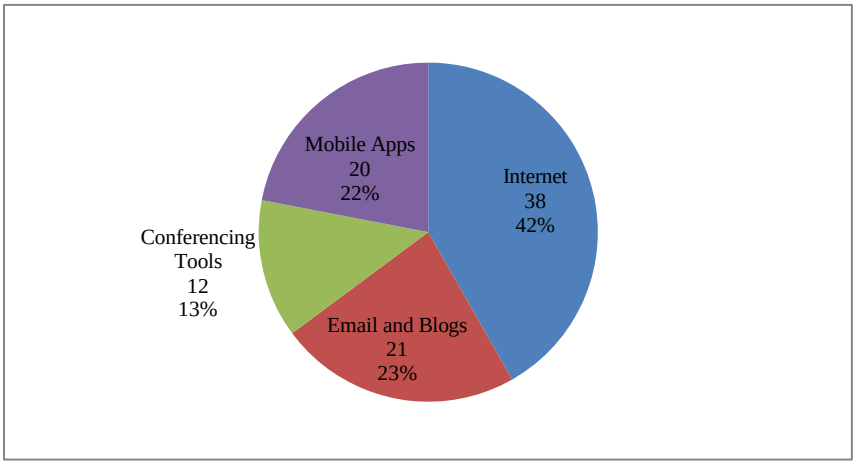
S/N	Pedagogical Technologies to Support Creativity and Innovation	Number of Responses
	MIT	11
	Edx	8
	Skype	13
	WhatsApp	25
	YouTube	21
	Facebook	17

e. Pedagogical Technological Tools to Support Collaborations

The result from (Figure 4.14) shows 42% of respondents use Internet to support collaborations, 23% use Email and Blogs, 22% use Mobile Apps and 13% use Conferencing Tools.

Figure 4.15

Pedagogical Technologies to Support Collaboration



e.1 Examples of Pedagogical Technologies to Support Collaboration

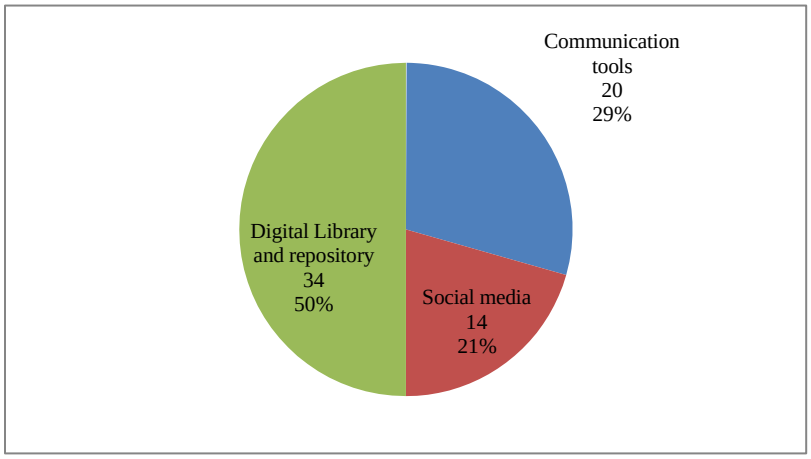
S/N	Pedagogical Technologies to Support Collaborations	Number of Responses
	LMS	23
	Zoom	8
	Moodle Mobile	19
	Mailing list	5
	WhatsApp	21

f. Pedagogical Technologies to Address Information Accessibility

The result from (Figure 4.15) shows that 50% of respondents utilize of digital library and repository to address information accessibility, 29% use communication tools and 21% use social media.

Figure 4.16

Pedagogical Technologies to Support Information Accessibility

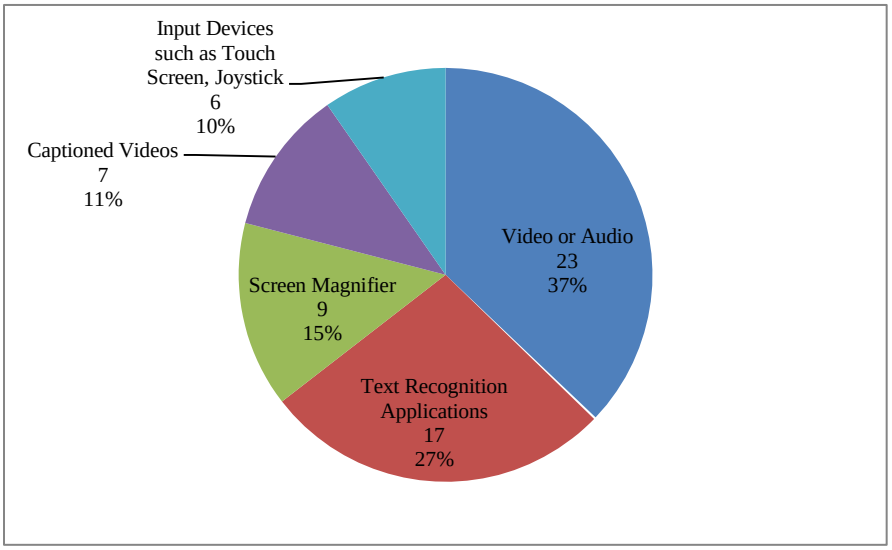


g. Pedagogical Technology to Address Information Accessibility for Special Needs Students

The result from (Figure 4.16) shows that 37% use video or audio to support information accessibility for students with special needs 27% use text recognition applications, 15% use screen magnifier, 11% use captioned video and 10% use input devices such as touch screen and joystick.

Figure 4.17

Pedagogical Technologies to Support Information Accessibility for Special Needs Students



g.1 Examples of Pedagogical Technologies to Support Information Accessibility for Special Needs Students

S/N	Responses on Examples of Pedagogical Technologies to Support Information Accessibility for Special Needs Students	Number of Responses
	Recorded lectures	28
	Screen reader	8
	Touch screen	12
	Joystick	5

B. Research Question 2.2

The connection between teaching approaches and pedagogical practices

I. Analysis of Structured Interview Data

a. About Pedagogical Models

The results from questionnaire (Table 4.29) shows that 23% of the respondents mentioned Didactic Model as the pedagogical model adopted by their institution, 45% adopted Authentic Model, 9% adopted Transformative Model, and 13% did not respond to the question.

Table 4.29

Pedagogical Models

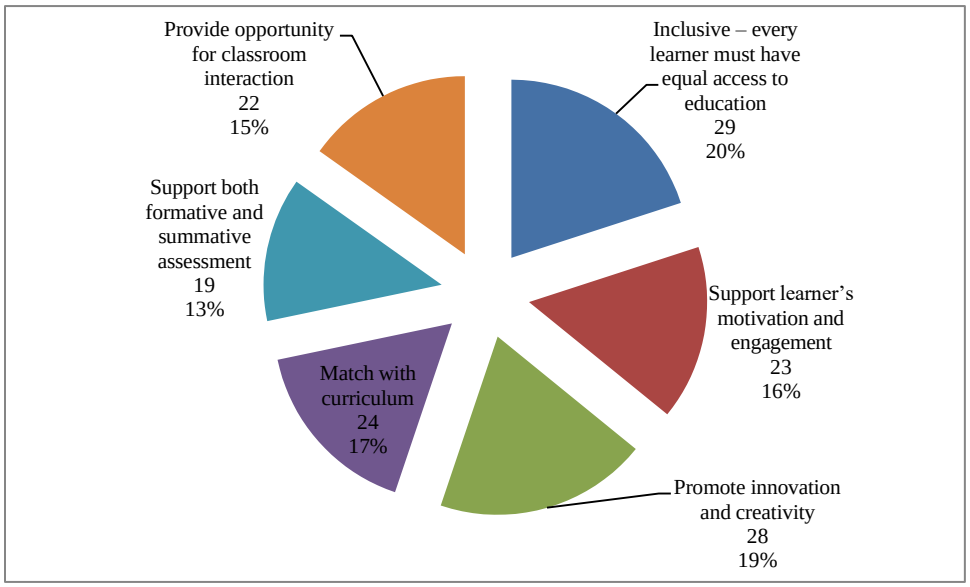
Pedagogical Models	Frequency	Percentage%
Didactic	11	23
Authentic	21	45
Transformative	9	19
Total Responses	41	87
Undecided	6	13
Total	**47**	**100**

b. About Pedagogical Principles

The result from questionnaire (Figure 4.17) shows that 20% of respondents said that pedagogy must be inclusive – every learner must have equal access to education, 19% said pedagogy must promote creativity and innovations, 17% said pedagogy must match with curriculum, 16% said it must support learners' motivation and engagements, 15% said pedagogy must provide opportunity for classroom interaction and 13% said pedagogy must support both formative and summative assessments.

Figure 4.18

Pedagogical Principles

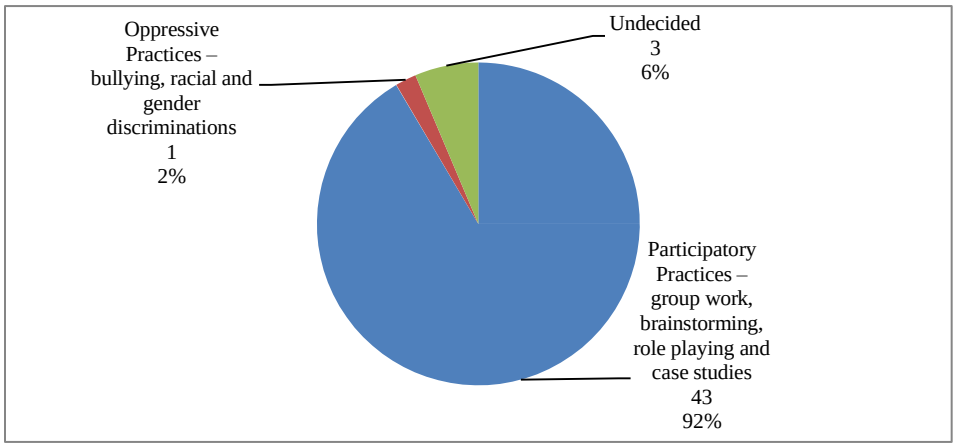


c. Pedagogical Practices

The result from questionnaire (Figure 4.17) shows that 92% of respondents said that institution/school encourage Participatory Practices – group work, brainstorming, role playing and case studies, 2% said the institution/school apply Oppressive Practices – bullying, racial and gender discriminations and 6% did not respond to the question.

Figure 4.19

Pedagogical Practices



II. Analysis of Observation Data

a. Classroom Practices

The result from observation checklist (Table 4.30) shows that the practices in 88% of the sampled institutions include learners listening to instructors and take note, instructors ask questions and learners respond to questions. 75% of institution provides individual assignments to learners and provide hands on assignment, 63% encourage group discussions, 50% gives research or project work to learners and asks them to present their findings and 25% encourage individual reflection based on their knowledge and experiences.

Table 4.30

Classroom Practices

Classroom Culture/Practices	Number of Institutions	Percentage %
Learners listen to instructor and take note	7	88
Instructors asks questions and learners responds to questions	7	88
Individual assignments	6	75
Hands on Learning	6	75
Group work discussions	5	63
Research or project work presentation	4	50
Individual reflection based on knowledge and experiences	2	25
Number of sampled institutions in this case (N) = 8		

4.3.7.3 Research Question 3

About pedagogical barriers that hinder technology integration in the classroom.

I. Analysis of Structured Interview Data

Q. 34 Technological Pedagogical Challenges

S/N	Responses on Pedagogical Challenges	Number of Responses
	Insufficient technological facilities	41
	High cost of internet/bandwidth	37
	Lack of technological competence among instructors	27
	Lack of reliable internet services	27

	Insufficient budgets	21
	Destructive use of technology among students	19
	Little time allocated to access technological facilities	19
	Lack of technology pedagogical experts	18
	Insufficient technology experts	17
	Technology illiteracy among students	12
	No policy to guide technology applications	8
	Instructors attitude towards technology	7
	Parents negative perceptions of technology use	6
	Unreliable power supply	5
	Technological phobia	5

II. Analysis of Semi-Structured Interview Data

a. Technological Pedagogical Challenges

During the interview the researcher identified a number of technological pedagogical challenges as a result most institutions have fails to appropriately adopt technology to enhance their education services. Ability to use, manage and maintain the technology was found as among the barrier of technology integration in schools. During the interview participants said that:

> *Instructors do not have relevant skills to develop online contents. In most cases they just copy the material and upload it online for students to download and read. This is also the case when it comes to special needs students. There is limited number of teachers with adequate qualifications in special needs education; in addition to this the technological*

facilities to support special needs students are inadequate. Beside this no technicians are employed to provide technical support to instructors and students; human resources employed in schools are mainly teachers, ICT technician are not considered as important resource in most of the training institutions. In this case, ICT teachers do multiple roles one as a teacher and at the same time as ICT technician.

Another participant said that:

Technological training is not given high priority; some instructors as well as students are not aware about existing technologies and even when exposed to them, they are not able to use them appropriately. Important skills such as instruction design are not given taught to instructors hence the quality of contents developed online is poor and does not meet the standard for online contents.

On the other hand, during the discussion participants pointed culture as another aspect that hinders technology integration in schools. Some instructors especially those who are at old age are reluctant to adopt new ways of teaching; they beliefs that the traditional face-to-face is the appropriate delivery mode and the only mode that can enhance education achievement. During the discussion, one of the participants said that:

Some instructors still have older mindset when it comes to teaching with technology, so they resist using technological tools to support their teaching process. Some instructors dislike technologies or complex devices, they fear to learn new things especially those

related to technology. Some instructors discourage school management to formalize technology applications and tools to be among the education resources.

Beside this, the study results shows that education institution use modern technologies at very low rate. Tools such as computers, printers, scanners, projectors are commonly available but not proportion to number of instructors and students. Internet services are available but not reliable mainly due to high cost of internet bandwidth. In some areas especially in remote areas internet connectivity is very low hence learners failed to access online contents. One participant said that:

My school has over 1,000 students and 90 instructors but we only have one computer lab with 40 computers; this number is very low to meet learners and instructors needs. Again, some of these computers are old and some needs repair, relevant applications are also not installed. With this situation, students lack access to digital facilities and when at school. This is also the same case at home because very few families own digital facilities for family use.

The study results show that most institutions are not financially stable, considering the regular changes in technology they cannot move with the pace of technology development. Despite this fact, acquiring technology application and services requires huge investment. In addition to this, the government has not yet highly invested in technological infrastructure, so the technological services supplier are investors mainly telecom companies who are currently on business hence they highly charge for these services. One participant said that:

Education software license are very expensive of which my institution cannot afford. This also applies to bandwidth cost; to date the cost of internet bundle is very high. Our school cannot afford to pay for internet to support the teaching and learning process. Teachers use their own money to pay for services through their personal gadgets which is not sustainable practice.

Further to this, technology has highly enhanced collaboration and communication. However, neither training nor code of conduct is available to guide its use. Parents are not comfortable to allow their children to access online contents and to participate in collaboration with peers. This is because online environment is free, and it is difficult to restrict on which information and individual should access in this case individual decision matters. During the interview one individual said that:

Parents do not have ability to closely monitor their children's learning through technology hence some student use technology for destructive activities example watching pornographic links. Again, young learners mainly focus on making friendship and share photos and stories. This is a reason for many students to spend more time on irrelevant issues that are not useful for their studies.

A summary of the results from semi-structured questionnaire is presented in (Table 4.30). The documented pedagogical challenges were categorized into five themes namely competence, culture, facilities, financial and moral values as summarized under the table 4.31.

Table 4.31

Technological Pedagogical Challenges

Main Concept	Theme	Categories/Sources
Pedagogical Challenges	Competence	Lack of technicians to support technology integration
		Different level of technological skills
		Students misuse technology
		Lack of technological pedagogical skills among instructors
		Failure to use technological equipment
		Unable to access contents
		Little knowledge about emerging technologies
		Failure to develop relevant contents
	Culture	Instructors' resistance to change
		Organization culture
		Instructors' perceptions and beliefs
		Parents negative perceptions about technology use by their children
	Facilities	Number of students is not proportional to available technological facilities
		Inadequate technological facilities
		Low connectivity
		Lack of access to contents
		Challenges associated to technology have and those who have not (Digital divide).

	Financial	Cost of software licenses
		High cost of internet
		Frequency change of technology demands for new technology
	Moral Values	Students' destructions
		Failure to balance study time
		Cheating

III. Analysis of Desk Review Data

a. About Pedagogical Challenges

The results from different research reports (Table 4.32) indicates that there are number of pedagogical challenges facing Tanzanian institutions related to technology integration in the education process.

Table 4.32

Pedagogical Challenges Documented in Literature

Author(s)	**Findings**
Ngenze (2017); Kihoza et al.(2016); Manyengo (2021); Joseph (2012) and Ogbomo (2011)	Inadequate teacher training for digital and pedagogical skills development; available training predominately focuses on basic technical and elementary skills, and does not addressing gaps in pedagogical practices
	Students lacks access to digital facilities and technology in schools and at home; available facilities are not proportion to the number

	of students
	Internet and other supporting infrastructure in the country are inadequate and unreliable.
Manyengo (2012) and Ndume and Kisanga (2021)	Some instructors use digital devices for elementary functions only including typing examination questions and processing examination results and not as a pedagogical tool
Barakabitze et al. (2015); Manyengo (2012); Joseph (2012); Ndume and Kisanga (2021) and Ogbomo (2011)	There is no specific policy to enforce the use of technology in the education field
	No Teacher Management Information System (TMIS); this is very important as it could contain important details about teachers and their professional competence
	Difficult for teachers and students in rural settings to access online platforms and websites due to limited internet connectivity and high cost of bandwidth.
	Lack of institutional ICT policies and strategies to guide the integration of technology in the teaching and learning process
	Insufficient number of technicians to support technology integrations
Joseph (2012)	Inability of some parents to closely monitor their children's learning through technology hence some student use technology

	for destruction.
Manyengo (2021); Kisanjara et al. (2014)	Lack of appropriate government structures for effective deployment and integration of digital technologies.
Joseph (2012) and Ndume and Kisanga (2021)	Limited budgetary allocation for technology integration in schools
Allam and Martin (2021); Mutugi (2018) and Ogbomo (2011)	Limited number of teachers with adequate qualifications in special needs education as well as inadequate technological facilities to assist students with special needs

4.3.7.4 Research Question 4

About eliminating pedagogical barriers in the technology-based teaching environment

I. Analysis of Structured Interview Question

Q. 35 Overcoming Pedagogical Barriers in the Technology-based Teaching Environment

S/N	Responses on Overcoming Pedagogical Challenges	Number of Responses
	Ensure availability of technological facilities/increase level of technology investment	39
	Plan for regular training for instructors	30
	Set annual budget specific to support technology applications	25
	Develop programs to motivate instructors and students to apply	20

	technology in their teaching and learning	
	Develop policy/guidelines to guide implementation of technology in the education process.	12
	Make technology use compulsory in schools	12
	Develop mentorship programs to help instructors and students to understand important of technology and how to use technology in a positive way	9
	Create awareness among instructors and students on ethical practices in a technology-based education	8
	Regular monitoring of technology use	6

II. Analysis of Semi-Structured Interview Data

a. About Eliminating Technological Pedagogical Challenges

Based on previous discussions participants pointed out that if the identified challenges will be eliminated institutions performance will be improved because the technological resources will be used effectively. Participants suggested use of appropriate technological resources to facilitate educational service delivery would help improve education performance. Beside this, developing standards guides for technology integration would enable institution to appropriately use technology to attain its potential. During the discussion one participant suggested that:

> *Each institution should explore the resources that are relevant for their environment; there are common tools that are easily found and which can support different educational practices. For example, adopting open-source learning management system will enable*

schools to deliver contents, perform assessment and collaborations. Adopting mobile apps will enable learners to access contents offline.

From the previous discussion it was found that integration of technology in Tanzania schools is affected by lacking computer literacy skills among instructors and learners. However, most teachers are aware of the importance of technology for improving education performance. However, the government has not set proper plans for in-service teachers training especially on pedagogical use of technology. In this regard, the participants suggested for alternative ways such as developing plans for institution collaboration and resource sharing among institutions and knowledge sharing among instructors. Since teachers are the key stakeholder in the education process participants suggested that when developing strategies for technology integrations educators should consider teacher's opinions. One participant said that:

Instructors are willing to integrate technology in their teaching process; however, there is a need for institution to consider upgrading teachers' basic ICT and pedagogical skills to enable them effectively integrate technology in their teaching process. Since most students in this generation have technology "know how" so it is important for teachers acquire technological skills in order to be able to match with this generation.

It is wise for school to make considerable financial investment in technology; educators should identify what technology to be chosen and how should be integrated. The efficiency can enable significance savings for schools. Participants suggested that educators should critically find ways to ensure appropriate technology is available for supporting education services. This should

include investing in facilities, human resources, education tools and resources. This also involves ensuring technical capabilities of adopted technology such as compatibility, access, privacy and security etc. One of participants suggested that:

> *The government should set aside funds for enhancing human capacity in terms of pedagogical technology knowledge, maintenance and support and availability of relevant tools. If the internal funds are not enough educators should seek support from education support organization as well as looking for special education packages for software and internet services.*

Furthermore, during the discussion, one of the participants concerns is that institution should pay careful attention to the types of contents and technological tools that are being used for education support. Another concern is on pedagogical considerations; this involves the learner's engagement, collaborations, content delivery and assessments. Issue such as usability, accessibility, compatibility, availability and maintainability are also important to consider. Finally, issues such as user satisfactions, which involve user perception about usability, value, and quality of technological tools, are also vital. In addition to this, participants insisted research as an area of priority; through research educators can explore new, easy and affordable technologies for education. More research is required to study better ways to improve the current technology-based approaches and practices. One participant said that:

> *Since technology is a new field, conducting researches can help to reveal potential tools and resources that are relevant for education; educators should explore the professional*

gap and develop plan to fill the gap. Again, since the frequency of technology advancement is very high, regular evaluation of tools is essential to check if they are still relevant and for the case of new technological tools to examine if they can add value in the education process.

A summary of the results from semi-structured questionnaire is presented in (Table 4.33). The results shows that technological pedagogical barriers can be eliminated through maximization of technological resources ensure instructors and student's competence, plan for technology investments and undertake research into education technology.

Table 4.33

Eliminating Pedagogical Challenges

Main Concept	**Theme**	**Categories/Sources**
Overcoming Pedagogical Challenges	Resources	Identify required resources
		Maximize the use tools already available
		Select technologies with multi-functional
		Develop relevant policy to guide the application of technological facilities
		Integrate resources to support offline access
	Competence	Plan for regular instructor trainings
		Collaborate with institutions which have advanced on technology use
		Plan for technology resource sharing among institutions

		Engage teachers in the process
		Teachers with experience to assist those without experience
	Investment	Use affordable technology alternatives
		Seek fund through projects
		Invest in teachers' professional development
	Research	Undertake research on emerging technologies
		Identify easy to use technologies
		Determine competence gap among instructors and learners

III. Analysis of Desk Review Data

a. Strategies for Eliminating Pedagogical Challenges

The results from different research reports (Table 4.34) proposes a number of solutions for eliminating existing pedagogical challenges facing institution when integrating technology in the education process.

Table 4.34

Strategies for Eliminating Pedagogical Challenges

Author (s)	**Findings**
Ngeze (2017); Stoilescu (2014); Shulman (1986); Mutugi (2018) and Ogbomo	Technological literacy should be made part of the education curriculum across different levels of education to ensure educators are digitally competent

(2011)	Teacher training should focus on realizing among other things, the competences in the technological, pedagogical and content Knowledge (TPACK)
	Plan and regular update of ICT-based professional development strategies to enable instructors upgrade their skills and dynamics of the education system.
Kihoza et al. (2016)	Government and other education stakeholders need to undertake collaborative efforts to integrate technologies and prepare teachers to use technology.
	Government should harmonize technology integration in schools; that the government should consider the existing opportunities and challenges facing Tanzania education systems
Ogbomo (2011)	Develop investment strategy for technological facilities in schools
Stoilescu (2014)	Equip instructors with technological skills for improving students' learning practices for 21st century skills
	Existing education policies should be translated into reality.
	Integration of technology in schools should not be an option rather a must
Hennessy et al. (2010)	Enforce schools to have computer labs connected to the internet

	as well as projectors and other computing devices for presenting contents during the classroom sessions.
Sarmah and Lama (2017); Galagedarage (2021); Shettima and Tomsu (2020)	Plan should be set aside to use television/radio for educational content delivery
Jhurree (2005) and Swarts and Wachira (2010)	Taxes/duties on ICT equipment and accessories, connectivity charges, internet and education software should be waived away to minimize cost for acquiring such devices.
Ogbomo (2011) and Mayes et al. (2015)	Provide training to students about critical and ethical use of technologies, especially when it comes to intellectual property, plagiarism and infringements of privacy.
Ogbomo (2011); Mayes et al. (2015); Criollo et al.(2021)	Choosing cheap, available and affordable technologies.
	Consider applying cloud-based solutions such as Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) to minimize startup costs.
	Mobile devices and curriculum based mobile apps should be considered as most relevant

4.4. Evaluation of Findings

This section contains the evaluation of the findings. The discussion is organized based on the four research questions and are linked to conceptual framework for the study as described in the first section of chapter 2. The research questions are (1) Pedagogical Tools and Practices Documented in Literature; (2) Technology-mediated Teaching Approaches used in Tanzanian Schools; (3) Pedagogical Barriers that Hinder Technology Integration in the Classroom; and (4) Eliminating Pedagogical Barriers in the Technology-based Teaching Environment.

4.4.1 RQ1 – Pedagogical Tools and Practices Documented in Literature

Data collected from documents indicates different pedagogical tools and practices available in a technology-based environment (Ndibalema, 2020; Aldosari, 2020; Zirawaga et al., 2017). From the literature a number of pedagogical practices were revealed; group work, brainstorming, role play, and case studies were found to be the common pedagogical practices used in the teaching and learning process. These practices support the enactment of education theories such as constructivism theory which emphasizes learners' construction of knowledge; cognitivism which focus on how information is retrieved by the mind; connectivism which focus on knowledge construction through digital network; behaviorism which emphasizes on measurable behavior; and humanism which emphasizes on human value and dignity (Hruby & Roegiers, 2012; Adom et al., 2016; Craven & Fabricatore, 2016). Regarding pedagogical approaches the results shows approaches which were grouped into five categories namely Information Access, Personalized Learning, Social Interaction and Engagement, Application of Modern Technologies and Utilization of Assistive Technology.

4.4.1.1 Information Access

It was revealed that LMS is one of the pedagogical tools used to facilitate interaction and collaboration among instructors and learners; it enables instructors to deliver course content to students and assess their performance.LMS is used to facilitate engagement hence it allows learners to interact with peers or with instructors as well as to enable them to construct knowledge through discussion forums. These findings resonate with constructivist approaches to learning whereby students construct knowledge through interactions and collaboration. Secondly, it was found that multimedia application is used to develop subject contents and make it more interactive and attractive. The findings also revealed that in some cases learners are provided access to Massive Open Online Courses (MOOCs) in order to enrich learning content. Furthermore, it was found that electronic library is among the pedagogical practices available to facilitate access to learning content; electronic libraries are considered as important resources that facilities web-based learning activities. Through the digital library, learners have the opportunity to share electronic resources such as books and recorded lectures in form of videos and audios. Television and radio were also found to be used to deliver education contents to learners especially those with no access to internet. These findings are in-line with cognitive approach of learning; all these practices help students build their memories and deepen their understanding (Swann, 2013; Ratniece, 2018).

4.4.1.2 Personalized Learning

It was revealed from the literature that mobile technology is commonly used as a pedagogical tool to provide mobility to learners and facilitate virtual learning; it has been a valuable pedagogical tool to work-based training. Mobile learning enhances learning experience and

makes learning easy and enjoyable (Ratniece, 2018). These findings broadly match with the constructivist approach which promotes learner-centered education as it requires students to reason based on their own experiences (Adom et al., 2016).

4.4.1.3 Application of Modern Technologies

The findings show that software aids like visual graphics, charts, presentations and drawing software are used to enhance education content delivery. Digital cameras are used to import graphics, photos and text presentation. Besides this, it was revealed that video conferencing software such as Skype, Zoom, GoToMeeting, Google Hangouts and Microsoft Teams are used to support technology-based learning. Games such as Word Search, Crossword Puzzle, Jigsaw puzzle, Hangman, Word scramble, Sliding Puzzle, Brain Teaser and Quiz Games were also found to be used as pedagogical tools. Furthermore, the findings show that in a few cases simulation software is used to help students understand difficult areas in their subject as well as for practical applications. According to Keramida (2015), application of modern tools facilitates instruction that stimulates learners hence providing opportunities to demonstrate their desired behavior as stipulated in the behaviorism approach. The findings are also supported by connectivity theory which considers modern technologies as important tools to enable knowledge distribution across information network (Banihashem & Aliabadi, 2017).

4.4.1.4 Social Interaction and Engagement

It was revealed that social media services are used as important pedagogical technologies to support education. Web 2.0 technologies were found to support communication, creation and sharing of wide range of digital artifacts. Social networking sites such as Facebook, YouTube,

WhatsApp and Instagram were found to facilitate prolonged interaction among learners, instructors and parents. The findings match with connectivist theory which views knowledge as distributed across a network (Siemens, 2005). Beside this, the study revealed low level use of wiki spaces as a pedagogical tool to enhance collaborations. These tools facilitate knowledge construction through community engagement (Mödritscher, 2006). Hence, the study suggested considering integrating wiki spaces to enhance the education process.

4.4.1.5 Utilization of Assistive Technology

Assistive technological tools were found to support students with special needs; the results revealed tools such as virtual support systems, text magnification, assistive learning systems and math talk recognition software as used to support students with special needs. It was also revealed that video and audio are used to delivery recorded lectures (Putriani & Kurniawan, 2016; Sabaruddin et al., 2020). The findings indicate that the learning process is inclusive to all individuals; these findings match with the humanism approach as suggested by Maslow (1943) who said that individuals achieve their full potential when their human needs are fulfilled. Similarly, Maslow's theory of human motivations emphasizes the consideration of human needs and wants in any aspects of life which include the education process (Mawere et al., 2016).

4.4.2 RQ2 - Technology-mediated Teaching Approaches used in Tanzania

Majority of respondents agreed that there are technological facilities including internet available for both instructors and students. These results were confirmed by observational data which indicated that most institutions are equipped with projectors, printers, scanners, interactive white boards, lecture rooms, computers labs as well as wired and wireless internet services. Again,

results from the document review process shows that most institutions are equipped with technological facilities such as computers, laptop and projectors as well internet connectivity. Beside this, 55% of respondents agreed that there is technical measure to protect online contents as well use of anti-virus software; some institutions have a firewall, security plug-in and desktop monitoring software's. All these results confirm that to some extent institutions have prioritized technology use in their education process. However, improving security is an important aspect for consideration.

Woyo et al. (2020) suggested that systematic efforts must be made towards adoption of ICT in education. Forty-five of respondents agreed that their schools have documented specific ICT policies strategies and guidelines. These results implied that despite the fact that some institutions have developed informal guidelines to enforce instructors to apply technology support to elementary functions such as examination processing, reports writing, and lecture presentations, minimal effort was placed on developing systematic procedures to guide its implementation. In this respect, it is important for institutions to develop specific policies and strategies to guide the process. Again, technology can ease the operation and administrative function of the institutions; according to Kapur (2019), technology is recognized as comprehensive in scale from file processing, storage and movements, communications, information sharing amongst other uses. However, the results show that the internet and Microsoft Office applications are the common technologies used to support operational and administration functions of the institutions. Therefore, educators must consider emphasizing the use of other type of pedagogical technological tools given its wider application.

Majority of respondents agreed that there is a special department dedicated to support pedagogical use of technology; the main function of the department is to support instructors training and as well as provision of other technical support. This is evidenced by the fact that 81% of respondents agreed that that there are workshops and training on pedagogical use of technology. These results were confirmed by the analysis of documents which revealed that there is an increased digital literacy among instructors and students due to individual self-efforts as well as regular professional trainings (Selemani et al., 2021). However, it was revealed that the main focus of the training is to provide basic computer application with little emphasis on pedagogical use of technology. Hence, the study suggests that the training should focus on technological, pedagogical and content knowledge (TPACK) (Mutugi, 2018; Ogbomo, 2011).

Majority of respondents (82%) agreed that there is a budget set specific for acquiring and maintaining technological facilities. Qualitative results also shows that the main source of institution budget come from both institutions internal sources and external sources that is support from government, community and donor funds. Other technological support offered includes technical and professional services, pedagogical support (trainings and evaluation services) and financial support services such as provision of affordable internet services, educational software and access to donors. These results confirm that, to some extent, institutions consider technology as their priority investments area. However, the results indicate that the budget to support technology integration is not sufficient hence it is suggested to improve the budget aspect of technology (Ogbomo, 2011).

Regarding learning delivery, 53% of respondents mentioned flipped/blended learning as learning delivery mode and 72% mentioned student-centered as the instruction strategies. This fact is supported by Bayram-Jacobs and Hayirsever (2016) and Bryan and Volchenkove (2016), who pointed out that student-centered instruction, makes students more active, responsible and accountable for their learning; the blended mode of learning helps educators to create more effective learning experiences, increasing access and flexibility as well as reducing the cost of learning. Observation results show that institutions combine direct instruction, demonstrations and coaching as methods of instruction. According to Liu and Long (2014), direct instruction helps students to increase their confidence level as they relate directly with their instructors while demonstration and coaching maximize skills attainments.

Fifty three percent of respondents agreed that their institutions have installed different kinds of LMS; out of this 36% of respondents mentioned Moodle as their LMS. Results from documents shows that other institutions use public LMS known as tHL, ShuleDirect and Tzshule to access online contents. Regarding LMS functions, 40% of respondents use LMS for content delivery and to provide access to other learning resources. These results indicate minimal use of other LMS functions such as course assessments, administration, reporting, and discussion forums, charting and others. Beside this, 23% agreed that their institutions have special techniques for content design; this indicates the need for institutions to develop guidelines for content design in order to improve quality of the contents. Regarding LMS evaluation, 47% of the respondents agreed that there are regular evaluations of their LMS which involves providing learners and instructors with questionnaire to rate their LMS. In some cases, technical evaluation is conducted

to measure LMS effectiveness and assess the quality of uploaded contents. This practice is very important as it helps not only to improve the LMS but also the education quality.

The development of mobile technology has given rise to new learning formats whereby students are able to access learning materials at any time and place. However, the results show that only 32% of respondents agreed that their institutions have integrated mobile technology in their education process. Mobile technology is mainly used to facilitate communication and very little to access online contents. Despite its low usage the potential of mobile technology was recognized especially in connecting instructors, students and parents through SMS and WhatsApp groups, and in accessing content using available mobile apps, searching and sharing of contents. The results suggest analyzing the mobile technology functions given its high developments and the advantages it offers. On the other hand, Deretić and Drašković (2020) pointed out that video conferencing has flourished and become a potential component in the education. However, only 26% of respondents agreed that their institutions have integrated video conferencing facilities to support the education process. Out of this, 61% responded that Zoom is the video conferencing tool mostly used for communication and presentations. The results suggest for exploration of affordable type of video conferencing tools to apply in other education functions.

Zirawaga et al. (2017) pointed out that applying games to learning can improve critical thinking skills to learners while teaching a particular subject, as it allows learners to think outside the box. However, only 10% of respondents agreed that their institutions have integrated games in their teaching and learning process. This implies that, despite the fact that games are important tools

to compliment traditional teaching methods and improve the learning experience, educational institutions have not taken advantage of these tools. These results make a call for educators to find out ways to identify and plan to integrate games in the education process. Beside this, Delgado et al. (2020) pointed out that Artificial Intelligence (AI) tools offers the opportunity to experience personalized, flexible, inclusive, and engaging learning. However, only 17% of respondents agreed that their institutions have integrated AI tools to support the education process; the integrated AI tools are mostly used for automatic assessments. The study suggests to critically planning for application of AI tools to enhance the education process.

Further, results from literature indicate the presence of government initiatives to facilitate the technology integration in schools (Kafyulilo et al., 2015). The results indicate the presence of centralized Education Management Information System (EMIS); the system is mainly used to collect, process, utilize and disseminate education data as well as related information to educational stakeholders. In addition to this, the Ministry of Education has also introduced other system such as School Information System (SIS) and the Primary Records Manager (PReM); these systems are important as they are used to manage teacher's professional development and performance records (Selemani et al., 2021; Daudi & Nzilano, 2019).

4.4.2.1 RQ2.1- Relationship between Teaching Approaches and Pedagogical Practices

Results revealed important requirements for pedagogical technologies which must suit educator's needs, match with learning goals, support access to additional resources, match with specific requirements of the course and should consider demographic characteristics. Very low percentage of respondents (4%) said that pedagogical technologies should consider prior

knowledge and experience of instructors and learners; despite the low response Diaz (2017) pointed out that lack of prior knowledge and experience among instructors and learners may hinder the teaching and learning of the person. Hence the results suggest considering prior knowledge and experience when integrating technology. In addition to this, the results show that instructors use e-resources to enhance learner's motivations; this includes the use of digital libraries/repositories. MOOCs, MIT, e-Library and Wikipedia are the most used resources from websites to enhance motivations. The findings are supported by Malik et al. (2021) and Chatterjee and Nath (2014), who pointed out that Wikipedia and MOOCs provides extended features including links to education resources and downloadable education contents.

The study revealed that social media services such as WhatsApp and YouTube and web conferencing tools such as Zoom are the main pedagogical tools used to enhance student's engagements. This is supported by Kahu and Nelson (2017) who pointed out that student's engagement is considered a critical aspect of education; it highly contributes to the success of the students. In addition to this mobile technology and internet are the most used tools to support creativity, innovation and collaboration. These results are supported by Firipis et al. (2018) and Atawneh et al. (2020) who stated that mobile learning can help to develop critical skills and support creativity as well as to enhance collaboration.

Results revealed that digital libraries are the most frequently used pedagogical tool to address information accessibility as it enables learners to access large amount of information from different sources. Results show that video and audio are commonly used to address information accessibility students with special needs. These results are supported by Brito and Dias (2020),

who suggested that special attentions should be given to address information accessibility to students with special needs. However, educators should plan to integrate other pedagogical tools such as screen magnifier, text recognition, touch screen and joystick to address information accessibility to students with special needs.

4.4.2.2 RQ2.2 - Connection between Teaching Approaches and Pedagogical Practices

Results show that 45% of respondents agreed that their institutions use an authentic pedagogical model which affords learners the ability to demonstrate and innovate and allows them to make connections between the acquired knowledge and real-life problems. The results indicate that majority of instructors are no longer using a didactic approach which is mostly teacher-centered and limits variety of study activities as revealed by Simuth and Sarmany-Schuller (2012).The findings also revealed important technological pedagogical principles available such as inclusiveness, interactivity, supporting motivation and engagement, promote innovation and creativity, match with curriculum and support both formative and summative assessments (Ahmad et al., 2015; Black, 2013; Black & Wiliam, 2018; Sert, 2019. In addition to this, 92% of respondents agreed that their institutions use participatory practices whereby teaching practices such as group work, brainstorming, role playing, and case studies are being used. These same practices were revealed under the observational results; classroom practices such as group work, research, hands on learning, reflection and engagement among students and instructors. This indicates that the education process has been transformed; learners are given opportunity to go beyond traditional practices and promote active participation of learners on issues and interventions that shape their lives.

4.4.3 RQ3 - Pedagogical Barriers that Hinder Technology Integration in the Classroom

Despite the fact, that to some extent, institutions have integrated technology in their education process the study revealed a number of technological pedagogical barriers that hinders the effective application of technology. Firstly, technological illiteracy among instructors and learners is among the barriers to technology integration; it was found that students abuse technology because they have little knowledge about technology risks. Beside this, instructors do not have relevant knowledge to develop online contents while some students are unable to access contents due to limited access they have. The results also revealed that educators have a little knowledge on emerging technologies; the main reason is inadequate training which limits teachers' knowledge of technology standards. Furthermore, it was found that most of the institutions do not have relevant technical competence to maintain the available technologies. These results suggest for critical review of the professional training plan for instructors and learners in order to effectively integrate technology in the education process.

Secondly, organizational, instructors and community culture affect the technology integration; it was found that in some cases instructors were not ready to adopt new way of teaching. The main reason was found to be their perceptions and beliefs. Gonçalvesa and Gonçalves (2012) pointed out thatin most cases people are not ready to leave their comfort zone hence introducing new practices cannot easily be accepted. Beside this, the findings revealed that parents are under stress as they believe that technology will create misery for their children. This study advocates the continuous cooperation between parents and instructors to enable parents gain confidence about their children's using technology but also to maximize the potential benefits and eliminate risks associated to children use of technology (Gjelaj et al., 2019).

Thirdly, insufficient technological facilities; it was found that the available technological facilities are not proportional to the number of students and, as a result, they study in groups which limit their individual creativity. Instructors and learners do not have access to digital facilities and internet connectivity at home; this is because internet and other supporting infrastructure in the country are inadequate and unreliable. In this respect, instructors and learners face difficulties when trying to access online contents. Fourthly, lack of sufficient budget; software license and internet services are very expensive to the extent that institutions cannot afford them. On the other hand, technology is constantly evolving, which demands for frequency upgrades. In this regard, there is a need to review budget planning and find alternative source of income to support technology institutions.

Fifthly, challenges related to moral value; it was found that some students spend more time doing non-education (destructive) activities. Beside this, technology has influences learners to practice unethical behavior such as plagiarism, bullying and cheating. Sixthly, lack of specific guiding documents and appropriate government structure to harmonize the integration process and deployment procedures. Based on these six challenges there is a need for educators to further review these technology integration challenges and plan to address each specific challenge.

4.4.4 RQ4 - Eliminating Technological Pedagogical Barriers

From the study results, it is evident that respondents have suggested strategies to overcome the identified pedagogical challenges. Respondents suggested that educators should ensure availability of relevant technological resources. Technological resources which are multi-functional should be given priority (Mayes et al., 2015). From the interviews it was revealed that

currently there are already available technological tools used to support the education process, hence the findings suggested maximizing use of the available tools and supplementing with new identified tools. Beside this, the results suggest the development of policies/strategies to guide the technology integration process as well as to incorporate tools that support offline access to contents in order to assist individuals with unreliable internet connection. The same findings were revealed by desk review data that the government should enforce technology integration and harmonize the process through consideration of the existing opportunities and challenges associated to pedagogical technological use (Kihozaet al., 2016). Further, the results suggested that the existing education technology policies should be translated into reality.

On the other hand, the findings suggested building pedagogical competence of instructors; respondents recommended putting in place a training plan in order to enable instructors to upgrade their skills and match with the dynamics of the education system. The results also suggested collaborations among institutions in order to facilitate resource and experience sharing. These findings were supported by results from the desk review which suggested that the education stakeholders should undertake collaborative efforts to prepare teachers for pedagogical use of technology (Kihozaet al., 2016). Results from the desk review suggested that students should be trained in the critical and ethical use of technologies in order to understand the risk associated with misuse of technology. It was also suggested that instructors should be engaged from the beginning of the technological integration process in order to make them confident as well as to increase their technology acceptance. Further, it was suggested that technological literacy should be made part of the curriculum and should focus mainly on technological, pedagogical and content knowledge (TPACK) (Mutugi, 2018).

Beside this, educators should consider investing on technology application; one way is to consider affordable technological services in order increase availability and accessibility (Mayes et al., 2015). The findings were supported by results from the desk review which suggested the use of radio and television for education content delivery (Sarmah & Lama, 2017); use mobile devices as well as cloud-based solutions in order to minimize the startup costs (Criollo et al., 2021). The government was asked to waive taxes for technological equipment, accessories and services in order to increase its affordability. Educators should consider investing in teacher's professional's development and other technology related projects to support the pedagogical use of technology. Furthermore, technological research was revealed as an important strategy to overcome the pedagogical technologies barriers; this will help the educators to analyze the emerging and easy to use technologies as well as to determine competence gap among instructors and learners.

4.5 Chapter Summary

This chapter presented the discussion of the research findings; it started by the introduction whereby a description of the content of each section of the chapter were provided. Before providing the presentation of the finding the researcher ensures that the trustworthiness, validity and reliability were established. The methods applied in different stage of the study helped the researcher to establish the credibility of data as well as the familiarization of the study population through physical visit and documents review. This study is qualitative in nature hence the profile of the population was well documented as well as the description of the whole process to enable the community to assess the applicability of the study findings to a larger population. The reflexive journal was used to record activities during the research process; the relationship

between the recorded notes and analyzed data were examined to assess the existence of researcher bias that may affect the research results. The data collection process was conducted using different methods and data were collected from different sources; the process helped to minimize the researcher bias and to establish confirmability. The systematic literature search and research protocol were reviewed at each stage of research study; a track of when and how changes were implemented were documented to enable the reader to measure the appropriateness of the methods used. In addition to this, the independent auditor was engaged to verify the process and confirm the accuracy of results in relation to participant's responses thus ensures dependability.

Validity and reliability of data were also considered in the study to ensure the findings are acceptable as credible results; both internal and external validity were ensured. The results were validated through a self-reflection which helped to minimize the possible bias that may result from researcher perceptions, beliefs and opinions. The recruitment processes were fairly conducted whereby only individual with relevant experience and knowledge were recruited; data collection instruments were also verified to ensure accuracy of the collected data. Beside this, participants were allowed to revisit the findings to ensure it reflects their responses. In addition to this, the reliability of the research was established through the triangulation of methods and data sources which enabled the researcher to reduce the potential bias. Descriptions on how the data were collected analyzed and interpreted were also presented to ensure consistence of the results.

The study findings were organized based on the four research questions which guided the study; data were analyzed differently based on the data collection methods. Data collected using structured interview and observation methods were put on tables and figures; frequencies and percentages responses of a particular response were calculated. This helped the researcher to determine the response rate for each question. Percentage of responses was used as criteria for interpretation of the results; results which were obtained from the open-ended questions available in the structured interview questionnaire were tabulated to analyze the list of concepts and the response rate for each concept. Data collected through semi-structured interview were classified coded and the related concepts were grouped together to form the main concept; the main concept were broken down into themes and thereafter, different categories were listed from each theme. Finally, the desk review data were presented into tables with two columns first showing author(s) and the second columns describing the findings from particular author. After the data were analyzed, the related results obtained from different methods were grouped together under relevant research question; the main purpose was to analyze the trend of the results in order to obtain answers for each research question.

After the data analysis process the researcher evaluated the findings to identify key issues which appeared in the study; the link to the conceptual framework was derived from the discussions. The study revealed a number of pedagogical tools used to support the teaching and learning process. This includes LMS, MOOCs, Digital libraries, TVs and Radios to support access to content; mobile technology; video conferencing facilities; games; simulation software; and Artificial Intelligence. In addition to this, social media sites are used to connect individuals living in different geographical locations and to facilitate interactions and collaborations among learners, instructors and parents. Furthermore, some assistive technologies such as recorded

lectures in a form of audio and video were also integrated to make the education process inclusive. The application of these tools differs in the level of use depending on how well the technology was integrated into respective institutions. However, the study suggested some improvements to each pedagogical tool to ensure that employed tools are relevant and are appropriately used. One way to improve the usage of the identified tools was to select the pedagogical tools that are aligned with the course objectives and activities; identify new, easy and affordable technology that is relevant to the course; and ensure monitoring and evaluation are regularly done to measure its effectiveness.

It was found that the instruction model has changed from didactic - teachers focused to authentic - students focused; learners are taking part in constructing their knowledge through different approaches including group work, brainstorming, demonstration and case studies. Further to this, it was found that most institutions have dedicated technological facilities for instructors and learners; these include hardware, software and the internet. The technological facilities are mainly used to support not only the teaching and learning process but also the administrative functions of the institutions. However, despite the technology integration initiatives the study suggested further strategies and efforts to integrate technology in the education process; it was suggested to improve the security aspects of technology as well as to develop strategies or procedures to guide appropriate integration of technology. This will ensure consistency in use of technology in institutions. Beside this, the study noted lack of professional technological knowledge to instructors; lack of technical support; challenges related to cultural transformation; lack of moral education; unethical use of technology especially for students which result in parent's distress and lastly insufficient technological facilities.

Several suggestions were given by respondents to improve technology adoption in education institutions. The suggestions include;

a. Development of technology awareness sessions for both instructors and learners is
b. Implement regular professional training for instructors, especially training related to education pedagogy concerning the application of digital tools.
c. Educators should develop and implement a change management strategy to improve technology adoption.
d. Engaging instructors in the process as it will enable them to create a sense of ownership.
e. Critical review of the technology budget to ensure all required technological facilities and services are available.
f. The government should consider prioritizing the development of technology infrastructure in the country to ease access and maximize usage in order to gain its potential.
g. Conduct research to explore technological resources with multiple functions as well as emerging technologies that are easy to use and affordable to enable institutions to move with the pace of technology development as well as minimize costs associated with technology adoption while maximizing its benefits.

Chapter 5: Implications, Recommendations, and Conclusions

5.1 Introduction

The focus of this study was to develop an effective research-based and theoretically informed pedagogical model for technology-based education among Secondary Schools in Tanzania. The proposed pedagogical model emerged from the critical review of educational theories, principles, and practices and the findings from the analysis of data collected from the interview, observation and desk review methods. The model is considered important due to the increasingly critical need for the provision of flexible learning which is aligned with the major components of learning, and which is driven by technology development. Again, the development of the model was necessitated by an absence of guidelines for technology adoption in the education process. This model will help educators to ensure the instructional design principles are followed when digital tools are used in delivery. Besides this, the model will guide educators to appropriately integrate emergent technological tools to develop knowledge structures that are accurately and meaningfully organized; it will serve as a conceptual map for the planning and evaluation of technology integration in the classroom.

The chapter is organized into four sections. The first section presents the implications of the results; it describes how the results are useful for educational policy makers, theory, practice and subsequent research. This is followed by a discussion on the limitations of the study to avoid the generalization of the results to other populations. This section is further divided into two parts; in the first part, the researcher presents a discussion about the implications of the research findings on technology-mediated teaching approaches and pedagogical practices. This is followed by a discussion of digital tools that were found by the study, the extent of their usage and the benefits

that these tools offer in the education process. The focus of the discussion is the study implications in facilitating access to education resources, inclusive education, education administration and security concerns and implications for pedagogical models and practices. The second part of this section presents a discussion of the implications of the findings and the pedagogical challenges which were found in the study.

The second section of this chapter presents the recommendations for practical implementation of the study results; the researcher presents specific measures and directions that should be taken to address the constraints and issues which were identified in the study. The description of the seven (7) elements which formed the proposed pedagogical model is also presented in this section. The third section presents the suggestions for future research; it involves the recommendations for future areas of study that the research did not address. The focus of the discussion is based on the pedagogical technologies, protection of online content, tackling financial challenges for technology integration, instruction capacity improvements, technology management and models of technology integration in education.

The fourth section presents the conclusion of the study; this section is intended to help the reader to understand the importance of this research. The section summarizes the key research findings; it provided important opportunities to demonstrate to the reader the overall understanding of the research problem. On the first end, the researcher presented the study population and study objectives. The presentation was organized into six sub-sections; each sub-section was organized into two parts; the first part presented two to three conclusive statements while the second part provides a detailed discussion of the conclusive statements in each sub-section. The focus of the discussion is the theoretical framework used to guide the research process; this is followed by a

conclusion regarding technological pedagogical practices, tools, models, limitations of technological pedagogical applications and finally the conclusion regarding the research methods employed as well as ethical related issues.

5.2 Implications

5.2.1Technological-Mediated Teaching Approaches and Pedagogical Practices

The advancement of technology has expanded the possibilities for students to attain education by affording learners greater and equal access to high-quality learning materials. A number of technological tools are integrated to support the education process in Tanzania such as Games, Simulation Software, Mobile Technology, Video Conferencing Facilities and Artificial Intelligence Tools. According to Zirawaga et al. (2017), using technology-based games in the classroom helps students to improve their critical thinking skills and build their self-confidence. Games were found to afford the enactment of elements of constructivist theory which envisages learners' opportunity for creativity through competition and collaborations (Polin, 2017). However, not all games are built with educational objectives in mind; hence educators need to identify games which are relevant to a specific topic. To attain the potential benefits of games it is important to evaluate the learning environment and the activities involved (Papadakis, 2018). In this respect, it is critically important to examine the requirements and characteristics of the learning environment as well as instructors' and students' characteristics. Besides this, games should be designed in such a way that it reinforces the relationship between behaviour, cognition and the learner's characteristics thus enriching the learning experience (Unsworth et al., 2015; Craven & Fabricatore, 2016). Further, Suyatna (2020) points out that the use of simulation software provides opportunities for dynamic, interactive and individual learning hence it can be

used to improve individual knowledge and skills as it imitates real-life situations (Campos et al., 2020). However, an adaptation of simulation software should be aligned with the learning needs, design and available technological infrastructure (Loke et al., 2012).

The study noted significant diffusion of mobile technology to the majority of individuals in the country which makes it a potential tool for delivering content. However, based on its nature the effectiveness of mobile technology highly depends on the ability of instructors to structure content in different formats from common lectures and books (Grimus & Ebner, 2014). In this regard, instructors need to understand the instructional design principles for mobile learning; they must have the ability to design content that learners can manage and access through mobile devices. Besides this, to effectively use mobile technology, institutions must have a system that supports the advantages of mobile devices that is availability, accessibility, flexibility, personality, and portability (Al-Karadsheh, 2009).

Even though the study revealed low use of video conferencing facilities, according to Trajkovik (2010), interactive video conferencing and video streaming technologies are extremely effective tools for delivering quality education to students located in different geographic areas. The tools provide real-time communication and community building (Shahmohammadi, 2014); however, teaching with video conferencing tools is different from teaching using the traditional face-to-face mode, therefore, careful planning is essential. In this regard, establishing specific guidelines to promote the effective use of web video conferencing tools to support teaching and learning functionality is important. On the other hand, the application of AI tools creates new opportunities in teaching and learning (Göçen & Aydemir, 2020). With AI tools educators' can

do complicated tasks which can increase the level of memory and cognition among students through the interaction between learners and machines (Delgado et al., 2020). AI tools enable instructors to analyze students' capacities thus taking appropriate action to scaffold the learning process (Fahimirad & Kotamjani, 2018). However, the combination of humans and machines in the education context demands new dimensions, functions, and pedagogies hence educators must work out suitable AI-enabled techniques to apply in a particular learning environment (Göçen & Aydemir, 2020). On the same hand, integrating AI tools should not be considered a central solution; decisions should be made automatically based on human reflections (Phillips-Wren, 2012).

5.2.1.1Tools Used for Information Access

Information access is central to the education process as it helps students better understand the subject matter and facilitates interaction with other students. The study revealed MOOCs and e-Libraries were integrated to supplement learning content. However, according to Israel (2015), it is difficult to find MOOCs that relate directly to the course hence recognizing a MOOC that best fits a course is critical to the discussion of education quality. Again, intellectual property and copyright issues are critical areas for discussion when integrating MOOCs into the educational process (Driha & Zafrilla, 2017).On the other hand, electronic libraries were found to provide opportunities for learners and instructors to access knowledge resources at any time and low cost compared to purchasing physical books (Anyim, 2018; Khan 2021). However, to increase the value of these resources, educators must critically analyze whether the available resources are relevant to support the learning objectives for specific institutions as well as to ensure both

librarians and library users have acquired relevant skills that enable them to access available resources (Khan, 2021; Vrana, 2017).

Besides this, the study revealed that social media sites such as Instagram, Facebook, Twitter and WhatsApp provide a collaborative web-based environment which allows multiple users to contribute to content; Yusop and Basar (2014) point out that integrating social media in the classroom gives students more control of their learning hence they become producers and not only consumers of information. However, for effective use of these resources, educators are required to critically examine appropriate social media sites that fit learners' needs (Pampapati & Ranjini, 2015). Integrating social media with LMS is another issue of concern; educators need to develop strategies to combine social media with LMS to enable meaningful and authentic social and intellectual interactions among learners (Ravisekaran & Ramakrishnan, 2018).

5.2.1.2 Implications for Assistive Technological Tools for Students with Special Needs

There are different types of assistive technologies available for students with different kinds of disabilities such as screen magnifiers, text recognition, touch screen and joystick. The study found that lectures and other education contents were converted to audio and video to facilitate the learning of students with special needs. However, according to Mahoney and Hall (2017), students with disability can be included in general education only if inclusion criteria meet each student's needs. In this respect, instructors need to explore the current needs of assistive technology that can meet the specific needs of students. In addition to this, instead of developing a separate setting for special needs students, educators should integrate the requirements for

special needs students into mainstream education to enable the realization of quality inclusive education for all (Kirschner, 2015).

5.2.1.3 Implications of Technology Use for Administrative and Information Security

The study revealed that the internet (information search and email communication) and Microsoft Office (documents and reports) were the main technologies used to support the administrative functions of the institutions. However, a variety of software is available to support administrative functions to increase institutions' efficiency and promotes transparency and accountability (Kapur, 2019). Researchers pointed out that technology can be used to facilitate file movements and storage which will ease the retrieval process (Mulauzi, 2020; Akporhonor, 2020); this can be achieved by developing and installing information management databases to facilitate student administration, personnel administration and management of resources (Keshtmand, et al., 2016). The development of institutional websites can also ease information access and dissemination to a wide geographical area (Gaur, 2016). In this regard, there is an urgent need for policymakers to guide on how technology can be used to support an institution’s administrative functions.

Security risks and vulnerability to cyber-attack on learning content and private education information are considered the major concern when using technology for teaching and learning (Bandara, 2014). The study revealed little security consideration for online education content. This calls for educators to implement measures that will help to ensure that educational content is handled using secure and trusted methods as well as to protect information against unauthorized access, alteration, malware/virus attack and/or loss of confidential information

(Bostan, 2015; Shonola & Joy, 2014).Besides this, creating security awareness amongst users can help to scrutinize security practices (Bostan, 2015).

5.2.1.4 Implications for Pedagogical Models and Practices

The study revealed increased application of the authentic pedagogical models; according to Yahaya et al. (2017), authentic learning is among the major resource that has been proved to bring meaningful knowledge. It is a learner-centered approach which gives opportunities for students to actively generate knowledge by integrating students' experiences with the new experience hence producing learners who have a better understanding based on the constructivist theory of learning (Bialystok, 2017). However, for effective implementation of this model, educators need to create a learning environment that emphasizes what students need to learn rather than what instructors believe they should teach. In this respect, educators should consider developing a framework for implementing effective authentic models (Trivedi et al., 2017); however, the effectiveness of such models depends on the willingness of both instructors and students to actively participate in the education process.

5.1.2 Implications for Technological Pedagogical Barriers

Despite the opportunities that technology can offer in the field of education, this study identified a number of pedagogical challenges facing Tanzanian schools and suggested ways to overcome the challenges. If these, the best ways to overcome the identified challenges are for the educators to focus on investing time and money to enhance technology application as well as to ensure that invested technology is applied in a pedagogical manner (Cloete, 2017). The study revealed that both instructors and students understand the potential of technology to improve their

instructional and knowledge constructions. However, the lack of relevant technological resources has directly affected the quality of education offered. In this regard, school administrators must identify the most relevant and affordable technologies to support the education process. This will improve the education system by ensuring the value added by technology is attained. The study also concludes that school administrators should look for other alternative sources of funding to improve their technological infrastructure and services.

At the outset of this study, the majority of the instructors have limited capacity to use technological applications. According to Albion et al. (2015), educators must be able to develop relevant online content hence continuing professional development is very important to help instructors to learn how to effectively use technology for instruction. Having very little experience with technology makes instructors less likely to use technology and unable to explore new possibilities for technologies to improve content design and instruction. On the other hand, the study establishes the fact that regular technological pedagogical training for instructors is vital; hence the training should focus on ensuring instructors are capable of selecting, evaluating, and using appropriate technologies and resources to create an educational experience that enhances students' engagement in the learning process. Enhancing instructors' pedagogical knowledge will increase their confidence in applying technology through transforming their profession (Mominó, 2015). In this respect, education administrators must ensure the instructor's capacity is built to a sufficient level to boost their confidence toward the application of technology.

Instructors' pedagogical beliefs and attitudes can be considered both enablers and barriers to the application of technology in schools (Tondeur, 2020). These are important constructs which impact technology application. Beliefs lead to action and practices which are difficult to change hence instructors' professional development must consider the initiation of the change in pedagogical beliefs among instructors (Tondeur, 2020).

According to Mayes et al. (2021), the application of technology in schools has raised prevalent ethical concerns. It has greatly impacted the design and education practices; giving students access to the internet and allowing them to participate in the online community giving rise to unethical practices including pirating of content, cyber-bullying or harassing others (Buchanan, 2019). In this respect, educators need to update themselves about changes in the educational practices and raise students' awareness and understanding of the consequences of their misuse of learning technologies.Preventative measures for these unethical practices should be developed and executed to minimize the practices as well as provision of moral education for learners.

Human resource with relevant expertise was found to be the major requirement for the successful application of technology as a pedagogical tool (Mayes et al., 2021). The results of the study revealed a lack of competent individuals to maintain and support technology applications. Ertmer et al. (2012) suggested that to effectively integrate technology in the education process, four kinds of support namely administrative, technological, and professional and peer support are needed. In this case, schools must have technical support specialists to assist users and maintain the digital tools. Undertaking an inventory of human resources needs and identification of competence is another important aspect when integrating technology into the education system.

Due to the dynamic nature of technology, it requires a strategic plan and policymaking to integrate with education. Policies can serve several functions as they provide a set of goals and vision on how the education process will be run and managed using technology (Ghavifekr & Rosdy, 2015). Proper structure and planning are needed when technology is integrated into school; this is because technology can make many changes to students, teachers and parents. Developing relevant policies can help educators to handle several challenges including infrastructure and resources challenges, instructor's professional development, ethical concerns, teachers' and parents' beliefs and attitudes and many more. ICT policy can serve as a blueprint for technology integration in the education process efficiently and effectively (Vanderlinde et al., 2011). From the results, most schools have failed to apply technology in their education practices because there are no set targets which demand the application of technology in the teaching and learning activities. It is high time for educators to make existing education policies a reality.

5.2 Recommendations for Application

According to Rutto (2017), quality of instruction is dependent on pedagogy; in this respect, integrating technology in the education process demands educators to re-think pedagogical issues. Technology integration in the education process will not add value unless the educators consider the pedagogical aspect of education before applying any kind of technological tool (Daniela, 2021). Against the backdrop of the elucidations and the findings from this study, the researcher came up with a proposed pedagogical model for technology-based education among Secondary Schools in Tanzania. The model was developed based on the research findings; special attention was given to recommended strategies to eliminate the existing pedagogical

barriers in the technology-based environment, as discussed in Chapter 4 section 4.3.6.4. In addition to that, the model has considered the conceptual framework presented in Chapter 2 section 2.1as well as the Literature Review presented in Chapter 2 of this study report. The proposed model structure consists of seven (7) key elements as stipulated in figure 5.1.

5.2.1 Learning Theories

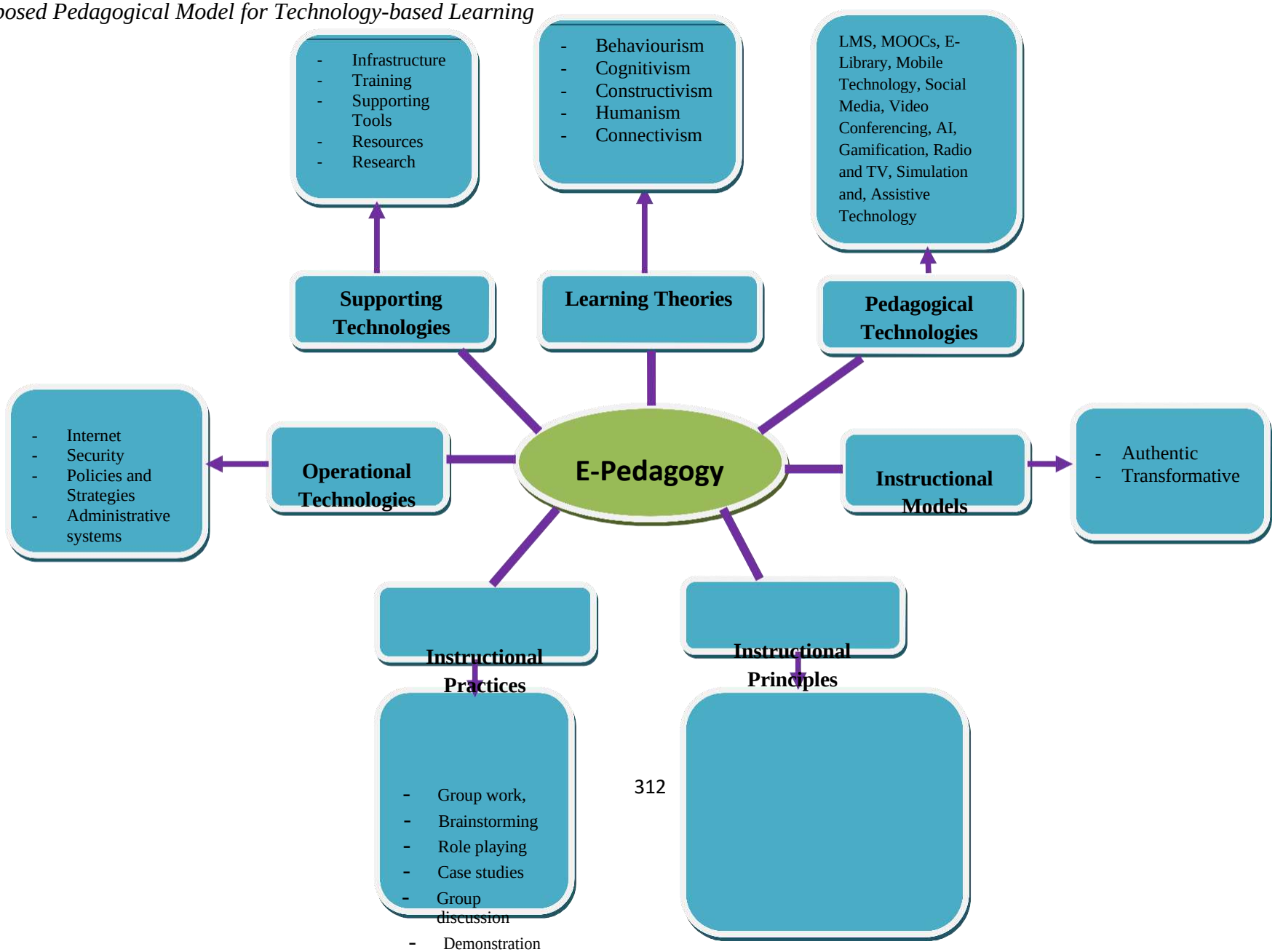
Rutto (2017) pointed out that pedagogical strategies stem from learning theories which serve as the conceptual framework for teaching and learning. In this regard, educators must consider existing educational theories when applying modern technologies in the education process. According to El-Jabali (2018), the development of interactive content can enable students to achieve self-efficacy when engaging with others and receiving positive feedback. Technology offers students opportunities to interact with others through digital platforms thus building their self-efficacy; it helps to shape student behaviour hence educators must consider behaviorist theory as among the prevailing education theory in the technology-based forms in order to reinforce the learner's behaviour, facilitates cognitive procedures and provides accurate and prompt feedback (Pange & Pange, 2011). Assymova et al. (2019) pointed out that it is very important to develop a student's cognitive competence when teaching with technology; cognitive skills mean the ability for a student to acquire certain knowledge, process and apply the acquired knowledge (Robinson, 2012). In this respect, this study recommends that technology application should facilitate the creation of a motivating environment that will help students to develop their cognitive skills.

According to Koohang et al. (2009), a constructivist theory which focuses on knowledge construction based on learners' knowledge and previous experience, can be best applied to technology-based education. This study recommends that learning design including content and activities should provide room for learners to construct their knowledge. This can be achieved if the instructors use relevant technological tools to develop content relevant to learners, guide and facilitate the learning process and instruction, allow learning to take place in real-world environments, assess students formatively, and encourage students to develop new knowledge in the framework of their existing knowledge and experiences (Isik, 2018; Secore, 2017).However, instructors should be provided with the skills and relevant tools needed to engage in constructivist learning.

Talukdar (2021) pointed out that humanism theory is a learner-centered approach which aims at developing learners' capabilities as well as paying attention to their feeling and emotions. This study recommends that for consideration of the humanist approach, technology should be applied in such a way that it enables teachers to create a flexible and convenient environment that motivates learners to actively participate. Individuals should be given the opportunity to select online courses and streams, to ensure that instructors respond to queries posted through chat or email on time. However, regardless of the technology used for content delivery and communications, the teaching and learning process must fulfil the humanistic approach (Talukdar, 2021; Barnová & Krásna, 2018).

Figure 5.1

Proposed Pedagogical Model for Technology-based Learning



- Inclusiveness
- Supporting learners' motivation and engagement
- Involving innovative approaches
- Matching with curriculum
- Supporting both formative and summative assessments

Furthermore, Herlo (2017) pointed out that technology has enabled new approaches to learning that connects learners from different geographical locations; students learn through interaction within the network. In this regard, the form of technology in the education process should enable learners' interactions regardless of their geographical location; the instructor's role is to ensure students create knowledge through these interactions. Therefore, this study recommends for consideration of a connectivist approach when teaching using technology (Herlo, 2017; Utecht & Keller, 2019).

5.2.2 Pedagogical Technologies

Technology integration in the teaching and learning process should be part of the normal teaching and learning process and not as an additional requirement (Okojie et al., 2006). In this respect, institutions must explore relevant pedagogical technologies that will best facilitate the learning process and outcomes. One of the criticisms cited in this study was the lack of specific guidelines for designing online content. Besides this, this study found that some instructors do not know how to use the existing technological tools in pedagogically sound ways to take advantage of the technology affordances. Therefore, technological pedagogical content training should be part and parcel of the education process (Schmidt et al., 2009). This study recommends the use of pedagogical technologies such as Digital Library/Repositories, MOOCs, OERs, AI, Video Conferencing facilities, Gamification, Mobile Technology, simulation software, Wikis and social media to address information accessibility, engagements, collaborations, innovation and creativity and motivations. Other technologies such as screen magnifier, text recognition, touch screen and joystick are also recommended to address information accessible to students with special needs.

5.2.3 Instructional Models

Instructional models are important for learning delivery as they can promote effective teaching and learning activities. Chukwuemeka et al. (2020) define instructional models as ways in which contents are presented to students. There is a significant difference between traditional teaching and technology-based teaching; the use of technology for teaching has influenced a student-centered approach (Samaranayake, 2020); it has promoted social and collaborative practices, critical thinking, problem-solving, communication and technical skills (Gökçearslan et al., 2019; Trivedi & Modi, 2021). In this regard, the study recommends the adoption of an authentic instructional model which incorporates the learner's interactions into the learning process and incorporates activities which have real-world relevance (Hawkridge, 2011). An authentic learning environment provides opportunities for students to reflect on their learning and collaborative construction of knowledge. Kalachanis et al.(2019) pointed out that the great success of technology is the fact that it provides sophisticated tools such as course management tools, information access and communication tools. In this respect, educators need to integrate the right technological tools to serve the purpose of transforming the learning process and creating change among the learners; this will make the education process more than just the transfer of knowledge but for learners to achieve true learning (Halupa, 2015).As described in the literature the study also recommends the adoption of the transformative model as it can shape the learners and help them to produce a significant impact or paradigm shift in teaching (Dorji et al., 2020).

5.2.4 Instructional Principles

A technology-mediated learning environment has the potential to deliver education that meets each individual's needs (Jutta & Roberts, 2006); this can eliminate barriers that learners with a

disability may face in a traditional learning environment. However, this study recommends that technology must be constructed in such a way that it can deal with diversity thus providing an accessible learning environment for all individuals. For education to suit the variety of learning content it should be designed in such a way that it accommodates different learning styles (El-Seoud et al., 2016; Adel & Eladl, 2021); contents should be incorporated with multimedia elements, possess hands-on activities, simulate real-world situations, provide feedback to the learner, and in a way that the learner can easily navigate the online course. This type of learning design can also allow learners to actively participate in a self-managed way hence facilitating learners' engagement which increases motivation for their learning (Gutierrez & Peralta, 2013; Domalewska, 2014). Inclusiveness and engagement are important pedagogical principles recommended by the study.

According to Cachia & Punie (2009), stimulating creativity has a positive effect on learning; it supports self-learning and lifelong learning and competence. To enhance learners' creativity and innovations, this study recommends that educators should design problem-solving activities and challenging tasks for learners (Seechaliao, 2017); also, instruction should include stimulating ideas that facilitate brainstorming in order to enhance learners' thinking capacity (Gökçearslan et al., 2019). Besides this, the literature recommends that educators should apply technological pedagogy that matches with curriculum and can support both formative and summative assessments (Livingston et al., 2017; McAleavy & Gorgen, 2020).

5.2.5 Instructional Practices

The education system can become a transformative agent when learners are engaged in the learning process (Simpson, 2018). A participatory approach is a kind of teaching approach that

stimulates learners' activeness and improves their thinking capacity through hands-on activities and methods of teaching originating from constructivist theory (Huang et al., 2019; Simpson, 2018). Allowing students to actively participate and interact with peers makes students more satisfied with their education, hence improving their performance. According to Burke (2011), practices such as group work, brainstorming, role-playing, demonstration and case studies foster learner participation. Group work can increase learning comprehension, improve creativity and increase students' commitments (Chiriac, 2014).It also helps students to develop positive attitudes towards peers, self-esteem and the ability to probe more deeply and critically into course contents hence offering greater academic success (Gunderson & Moore, 2008). From the study findings, it is recommended to apply technological tools such as online group discussion through the LMS and chat rooms, PowerPoint presentations and social media tools to facilitate group work activities.

Brainstorming is another practice considered in the model as it aims at facilitating problem-solving skills and critical thinking among learners (Khan & Ashraf, 2021); brainstorming practices can bring attention and increase active participation amongst learners thus creating positive effects on student's achievements. According to Selvaraj (2011) and Vivek et al. (2021), educators can take advantage of technological tools such as video tools, mind mapping software, LMS, and Web conferencing tools to facilitate brainstorming sessions.

The model has also considered role play as an important practice that can promote active teaching; it strengthens learners' confidence and encourages learners to learn new things (Rojas & Villafuerte, 2018). Application of asynchronous technologies, such as online forums and discussion boards, computer games, and social media tools can facilitate role-play practices

(Glover, 2014); these tools enable learners to be better engaged hence supporting the core aspect of learning. Furthermore, according to Bonney (2015), the case study method of instruction is among the highly accepted method that can promote analytical skills; it helps to increase student motivation towards classroom activities, which promotes learning and increases student performance. AI tools such as virtual reality and simulation software are very useful tools to facilitate the case study methods thus enhancing the entire learning experience (Madathil et al., 2017).

5.2.6 Operational Technologies

In this study, the internet is considered a powerful and transformative tool for education (Ezechina et al., 2015); through the internet information access and communication were made easy (Kouser & Majid, 2021; Oprea, 2014). In this respect, institutions need a robust connection to the internet and an array of web servers to assure prompt response and reliability of other technological services. Besides this, this study recommends that institutions should enhance administrative needs to support other enquires related to educational services. These include the availability of online application systems, registration systems, fees processing/financial systems, examination processing, and grade book and certificate/transcript provision processes. However, all these essential systems must be built in a secured environment to make them sustainable. Even though there is a national ICT policy that governs technology application in different sectors including the education sector in Tanzania, this study recommends that each respective institution must develop its ICT policy that will guide both long and short-term technology integration plans; this will enable institutions to achieve their education promise though technology (Austin & Hunter, 2013).

5.2.7 Supporting Technologies

The availability of infrastructure and other resources are the necessary condition for the integration of technology in the teaching and learning process. Institutions must ensure the availability of servers to provide power backup, data backup, recovery systems and proper cooling systems. Besides this, institutions must ensure the availability of technical service desks to support both instructors and students to find solutions to their problems (Harcenko et al., 2010); tools like shared inbox, knowledge base and live chat may be installed to facilitate helpdesk services. Installation of mobile apps for information dissemination, efficient management of operations and resolving technological challenges is recommended (Azeta et al., 2015). To ensure the sustainability of adopted technological tools, institutions must consider employing competent technicians to troubleshoot and maintain the hardware and software and monitor system downtime and ensure quick recovery of data.

Based on this study, some instructors' attitudes were found to affect the pedagogical application of technology. A training programme that will create a positive and significant difference in instructor attitudes towards technology integration was recommended (Chatterjee, 2016); moral education should be provided to both instructors and learners to assist cultivate their moral and intellectual characters in teaching and learning (Metro-Roland & Farber, 2022). In addition to this, Ezechina et al. (2015) pointed out that instructors' and students' ability to appropriately use the technological tools can determine how efficiently technology can be exploited to enhance the education process. The findings from this study indicate technological incompetence among instructors and learners. In this regard, both instructors' and students' training should remain a central focus to enable them to attain the skills needed to navigate online systems, communicate online and how to obtain technical support services (Appiah, 2016; Gupta, 2019). Furthermore,

instructors must be equipped with information about the available online educational resources such as MOOCs and other digital content that can be used to enhance learning including details about online simulation tools, skills and websites where laboratory experiments can be replicated (Hinostroza, 2010).

Many educators use research to improve their education practices (Kapur, 2018); educators can use research findings to improve their competencies in the teaching and learning process. As the technology continues to advance more and more research is required to examine better ways to improve the current technology pedagogical practices. This fact made research an important aspect of the model.

5.3 Recommendations for Future Research

One of the requirements of technology integration in education is to fulfill pedagogical goals and address problems associated with education content delivery (Okojie et al., 2006). The purpose of this study was to explore the extent to which technology integration in education has considered existing instructional theories and principles. The study evinced a model for meaningfully technology integration in the education process; the model can be of interest in ensuring the successful integration of technology among secondary schools in Tanzania. However, future work should include the implementation of the model in the educational process while studying its short and long-term impacts on the education system. The researcher recommended that both qualitative and quantitative research should be undertaken simultaneously to investigate different aspects of the model (Abuhamda, et al., 2021). Quantitative research is very useful as they enable the researcher to reveal insights that can be extended to other populations while the qualitative approaches enable the researcher to make

sense of human experience, beliefs and actions to inform meaningful decisions (Abuhamdaet al., 2021; Ahmad et al., 2019). The two approaches can help a researcher to validate the modal by gaining insights, into whether the model is useful in guiding instructors' practices, reflection and pedagogical change.

On the other hand, the study revealed several challenges facing education institutions in their effort to improve the quality of education through the application of modern technologies to the teaching and learning process. Although the study recommended ways to overcome the identified challenges, further qualitative research to examine the details of the existing challenges is essential; the research outcomes will enable institutions to acquire not only relevant technological tools but also apply them in a sound pedagogical manner. The following section describes important areas for further research as recommendations arising from this study.

5.3.1 Pedagogical Technologies

The pace of technological advancement is rapid, yet it fluctuates across time (Coccia, 2019). Again, the flexibility of education is increasing and a need for continued research is critical to ensuring that the education process is moving at the same pace as technology growth. This study found that game-based learning was among the strategies to enhance learners' motivation; however, according to Selvi and Çoşan (2018), games have entertainment elements and learning elements, therefore, if ill-designed, learners will end up entertaining themselves without gaining any knowledge. However, the application of games to teaching and learning is considered a new approach in teaching hence special attention must be given when designing educational games to ensure they meet the curriculum needs (Prieto et al., 2017). Therefore, further research is important to investigate the design feature of educational games that will connect the

entertainment elements with the education elements (Bylieva, 2018). An experimental study involving human subjects is suggested; this will enable the researcher to compare the effects of various games on students' learning performance and attitude. The aim should be to measure the level of knowledge achieved by learners and their intention to use games. Besides this, it would be useful for educators to evaluate the simulation contents and appropriateness to the curriculum to ensure that they are aligned to the learning outcome. A mixed method approach is considered relevant for this study as it will allow the researcher to collect sufficient quantitative and qualitative data to detect significant changes in scores as well as to enable the construction of meaning.

MOOCs were among the resources which were used to enrich the learning contents. However, Alturkistani et al. (2019) suggested that it is important to evaluate MOOC courses before adopting them as an educational resource to ensure relevant material is available to supplement other available materials. MOOCs must also be evaluated to ensure that related design and delivery of instructional activities match with the curriculum and can facilitate knowledge acquisition (Bali, 2014). In this regard, in future empirical research is important to explore frameworks for quality control when designing and implementing MOOC courses (Gamage et al., 2016). The empirical method is useful as it enables the researchers to assess the appropriateness of MOOC courses (Correia et al., 2020). Further to this, only a few schools have integrated Video Conferencing and AI facilities into their educational processes; the main reason was the cost associated with these tools. Based on these findings, it is recommended that a comparative study to explore low-cost video conferencing and AI tools including those which are based on open source should be undertaken. The comparative study is useful in comparing the advantages of one system over the other (Nadire & Daniel, 2021); this will enable institutions

to make informed decisions on the right system to adopt. Besides this, further qualitative research should be conducted to explore more innovative approaches and identify suitable techniques for implementing these tools to ensure they meet the diverse need of learners (Lawson et al., 2010).

Social media support education by providing ease of access to information including education resources (Şahin, 2021). However, most parents' view social media as the cause of time wastage and can expose their children to undesirable content which can lower students' academic performance (Şahin, 2021; Greenhow & Askari, 2017). According to Hamadi et al. (2021), social media cannot be used as a standalone tool hence there is a need for educators to explore the way to develop a standard integrated model of social media sites with other educational tools such as LMS. Such a model could guide educators to appropriately design courses with sound pedagogical approaches (Dijck & Poell, 2017; Alabdulkareem, 2018). However, several studies to explore how different social media can be supportive in the education process are available (Devi et al., 2019). In this regard, a desk-based review approach will help educators to develop a relevant model for integrating social media in different education settings and functions thus reducing the risks associated with social media such as cyber bullying, sexual harassment and discrimination and to safeguard learners from these risks (Meena & Mohammad, 2013).

On the other hand, some students have different kinds of disabilities which need to be addressed (Kirschner, 2015); however, the study revealed that most of the technological tools available are those which are relevant to students with visual challenges. According to Naggar and Sharafeldin (2018), high-tech tools such as Virtual Reality (VR) and AI tools can provide supportive environments for individuals with varieties of disabilities including physical, sensorial and

cognitive disabled students. VR and AI tools have influenced the teaching and learning process and made it more inclusive and accessible for students with visual, hearing, mobility and intellectual disabilities (Garg, 2020; Drigas & Ioannidou). Considering the potential of VR and AI tools further focus group qualitative design is suggested as a relevant method to explore VR and AI tools that are appropriate in addressing issues affecting special needs students with different kinds of disabilities (Viner et al., 2020). A group discussion will encourage individuals to share their experiences rather than constituent individuals.

It was found that different kinds of LMS were integrated to facilitate content delivery, assessments, reporting and course administrations. However, for effective utilization of LMS, it is crucial to take advantage of many other available LMS features (Awad et al., 2019). According to Turnbull et al. (2019), future development of LMS will require the application of sophisticated tools to enable genuine synchronous communication by including the user's capability to use devices such as smart phones, watches, and glasses as well as video conferencing apps and peer-to-peer messaging tools. In this regard, this study recommends future exploration of other LMS capabilities and tools for developing a future version of LMS. The exploratory mixed research consisting of opinion surveys and reflexive comments is useful to gather useful information to improve LMS capabilities. Again, according to Conklin (2020), evaluation of the LMS is an essential process for the sustainability of the system; the findings show that there is no defined framework for evaluation of institutional LMS; therefore, further research is essential to develop a framework for monitoring and evaluation of institutional LMS. Survey research is suggested as it allows for wide opinions to contribute to the development of the framework (Ponto, 2015). The availability of the framework will help to improve existing LMS hence enabling institutions to move with the pace of technological changes.

Furthermore, according to Istrate (2009), the pedagogical design of learning content in a digital environment should focus on content design principles to support participants' confidence and comfort; the contents should place the learner's needs at the centre to enable the achievement of the learning outcome (Hamtini, 2016). Most institutions were found not to have guidelines for designing online content; instructors upload content based on their willingness. Therefore, further study is essential to develop an e-content framework to guide the design of standards online content. A meta-synthesis of the literature involving the peer review of quantitative and qualitative research studies published in international journals and articles focusing specifically on e-learning success and barriers can enable researchers to obtain important elements of the framework.

5.3.2 Security for Online Contents

Haseski (2020) and Gade and Reddy (2014) pointed out that the digitization of the education process has introduced various risks including cyber piracy, technology addiction, cyber bullying, intellectual property violations and many more. The findings show that there is a low implementation of security measures to protect online content from cyber-attacks. However, the researcher did not analyze the details of the security measures adopted for each specific institution. Therefore, the follow-up mixed method research to analyze the security aspects of online content including instructors' and learners' knowledge of cyber ethics is crucial (Gade & Reddy, 2014). Mixed research has a broader focus than a single research design hence can enhance the ability to provide insights about security aspects of technology. This should be followed up by action research designed to improve the current level of cyber-security in the education systems.

5.3.3 Pedagogical Models

Institutions are moving away from the didactic approach to teaching to authentic and transformative approaches to teaching (Abdullahi, 2019). In an authentic model, students are allowed to explore, discuss and construct meaning concepts that connect to their real-life (Aynas & Aslan, 2021; Abdullahi, 2019) while in transformative learning both students and instructors participate in facilitating the required change (Halupa, 2015). These two models are new in the Tanzania education system, so their application needs further evaluation to analyze their impacts on learning activities among secondary school students. A comparative analysis will be useful for comparing elements of different models to identify and develop a model that suits the Tanzanian education context. Further qualitative research is also recommended to develop a framework for the effective implementation of both an authentic and transformative model.

5.3.4 Financial Aspects for Technology Integration

Management of technology infrastructure and acquisition of technical facilities as well as maintenance activities have led to huge costs (Deka & Borah, 2012). The application of cloud computing can help institutions to reduce costs through optimization of resource utilization (Koch et al., 2012). Margianti & Mutiara (2015) defined cloud computing as networks of computing resources that can be shared easily thus ensuring the quality of education services. Through cloud computing, learners can create their cloud-based personalized learning environment or can use mobile technology to access education resources (Kurelovic et al., 2013). Cloud computing can also be used to facilitate resource sharing among institutions through the building of interactive and open sharing platforms of high-quality resources (Guo & Niu, 2014).

To minimize technology investment costs among institutions it is recommended to undertake further study to examine the cloud services that best fit the country's education context. In recent years, cloud computing has attracted a growing number of studies (Senyo et al., 2016; Rashed, 2014); a literature review using a meta-analysis approach will provide useful insights into cloud computing. On the other hand, education resource sharing is important and can minimize the costs associated with designing and implementing new education systems and supporting resources (Ayoo & Lubega, 2014). According to Yongqiang and Qin (2016), educational resource sharing can accelerate the improvement of educational efficiency and quality of education. Further research is recommended to develop a framework for resource sharing among the educational institutions in Tanzania. An in-depth literature study involving reviewing existing research reports to understand the education technology resource sharing environment together with empirical research to analyze the existing environment will provide important information for designing the framework.

5.3.5 Cultural Change and Instructional Capacity

Rapidly technological innovations have created the need to empower instructors' understanding of how best the technological tools can support their effort to deliver education content (Ngoc et al., 2020). According to Tosato et al.(2014), the number of digital resources has been constantly increasing in the last twenty years. To take advantage of emerging technologies and enable instructors to move with the pace of technological development, it is important to undergo continued studies on emerging technologies; the study results will inform the instructors' career development process. A quantitative descriptive study is appropriate to gauge the instructors' knowledge and use of digital tools as well as institutions' willingness and readiness to adopt emerging technologies (Chimbo & Tekere, 2014).

According to Vintere and Maļinovsk (2009), the introduction of technology in the education system demands new methods of instruction; the methods foster cultural change among instructors who are the main agents of education service delivery (Howard & Mozejko, 2015). Technology development has roused fears, resistance, and discussions among educators on how to apply these advanced tools in the education context (Da-Silva et al., 2020; Chandler, 2013). Based on the scope of the study limited detail was sought regarding cultural influence on technology application. However, resistance to cultural change was mentioned as among the barriers educators faced in integrating technology in the classroom. In this regard, institutions must consider changing the existing structure and identify cultures that would affect their efforts to integrate technology into the teaching and learning process (Erdurmazli, 2020; Amah et al., 2913). Educators must examine appropriate steps to foster cultural change; therefore, it is essential to conduct research to analyze the influence of both institution and individual cultures on the changes caused by technology, trace the main aspects of changes and identify the best ways to implement change management without affecting educational quality. An ethnographic qualitative study whereby researchers interact with participants in their real life is essential to developing a more nuanced understanding of cultural resistance; the study results may provide useful cultural information for implementing a change management system (Sharma & Sarkar, 2019; Shea, 2013).

5.3.6 Technology Governance

Technology integration involves the creation of an interface between modern tools, learners, instructors and other education stakeholders. To effectively integrate technology into education, it is important to consider different models (Akcil et al., 2021). However, constant technological changes make it difficult to define the process; in this study, different institutions were found to

have integrated technology at different levels using different tools. Currently, the country does not have a defined structure for technology integration; however, according to Da-Silva et al. (2020), the impact of technology in schools is dependent upon how successfully the technology was integrated as well as the educator's competence. Therefore, further study to examine the best structure/framework for technology application to fit both integration and operational standards is important. However, according to Akcil et al. (2021) and Ghavifekr et al. (2018), technology integration is complex and dynamic in nature hence its integration requires a strategic plan; it can be used to support a variety of activities in the education process including administrative functions, content delivery, assessment, information access and teachers' professional development (Adom & Aravind, 2019). Mixed method research is a relevant approach as it can handle complex research issues; it offers methodological flexibility and an in-depth understanding (Shrestha & Giri, 2021; Molina-Azorin et al., 2018).

5.4 Conclusion

5.4.1 Introduction

Modern technology and its applications have made an important contribution to the teaching and learning process. Therefore, institutions are encouraged to focus on how to best integrate technology into their educational processes. This will help institutions to benefit from the pedagogical potential technology offers to contribute to the delivery of quality education for all. This study established a pedagogical model for technology-based teaching among Secondary Schools in Tanzania. The research was conducted in three regions of Tanzania, which are, Dar es Salaam, Morogoro and Arusha and was guided by four specific objectives:

a. To critically analyze the pedagogical tools and practices available in the literature that are relevant for technology-based learning.
b. To examine the current teaching approaches applied in Tanzanian Secondary Schools in relation to the application of technology in teaching.
c. To examine the pedagogical challenges experienced by teachers and students when integrating technology in the classroom.
d. To design a theoretically informed and evidence-based pedagogical model to guide the technology integration for teaching among Secondary Schools in Tanzania.

The section is structured into two parts; the first part presents two to four conclusive statements which are italicized, and the second part describes the conclusive statements.

5.4.2 Theoretical Underpinning

Learning is not complete unless there is a consideration of the learning theories; these theories guide educators to deliver learning in a targeted and effective way. Educators need to integrate practices that promote creativity, feedback, mentorship, social group and foster individual basic needs. Relevant technology should be applied to ensure up-to-date information is provided when designing technology-mediated teaching.

To summarize and synthesize the existing knowledge, arguments and ideas on this particular topic the researcher reviewed numerous research reports, conference papers, journals, websites and book chapters to learn from the early Endeavour and avoid duplication of work. In contrast, the theoretical and conceptual frameworks were constructed and based on existing substantive theories of learning which were used to guide the research process. This study was grounded on

five contemporary education theories namely Behaviorism, Constructivism, Cognitivism, Humanism and Connectivism; these theories form the conceptual framework of the study. This is because each learning theory contributes differently to the analysis of the learning process; according to Ng'andu et al. (2013), behaviorism theory applied to learning encourages long- and short-term reinforcement, increases in self-belief and the building of trust and confidence. However, in a rapidly expanding technology era where learning development has advanced, researchers focus on motivational influences rather than behaviour (Gunnars, 2020). Despite this fact, behaviorist approaches are still needed as it brings up some form of motivation that deepens learners' contextual knowledge (Gunnars, 2020). Therefore, technology should be used to design a learning environment that can activate learners' stimuli and responses. Technological tools and strategies applied in the education process must consider learners' interest in giving rewards or awards, in order to generate a spirit of competition.

The constructivism approach as part of the conceptual framework was considered as it allows learners to construct their knowledge as they attempt to make sense of their experience (Kapur, 2018). The significance of this learning theory is the fact that it provides an active and engaging environment that affords learners the ability to develop critical thinking and communication skills; learners can apply skills gained to their real-life situations (Yadav, 2016). Digital tools promote the involvement of social groups in the learning process; hence new skills can be gained based on the learners' experiences, knowledge, habits and preferences. In addition to this, according to Jha (2018), technology-based pedagogy as a social constructivist activity can facilitate collaborative learning, knowledge learning, alternative assessment and knowledge construction; it helps students to develop alternative perspectives and the ability to see things from different points of view (Isik, 2018). The findings from this study revealed that in

technology-based learning environments learners are expected to function as self-motivated, self-directed, interactive and collaborative in their learning hence creating a unique context in which to infuse constructivist principles. In this respect, it is important to ensure that integrating technology in the education process conforms to a constructivist approach.

In this study, cognitivism theory was found to have many practical applications; however, it is best used to guide learning when trying to build useful knowledge structures, and reasoning teaching (Alahmad, 2020). In this study, it was revealed that technology application provides the main components of cognitivism; the human mind is replicated through technological tools such as intelligent tutoring systems (ITS) and AI tools. The application of multimedia such as audio, video, and animations can facilitate the learning design which focuses on learners working memory and sensory system. However, the main challenge is how to design instruction that supports cognitive learning; if the integrated technological tools are not well assessed it may result in the manipulation of learning contents which may affect the critical knowledge that learners need to acquire (Dror et al., 2011).

Another theory which is critical to technology-based learning is humanism; the humanism approach encourages consideration of individual qualities. According to Jingna (2012), humanism considers students' inner thoughts, relationships between instructors and learners as well as the classroom atmosphere; this can lead to refinement of the teaching style hence improving the learning process. Enhancing student-instructor relationships enables instructors to learn new concepts from students; this can contribute to their careers by leading to developments in their practice. On the student side, it fosters self-realization which is a core part of the knowledge gain (Javadi, 2020). Even though the purpose of using digital technologies in the

education field is to make educational procedures simpler, it is still necessary to ensure the purposeful and meaningful application of technology (Barnová & Hlásna-Krásna (2018). If digital technologies are not applied sensibly and meaningfully, they might represent a serious threat to the education process. Therefore, educators must be provided with the skills to develop a humanistic learning environment and employ relevant pedagogical technology (Barnová & Hlásna-Krásna, 2018).

Furthermore, the connectivism approach was found to be useful as it combines important elements of different learning theories, social structures and technological tools hence creating a strong foundation of understanding of learning principles in the digital environment (Szada-Borzyskowska & Jaszczyszyn, 2014). The approach considers knowledge creation as a result of connections between information sources; through these networks, learners can acquire the viewpoint and diversity of opinions to make critical decisions (Duke et al., 2013).Through digital tools, students may acquire knowledge from a limitless number of new sources of information and can make connections with experts from a variety of fields in different parts of the world as well as peers who are exploring the same topics (Foroughi, 2015). Application of internet services such as Facebook, YouTube, Yahoo Groups, Flickr, and iGoogle can enable learners to share their work with others on a network which is vital for learning (Kop, 2011). However, learners tend to learn content that they mostly like hence this approach can create a possibility for learners to concentrate on irrelevant content; therefore, there is a need for different competencies and abilities to make learners comfortable and access relevant content. The presence of educators to guide learners and challenge their ideas and beliefs is another essential element in a digital environment (Kop, 2011).

5.4.3 Technology Pedagogical Practices

Technology tools used in the education process must support pedagogical practices such as group work, brainstorming, role play and case studies. Besides this, instructors must actively participate in the teaching process and should be capacitated with skills to apply different technological tools to enhance these practices as well as to improve their ability to evaluate the existing tools to ensure their relevance.

The primary findings of this study, and evidence from documentary sources, revealed a number of pedagogical practices such as group work, brainstorming, role-playing and case studies which can be supported by technology. Group work was found to be an effective pedagogy which provides an incentive for learning (Chiriac, 2014). In group work, learners take responsibility for their learning which allows them to achieve higher-order thinking skills through collaboration (Taqi& Al-Nouh, 2014).Technology has provided opportunities for using different forms of media to facilitate group interactions; these media facilitate group formation, online discussions, and peer assessment (Brown & Thomas, 2020). Pedagogical tools such as LMS – discussion forums, emails, Google Docs, and social media apps were suggested as effective tools to facilitate group work activities. Costley and Lange (2018) pointed out that group work promotes high cognitive abilities; it is a powerful constructivist pedagogy that facilitates a collaborative and enquiry-based learning environment (McKinney & Sen, 2016). However, coordinating group work requires a skill; educators should be trained on how to establish groups, assign tasks and identify relevant digital tools to facilitate remote meetings (Ferdous & Karim, 2019).

Brainstorming practices are highly supported by technology; the practices are among the teaching strategies that have a great power to facilitate critical thinking and problem-solving

skills. Brainstorming practices are based on cognitive theory as it involves the use of the brain to solve the problem and develop creative solutions (AlMutairi, 2015; Selvaraj, 2011). However, instructors need to evaluate the available technological tools to choose tools which are relevant for brainstorming. Role play was found as another example of active and exciting teaching practices in the digital age (Erturk, 2015); assigning roles through digital games engages individual learners in the learning process which reinforces their motivations (Selfa-Sastre et al., 2022). Furthermore, the case study strategy was also found to be a powerful student-centered strategy that challenges students to think critically and to use communication and interpersonal skills. In the case study teaching practices students are required to evaluate multiple sources of information which foster their information literacy. It is an effective way that increases learners' proficiency with oral and written communication skills, and managerial skills including teamwork formation and presentation (Minnitiet al., 2017). Therefore, in the current education system, educators should emphasize the application of case study strategies thus complying with the constructivism approach (Tuncel & Bahtiyar, 2015). Learners should be encouraged to become active and apply their prior knowledge and experience to develop new knowledge and apply that knowledge in the real world.

5.4.4 Technology Pedagogical Tools

Several digital resources and tools such as the Internet, Video Conferencing, Mobile Technology, AR, VR, AI, Games, Digital Libraries, social media, Wikis, MOOCs and LMS are available to enhance the education process. These tools facilitate education access, engagement, collaborations, support creativity and innovation and can help improve problem-solving and communications skills as well as support other institutions' administrative functions. However, educators must modify the tools to meet the educational needs of different individuals and should

develop an attractive design to increase its usability. In addition to this, consistent integration of these tools can increase their effectiveness and improves their availability to the intended learners.

The history of the development of education technology can be traced back to the 15th century; different stages of technology development have contributed to the education process transformation. Today, the world is experiencing tools like LMS, Games, Social Media, Wikis, AI, VR, Mobile Technology and Video Conferencing being applied in the education process. The application of these modern tools has changed the nature of education roles for students and instructors in the teaching-learning process (Bhattacharjee & Deb, 2016); technology has also supported school administrative functions whereby issues related to admissions, processing of results and reporting can be automated. In addition to this, technology can help education functions by supporting instructors with instruction design techniques including content design and delivery, facilitating access to educational resources and assessments. The application of digital tools enhances critical thinking and problems solving skills because learners are engaged in learning and can engage with their instructors.

On the other hand, the internet was found to be the most influential resource in the education field (Kazak et al., 2021; Pratama et al., 2019); it is the location of most of the education resources. Modern education technology tools and applications such as social media, Mobile Technology, Digital libraries, MOOCs and Video Conferencing are applicable only in the availability of either wired or wireless internet. However, managing the security of contents is the major challenge when working with internet application services; in this regard, special attention should be given to security issues related to internet use especially in preserving online

content and abiding with online policies and regulations. Besides this, the design of policies and guidelines which are relevant to specific education environments are essential; educators and policy makers should set aside policies and regulations on internet use and other technological tools and application-specific for each institution. This will help institutions to realize gains from the potential value of technology in their education process. These policies should as well guide the establishment of dedicated units equipped with skilled staff with the roles to manage and support the adopted technologies for sustainability purposes. In addition to this, technology cannot only be used for academic purposes but can as well used to transform other institutions' functions and provide reduction, management support as well as outreach services including supporting employees and the community.

Technology has facilitated the availability of resources such as e-journals, e-books, videos, apps and online lectures; provided access to social media pages such as Twitter, Instagram, WhatsApp and YouTube as well as Wikis; other resources to enable learner and instructor interactions and collaborations such as instant messaging, Google Docs, Zoom, Google Meeting and Slide Share are also available for education support. These tools have been used to enhance access to educational materials and information. A tool like LMS is very useful in facilitating instructors' and student's interaction as well as students' access to the learning contents; Blogs, Wikis, and Instant Messaging are mainly used for personal communication; Digital Libraries for accessing journals and publications, e-books and other learning contents and MOOCs courses for supplementing existing education resources (Gbaje, 2016).Through these tools, educators can create constructive, supportive and rich learning environments which can dramatically improve the education process (Alzaidiyeen & Almwdiah, 2012). Again, the development of mobile technology has changed the way we live; it has increased the possibilities for information access

and has created informal and formal learning opportunities. However, appropriate use of mobile technology is essential to enhance the process of creating and sharing knowledge and experiences that foster learners' understanding and development of intellectual competencies (Ally & Prieto-Blazquez, 2014). The application of mobile technology can extend the environment for collaborative practices and knowledge constructions in-line with the constructivism theory of teaching and learning (Pedro et al., 2018).

Today workforces have prioritized mobility and flexibility through the application of modern communication tools to facilitate online meetings rather than conducting physical meetings which may require travel costs. Nowadays, video conferencing tools are common in facilitating online meetings which increase productivity, save time, reduce the cost of travelling as well as promote collaboration (Rop & Bett, 2012); it provides an opportunity for meeting recording and live streaming, hence minimizing redundancy. Video meetings facilitate knowledge construction through human connections. In this study, video conferencing was found to be an effective pedagogical tool for communication and for delivering content. However, integrating commercial video conferencing tools is costly; besides this, not all learners especially those in remote areas can access video conferencing tools. Therefore, educators must further explore an easy and inclusive way of applying video conferencing tools in the education process.

According to Göçen and Aydemir (2020), the in-depth development of AI has affected many situations including the education administration processes. AI is considered a powerful tool to support personalized learning hence it fulfils education requirements; it provides a huge help in assisting teachers and students in their learning process. It also helps to resolve education issues such as accessibility of content, and shortage of instructors where few instructors can handle

many students with the assistance of AI tools (Ahmad et al., 2021). Combining machines and instructors helps to pull out the best results from students (Kengam, 2020). However, there is a worry that instructors will be replaced by robots in the near future which may reduce physical interaction between instructors and learners; this may hurt learners instead of supporting them to acquire the required knowledge (Kengam, 2020).Despite this fact, AI tools are unavoidable in the education sector; today, several AI technologies apart from smart learning, tutoring systems, and social robots were introduced. Tools like virtual facilitators, smart learning management systems, and learning analytics tools are available and have significantly contributed to the education sector as well as other sectors (Ahmad, 2021). However, when introducing AI solutions in education educators must carefully analyze and customize the existing solutions to make attractive solutions to the users. Besides this, Göçen and Aydemir (2020) suggested that AI solutions should not be considered as an answer to all but just a solution to improve the process in some specific topics of the course.

On the other hand, VR tools were found as useful tools in providing different learning opportunities; it helps to increase student engagement, enhance constructivism and authentic experience for learners and creates the ability for students to visualize difficult concepts (Hu-Au& Lee, 2018). VR tools are excellent media for constructivist learning experiences; therefore, developing a pedagogy based on VR tools must be grounded on constructivist learning approaches (Christou, 2010).

Today, technology was found to play a significant role in helping students with special needs overcome their education challenges; it enabled students with special needs to participate in the classroom discussion as well as to accomplish their academic tasks (Iyer, 2019). In the study,

video and audio were mostly found to support learners with special needs to access their learning materials. However, there are other advanced technologies that educators need to explore to make education inclusive; appropriate integration of Augmented Reality (AR), VR and AI tools can help educators to design an inclusive learning environment relevant for students with a variety of disabilities.

5.4.5 Technology Pedagogical Models

Learner-centered is an appropriate approach in digital learning as it improves learners' attitudes toward learning; learners can develop a natural ability to think and work independently hence developing real-life skills such as higher order thinking, problem-solving, collaboration, leadership and communication skills. However, educators must integrate appropriate digital tools that facilitate practices such as problem-based, project-based and enquiry-based learning to foster learner-centered.

Technology advancement has created an opportunity for interactions among learners and instructors (Magano et al., 2020); this has made the education process undergo a pedagogical shift. Most institutions have moved their teaching approaches from teacher-centered to learner-centered approaches. The learner-centered approach put students' interests first; in this approach learners' ideas and experiences are acknowledged thus promoting active engagement in the learning process (Singhal, 2017). The contextual change to learners-centeredness promotes self-learning even with students who are used to a teacher-centered approach; this is because in the learner-centered approach students begin to construct their future, conduct reflection on their current and future selves and can seek diverse learning strategies. The approach has greatly provided a great connection between the teaching strategies and the constructivism learning

theory underpinned by the study; learners construct new knowledge based on experiences with real practice because a special focus is on social interaction (Schreurs & Dumbraveanu, 2014). However, implementing a learner-centered approach is dependent on several factors including the availability of relevant instruction contents, the learning environment to foster group work, instructors' attitudes, and other administrative support (Tadesse, 2020). In this case, educators must ensure the availability of tools for developing skills needed; also, instructors must have skills to monitor students' progress and measure their competence to ensure it is relevant to the course (Aslan & Reigeluth, 2015).

5.4.6 Limitation of Technology Pedagogical Application

Acquisition of digital tools and adaptation of curriculum and teaching theories and principles present significant challenges which educators need to overcome. Among the strategies to overcome these challenges include ensuring that instructors are capacitated with pedagogical and effective digital course design content skills; designing a technology-supported learning environment to help learners attain knowledge more efficiently; and designing an environment that encourages active learning, and engagements and collaborations. The selection of digital tools must also consider its ability to provide access to relevant digital learning resources for all learners and its accessibility, availability and integrity.

The study findings showed that technology has created some negative impacts on the teaching and learning process. In this respect, educators must ensure a plan to mitigate these negative impacts is put in place before integrating technology into the education process. However, an instructor's ability to consider education pedagogy when teaching with technology can determine the success of technology application in the education process. This is because the application of

technological tools demands for educators develops curricula that consider technological affordances to improve the quality of learning. This can only be achieved if instructors are equipped with not only technical skills but also pedagogical knowledge to enable applying these technological tools in a sound pedagogical way.

In addition to this, according to Ertmer and Newby (2016), technology demands new or modified instruction practices and theories due to the changes brought in the education; this has resulted in the changes in the learning design that demands new knowledge among instructors. With technology instructors' and students' roles are changed (Mechlova & Malčík, 2012); instructors are not the only source of information, there are other available sources of information that learners can consult. Therefore, a learning environment that fosters students' motivation, engagements, and collaborations, enables creativity and innovation and provides access to diverse learning content should be designed.

Finally, this study came up with a pedagogical model which is relevant to technology-based teaching among education institutions. The model has provided guidelines on important pedagogical elements that educators must consider when integrating technology into the teaching and learning process. However, this model needs to be tested in a real-life environment to validate it before recommending it for application.

5.4.7 Research Methods and Ethical Concerns

The choice of the research method determines the accuracy of results, reliability and validity of research; the researcher should choose the methodology based on the nature and practicality of the research. Other factors such as the availability of resources should also be considered.

However, it is important to ensure researchers possess research ethics skills to signify the credibility of the research results.

The main concern of the study was to measure the aspect of realities which cannot be quantified as it focuses on a deep understanding of the situation (Almeida et al., 2017). This is the reason for choosing exploratory qualitative research methods as recommended by Zukauskas et al.(2018); the qualitative method is among the useful methods as it enables the researcher to obtain an in-depth understanding of the situation through interaction with participants (Almalki, 2016). Primary data were collected through an interview method; direct observations and documents review of education policies and study reports were also used to supplement data which were collected from the interview method. However, according to Rahman (2017), analyzing qualitative data is far more challenging, and time-consuming; sometimes the time pressure may lead to inaccurate results which may also lead to a poor conclusion (Silverio et al., 2020). However, it is a researcher's responsibility to choose the methodology that best suits the situation; therefore, in qualitative studies, researchers must allocate enough time for each stage of qualitative enquiry to ensure the accuracy of the results.

Ethical considerations pertinent to any research project undertaken are very crucial issues nowadays (Rahman, 2017). Ethics can promote the research aim, promote essential values for collaborative work, promote moral and social values, and ensure accountability to the public to build public support (Resnik, 2020). In this study, standards for conducting scientific research were considered; the REAF was appropriately filled and approved by UREC. Participants were given opportunities to provide their consent after they were given sufficient information about the study. Parents of children participants below 18 years filled the consent forms on behalf of

their children after a simple oral simple oral description was made through their school head. Other ethical principles including anonymity, confidentiality, privacy, justice and respect for a person were also taken into consideration. However, a lack of research integrity and knowledge about appropriate ethical practices among researchers and communities may result in misconduct (Erazo, 2021). Training on research ethics can introduce researchers to some important concepts, tools, principles, and methods that are useful in resolving ethical dilemmas (Resnik, 2020).

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LIST OF APPENDICES

Appendix 1: UREC Provisional Decision

UNICAF UNIVERSITY

UREC's Decision

Student's Name: Jane Bethuel Peter

Student's ID #: R1811D6909600

Supervisor's Name: Dr. Tanya Marie Hathaway

Program of Study: UUZ: PhD Doctorate of Philosophy

Offer ID /Group ID: O18053G17583

Dissertation Stage: 1

Research Project Title: E-pedagogy: A Model for ICT Based Education for Secondary Schools in Tanzania

Comments:

Decision: A. Approved without revision or comments

Date: 23-Jun-2020

Appendix 2: UREC Final Decision

UNICAF UNIVERSITY

UREC Desision, Version 2.0

Unicaf University Research Ethics Committee Decision

Student's Name: Jane Bethuel Peter

Student's ID #: R1811D6909600

Supervisor's Name: Dr Tanya Marie Hathaway

Program of Study: UU-DOC-900-3-ZM

Offer ID /Group ID: O26179G25894

Dissertation Stage: DS 3

Research Project Title: E-Pedagogy: A Model for ICT Based Education for Secondary School in Tanzania

Comments: 9.4, it should be tick as 'applicable'

Decision*: B. Approved with comments for minor revision

Date: 05-Aug-2021

*Provisional approval provided at the Dissertation Stage 1, whereas the final approval is provided at the Dissertation stage 3. The student is allowed to proceed to data collection following the final approval.

Appendix 3: Sample Non-completed Informed Consent Form

UNICAF UNIVERSITY

UU_IC - Version 2.1

Informed Consent Form

Part 1: Debriefing of Participants

Student's Name: Jane Bethuel Peter

Student's E-mail Address: jane.bethuel@gmail.com

Student ID #: R1811D6909600

Supervisor's Name: Dr. Tanya Marie Hathaway

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: E-pedagogy: A Model for ICT Based Education for Secondary Schools in Tanzania

Date: 22-Jul-2021

Provide a short description (purpose, aim and significance) of the research project, and explain why and how you have chosen this person to participate in this research (maximum 150 words).

The purpose of this study is to construct a valid pedagogical model that utilizes the perceived accordances of technology in the classroom. The motive behind this study is the fact that technology has created profoundly changes in the teaching methodology hence demands for the new pedagogical framework which is relevant for technology mediated education. The model will help teachers to maximize their pedagogical knowledge and competence hence improve their teaching effectiveness. The outcome of the study will serve as a guide for the reviewing strategies towards technology integration among secondary schools in order to increase the potential of available technologies in education. As an experienced practitioner in this field you have been identified as a potential candidate to discuss your feelings, perceptions and concerns related to the topic as well as to share your experiences in order to contribute to the model development.

The above named Student is committed in ensuring participant's voluntarily participation in the research project and guaranteeing there are no potential risks and/or harms to the participants.

Participants have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In these cases, data collected will be deleted.

All data and information collected will be coded and will not be accessible to anyone outside this research. Data described and included in dissemination activities will only refer to coded information ensuring beyond the bounds of possibility participant identification.

I, Jane Bethuel Peter **, ensure that all information stated above is true and that all conditions have been met.**

Student's Signature: _____

1

Informed Consent Form

Part 2: Certificate of Consent

This section is mandatory and should to be signed by the participant(s)

Student's Name: Jane Bethuel Peter

Student's E-mail Address: jane.bethuel@gmail.com

Student ID #: R1811D6909600

Supervisor's Name: Dr. Tanya Marie Hathaway

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: E-pedagogy: A Model for ICT Based Education for Secondary Schools in Tanzania

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that I am free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of my participation to this study. I understand that my data will remain anonymous and confidential, unless stated otherwise. I consent voluntarily to be a participant in this study.

Participant's Print name: _____

Participant's Signature: _____

Date:

If the Participant is illiterate:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had an opportunity to ask questions. I confirm that the aforementioned individual has given consent freely.

Witness's Print name: _____

Witness's Signature: _____

Date:

Appendix 4: Sample Non-completed Guardian Informed Consent Form

UNICAF UNIVERSITY

UU_GIC - Version 2.1

Guardian Informed Consent Form

Part 1: Debriefing of Participants

Student's Name: Jane Bethuel Peter

Student's E-mail Address: jane.bethuel@gmail.com

Student ID #: R1811D6909600

Supervisor's Name: Dr. Tanya Marie Hathaway

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: E-pedagogy: A Model for ICT Based Education for Secondary Schools in Tanzania

Date: 15-Jul-2021

Provide a short description (purpose, aim and significance) of the research project, and explain why and how you have chosen this person to participate in this research (maximum 150 words).

The purpose of this study is to construct a valid pedagogical model that utilizes the perceived accordances of technology in the classroom. The motive behind this study is the fact that technology has created profoundly changes in the teaching methodology hence demands for the new pedagogical framework which is relevant for technology mediated education. The model will help teachers to maximize their pedagogical knowledge and competence hence improve their teaching effectiveness. The outcome of the study will serve as a guide for the reviewing strategies towards technology integration among secondary schools in order to increase the potential of available technologies in education. As a current secondary school student your child has been identified as a potential candidates to discuss his/her feelings, perceptions and concerns related to

The above named Student is committed in ensuring participant's voluntarily participation in the research project and guaranteeing there are no potential risks and/or harms to the participants.

Participants have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In these cases, data collected will be deleted.

All data and information collected will be coded and will not be accessible to anyone outside this research. Data described and included in dissemination activities will only refer to coded information ensuring beyond the bounds of possibility participant identification.

I, Jane Bethuel Peter , **ensure that all information stated above is true and that all conditions have been met.**

Student's Signature:

Guardian Informed Consent Form

Part 2: Certificate of Consent

This section is mandatory and should to be signed by the participant's legal guardian

Student's Name: Jane Bethuel Peter

Student's E-mail Address: jane.bethuel@gmail.com

Student ID #: R1811D6909600

Supervisor's Name: Dr. Tanya Marie Hathaway

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: E-pedagogy: A Model for ICT Based Education for Secondary Schools in Tanzania

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that the participant is free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of the participation to this study. I understand that all data will remain anonymous and confidential, unless stated otherwise.

I, _____, the legal guardian of _____ allow and provide consent that _____ can willingly participate in the study.

I, _____, the legal guardian of _____ have been ensured that verbal consent given by _____ will also be taken before the study.

Appendix 5: Gatekeeper Letter

UNICAF UNIVERSITY

UU_GL - Version 2.0

Gatekeeper letter

Address:

Date:

Subject: Request for Research Data Collection

Dear XXXX,

I am a **doctoral** student at Unicaf University **Zambia**.

As part of my degree I am carrying out a study to explore pedagogical practices which are relevant for technology-based education.

I am writing to enquire whether you would be willing to give permission to access institution documents and to recruit employees/students from your institution to participate in this research.

Subject to approval by Unicaf Research Ethics Committee (UREC) this study will be using a set of questions, physical observations and documents review to gather information about the topic.

The title of the study is "E-pedagogy: A Model for ICT Based Education for Secondary Schools in Tanzania". The project involves construction of a valid pedagogical model that utilizes the perceived accordances of technology in the classroom. It is estimated that the researcher will spend 4 days for each selected institution. This study is being supervised by Dr. Tanya Marie Hathaway

The project requires participation of employees and students in responding to set of questions, provide access to education policies and guidelines as well as other relevant documents for the study.

Thank you in advance for your time and for your consideration of this project. Kindly please let me know if you require any further information or need any further clarifications.

Yours Sincerely,

Student's Name: Jane Bethuel Peter
Student's E-mail: jane.bethuel@gmail.com
Student's Address and Telephone: +255713460541
Supervisor's Title and Name: Dr. Tanya Marie Hathaway
Supervisor's Position: Academician
Supervisor's E-mail: t.hathaway@unicaf.org

Appendix 6: Data Collection Tool – Structured Interview Questionnaire

E-Pedagogy: A Model for Technology Based Education for Secondary Schools in Tanzania

Researcher: Jane Bethuel Peter

Unicaf University Zambia

The goal of this interview is twofold; first, to understand teaching approaches and pedagogical practices that are relevant to technology-based learning and how they relate and influence pedagogical practices, and secondly, to determine the pedagogical barriers hindering technology integration in schools and how these can be eliminated. No risks or discomforts are anticipated. You may decide not to answer some questions. This is perfectly acceptable. Your response will be made confidential and only used for intended purpose. The interview should take about 20–25 minutes.

Important note:

This questionnaire will be developed online for easy dissemination to individuals before interview date for them to familiarize with the questions. The participants will be asked to answer the questions and thereafter, the telephone interview will follow to clarify and give more descriptions about their responses.

a. Questions with options written using radio buttons indicate that participants will be able to select only one option/answer.
b. Questions with options written using check boxes allows participants to select more than one option

QUESTIONS FOR INSTRUCTORS AND STUDENTS	
A. BACKGROUND INFORMATION	**B. DEMOGRAPHIC DATA**
1. Name of Institution/School…….	5. Respondent gender ○ Male ○ Female
2. Is your Institution/Private ○ Public ○ Private	6. Respondent age …… years
3. Education services offered ○ Secondary School Education – ordinary or advanced secondary education ○ Mid-level Institution - certificate and diploma courses ○ Higher Learning Institutions - bachelor and postgraduate courses	7. Respondent work Experience …….years. (For employees [instructors & education administrators] only) 8. School year (Form I, II, II….

support) institution 4. What is your current position? ○ Instructor ○ Education administrator ○ Student	etc)…… (For students only)
C. EDUCATION MANAGEMENT AND ADMINISTRATION	**D. EDUCATION SERVICE DELIVERY**
9. Does your institution/school have dedicated technological facilities for students and instructors? If the answer is YES, then proceed with parts (a) to (d). If the answer is NO, skip to question 8 a. Are there technological facilities available for instructors and students? b. Does your institution/school have wireless internet (WIFI) access? c. Does your institution/school provide internet access to students and instructors computers? d. Does your institution apply technical measures (such as filtering) to prevent access to content available on the institutions'/schools' computers? If the answer is YES please provide more details (For instructors only). 10. Does your institution/school document specific policies/strategies/guidelines to promote technology mediated teaching and learning? Provide details. 11. What type of technologies does your institution/school use to support operational or administrative functions of education process? (For instructors only). 12. Is there a special department/unit dedicated to support the pedagogical use for technologies at your institution/school?(For instructors only) 13. Are there workshops, trainings or other learning activities about pedagogical use of technology-based learning provided to instructors and students? If the answer is YES, then please provide detail. 14. Is there specific budget set for acquiring and maintain technological facilities (hardware, software, internet, trainings) at your institution/school? Is the budget sufficient? (For instructors only)	15. What learning delivery format is applied in your institution/school? ○ Face to face - (Learning done in classroom environment only) ○ Flipped/blended mode (include both classroom and homework element of the course) ○ E-Learning (learning with the aid of electronic resources) ○ Others (mention)…… 16. What are instruction strategies that are applied in supporting teaching/learning at your institution/school? ○ Teacher-centered (students put all their focus to teacher) ○ Student-centered (students are active participants to their learning)
E. TECHNOLOGY APPLICATION	**F. EDUCATION PEDAGOGICAL DESIGNS**
17. Does your institution/school integrate technology as a	26. What do you think are the important

pedagogical tool in the teaching and learning process? If the answer is YES, then proceed to question 16.

18. Does your institution/school use an integrated Learning Management System (LMS)? If the answer is YES, then which type of LMS is integrated?

a. Types of Learning Management System (LMS)

- Moodle
- WebCT
- Blackboard
- Desire2Learn
- ATutor
- KEWL
- ☐ Others ……..

b. What is the LMS used for?

- Course administration
- Content delivery
- Tracking learners progress
- Course assessments
- Reporting
- ☐ Others……
…

c. What other supporting functions does the LMS offer?

- Discussion forums
- Charting
- Assessment such as assignments, online quizzes and examinations
- Learning analytics
- Provide access to massive learning resources
- ☐ Others……..

19. Does your institution/school documented special techniques for content design? If the answer is YES please provide more details (For instructors only).

20. Does your institution/school regularly evaluate its LMS to explore its effectiveness and ensure it creates positive impact? If the answer is **YES,** please provide more details.

21. Do you apply mobile technologies to the education process? If the answer is **YES,** please provide more details?

22. Do you have video conferencing tools installed specific for education support? If the answer is **YES** proceed with parts

pedagogical aspects that need to be considered when integrating technology in the classroom?

- Integrated technologies should suit the learners' and instructors' needs
- Integrated technologies should match with learning goal(s)
- Integrated technologies should support access to additional resources
- Integrated technologies should match with specific requirements of the course
- Integrated technologies should consider demographic characteristics (gender, age, disability)
- Integrated technologies should consider prior knowledge and experience of instructors and learners
- ☐ Others……
…

27. What are the pedagogical technological resources available to help instructors to develop scenarios which **motivate** students to learn independently? Please provide examples in each selected case (For instructors only).

- E-resources from websites
- Social media
- Digital Library/Repositories
- Wikis
- ☐ Others……

28. What are the pedagogical technologies that were integrated to enhance **engagement** among students and instructors? Provide examples in each selected case.

- Web conferencing tools
- Blogs
- Wikis
- Social media
- ☐ Others……

29. What are the pedagogical technologies available to support learner's **creativity and innovations**? Provide examples in each selected case.

- Online spaces
- Mobile Learning
- Webinar

(a) and (b) otherwise skip to question 21.

a. What types of video conferencing tools are available?

Skype
Zoom
GoToMeeting
Google Hangouts
Microsoft Teams
☐ Others……

b. What functions are being supported by the available video conferencing tools?

Communication and presentation
Resource sharing
Access to national and international experts
Real time assessment
Enhancing social presence
☐ Others…….

23. Do you have video conferencing tools installed specific for education support? If the answer is **YES, then** proceed and answer parts (a) and (b).Otherwise go to question 22.

a. What types of video conferencing tools are available?

Skype
Zoom
GoToMeeting
Google Hangouts
Microsoft Teams
☐ Others……

b. What functions are being supported by the available video conferencing tools?

Communication and presentation
Resource sharing
Access to national and international experts
Real time assessment
Enhancing social presence
☐ Others……

24. Does your institution/school integrate games in the teaching and learning process? If the answer is **YES,** proceed with part (a) and (b). If the answer is **NO,** skip to question 23

a. What types of games which are designed specific for education, available?

Social media
☐ Others……

30. What pedagogical technological tools are available to support **collaborations**? Provide examples in each selected case.

Internet
Email and blogs
Conferencing tools
Mobile devices and apps
☐ Others……

31. What pedagogical technologies are available to address **information accessibility?** Provide examples for each selected case.

Communication tools
Social media
Digital library and repositories
☐ Others……

32. What pedagogical technologies are available to address **information accessibility for special needs** students? Provide examples for each selected case.

Video or audio
Text recognition applications
Screen magnifier
Captioned videos
Input devices such as touch screen, joystick
☐ Others……

Games points Levels, badges Leader boards Rewards Progress bar Feedback Avatar ☐ Others…….. b. Are there other commercial games available to you that have been customized for education support? If the answer is YES, which of the following are available? Word search Crossword puzzle Jigsaw puzzle Hangman Word scramble Sliding puzzle Brain teaser Quiz games ☐ Others…… 25. Are there artificial intelligent (AI) tools integrated to support teaching and learning at your institution/school? If the answer is **YES**, proceed with parts (a) and (b), if the answer is **NO** go directly to question 24. a. What types of AI tools are available? Intelligent Tutoring Systems (ITS) Personalized learning Adaptive tutors ☐ Others…… b. What are the main applications of the adopted AI tools? Automatic assessment Automatic records of attendance Automatic test and questions generations Automatic grading ☐ Others……	
PEDAGOGICAL MODELS AND PRINCIPLES	**PEDAGOGICAL CHALLENGES**
33. What type of pedagogical model does your institution/school follows? ○ Didactic - structured and informed teaching directed by specific learning objectives	36. What do you think are the main technological pedagogical challenges that hinder the integration of technology in the education process?

○ Authentic – flexible to allows construction of knowledge from learners' experiences ○ Transformative – influence change in learners ○ Others …… 34. What kind of pedagogical principles are being considered at your institution/school? Inclusiveness–every learner must have equal access to education Supporting learners' motivation and engagement Promote innovation and creativity Match with curriculum Support both formative and summative assessments Provide opportunity for classroom interaction ☐ Others…… 35. What are the pedagogical practices used in your institution/school? ○ Participatory practices - group work, brainstorming, role playing and case studies ○ Oppressive practices - bullying, racial and gender	37. In what ways do you think educators can overcome the existing challenges?

Appendix 7: Data Collection Tool – Semi-structured Interview Questionnaire

E-Pedagogy: A Model for Technology Based Education for Secondary Schools in Tanzania

Researcher: Jane Bethuel Peter

Unicaf University Zambia

The goal of this interview is twofold; first, to understand teaching approaches and pedagogical practices that are relevant to technology-based learning and how they relate and influence pedagogical practices, and secondly, to determine the pedagogical barriers hindering technology integration in schools and how these can be eliminated. No risks or discomforts are anticipated. You may decide not to answer some questions. This is perfectly acceptable. Your response will be made confidential and only used for intended purpose. The interview should take about 20–25 minutes.

Important note:

This questionnaire will be administered through face-to-face mode; during the interview participants will be required to clarify some responses as well as narrating related stories. However, the questions will be shared to participants though email prior to the interview date to allow them to familiarize with the questions.

INTERVIEW QUESTIONS FOR EDUCATION ADMINISTRATORS	
A. BACKGROUND INFORMATION	**B. DEMOGRAPHIC DATA**
38. Name of Institution/School…… 39. Is your Institution/Private ○ Public ○ Private 40. Education services offered ○ Secondary School Education – ordinary or advanced secondary education ○ Mid-level Institution - certificate and diploma courses ○ Higher Learning Institutions - bachelor and postgraduate courses ○ Education administration – non-teaching (education support) institution	41. Respondent gender ○ Male ○ Female 42. Respondent age ……years 43. Respondent work Experience …….years. (For employees [instructors & education administrators] only)

C. OTHER QUESTIONS

44. What is the main support offered by your institution to schools and colleges? Provide more details.

45. Does your institution offer specific technological support to instructors and students? Please provide details on the type of support given and how useful the support is?

46. Is there support available for instructors and students regarding pedagogical use of technology at schools and colleges?

47. How often do you evaluate the quality of pedagogical use of technologies in schools and colleges?

48. How do you rate the quality of pedagogical technological support?

49. Do you have a documented policy or strategy for guiding pedagogical use of technology in schools and colleges? If YES, how often do you monitor its implementations?

50. Does your institution set annual budget to support technology integration in schools/institutions? Is the budget sufficient? If NO what are the plans to add the budget amount?

51. What do you think are the major challenges facing institutions/schools in implementing technology- based education?

52. What have you done so far to overcome those challenges?

53. What plan exists to ensure the challenges are completely eliminated?